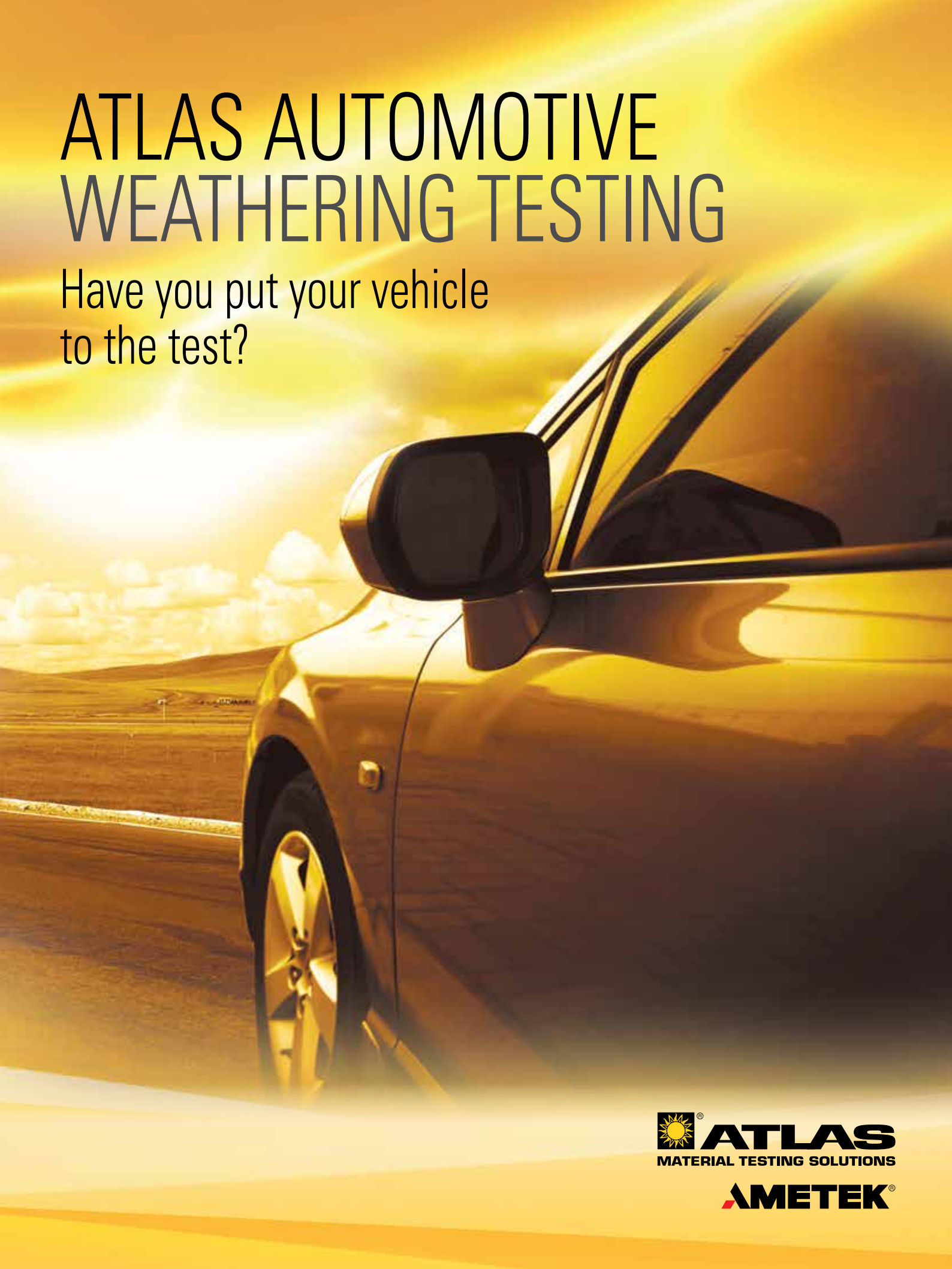
ATLAS AUTOMOTIVE WEATHERING TESTING

Have you put your vehicle to the test?



ATLAS®
MATERIAL TESTING SOLUTIONS

AMETEK®

TO TEST REAL WORLD PERFORMANCE, YOU NEED TO REPLICATE REAL WORLD CONDITIONS.

When predicting how a car will stand up to the elements, it isn't enough to guess. You need to know. For over 75 years, Atlas has worked with nearly every major automotive manufacturer on the market today to develop comprehensive testing programs that deliver reliable results.

Atlas offers:

- Weathering and corrosion instruments
- Outdoor weather testing of materials, components and full vehicles
- Methodology and standards development
- Material performance tests for plastics, coatings, textiles, rubber and glass
- Consultation and client education services

LET ATLAS DRIVE YOUR TESTING PROGRAM.

HISTORY OF ATLAS

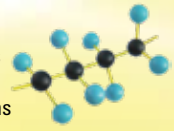
Automotive Events Related to Materials and Durability

1908
Mass production helps popularize the automobile

1915
Birth of Atlas as a provider of materials test equipment as an outgrowth of their stage lighting business

1930's
Outdoor testing of automotive materials begins in the benchmark subtropical climate at South Florida Test Service

1950's
Use of plastics in automobiles increases dramatically for a variety of applications



1954
Heraeus develops the first xenon-arc weathering instrument, the Xenotest 150

1977
Atlas patents the first xenon-arc instruments with controlled irradiance, the Atlas Ci65 Weather-Ometer

Late 1970's
Growth of Japanese automotive industry, largely fueled by improved quality and reliability

1980's
Society of Automotive Engineers (SAE) develops test methods for automotive interior and exterior materials. These became the industry standards for 20+ years

2000's
Global OEM's complete significant work on materials analyses for better weathering simulation resulting in company-specific test methods

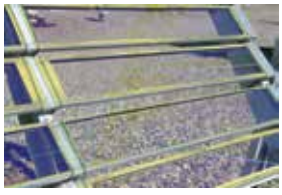
2013
Atlas instruments meet the new ASTM D7869 coatings testing standard

2017
The world's most advanced xenon-arc instrument for standard weathering testing, the Atlas Ci4400

1980's
Full-car testing is popularized by Atlas using metal halide lamps

2010's
Atlas introduces the Right Light™ filter to further increase testing consistency and accuracy

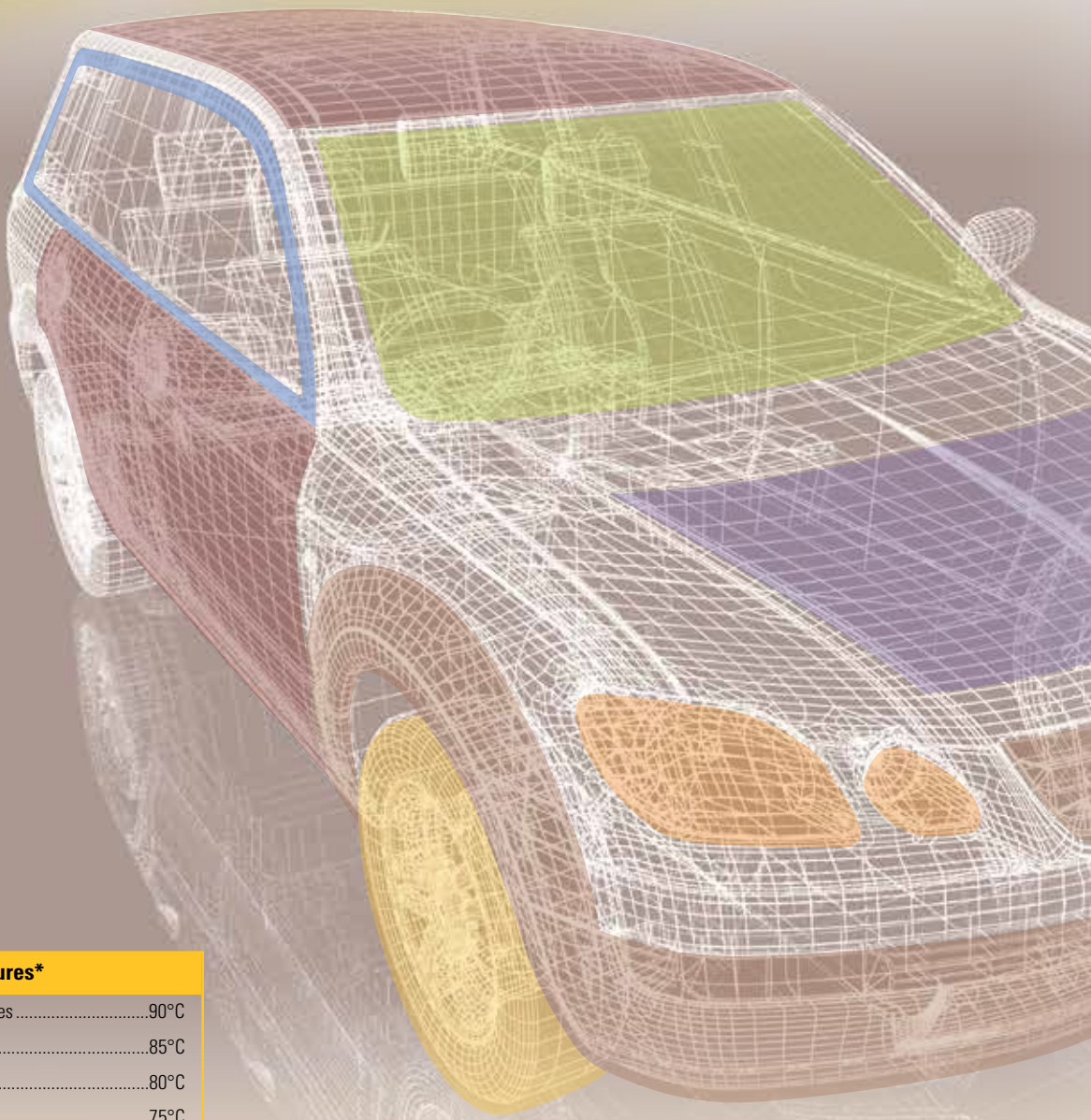
2013
The compact rotating rack weathering & lightfastness tester with unique XenoLogic™ twin-lamp technology, the Xenotest 440



2018
Cool-mirror technology for accelerated natural weathering

WEATHERING TESTING FOR EXTERIOR MATERIALS AND COMPONENTS

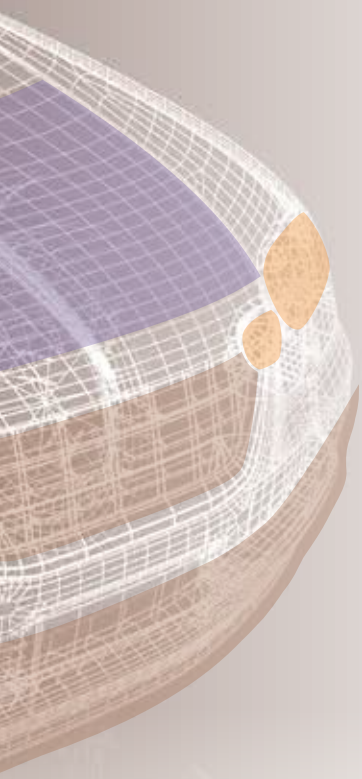
Atlas' rigorous automotive test method development process is designed to replicate real world conditions. The result is an in-depth understanding of the long-term performance of materials commonly used in the automotive industry.



Automotive Maximum Temperatures*	
Coating System Roof/Hood/Trunk Surfaces	90°C
Bumper Fascia Horizontal Surfaces	85°C
Upper Exterior Door Panel	80°C
Lower Door Panel	75°C

* based upon outside ambient temp. of ....52°C

EXTERIOR WEATHERING



Paint

- Gloss loss and color change
- Cracking and peeling
- Corrosion of substrate
- Scratch and mar

Fascias and Body Panels

- Gloss loss and color change
- Delamination
- Scratch and mar

Headlamps

- Yellowing
- Micro-cracking
- Delamination

Wheels and Wheel Covers

- Filiform corrosion
- Cracking
- Delamination

Glazing

- Loss of laminate adhesion
- Hazing
- Yellowing of laminates

Weather Seals and Gaskets

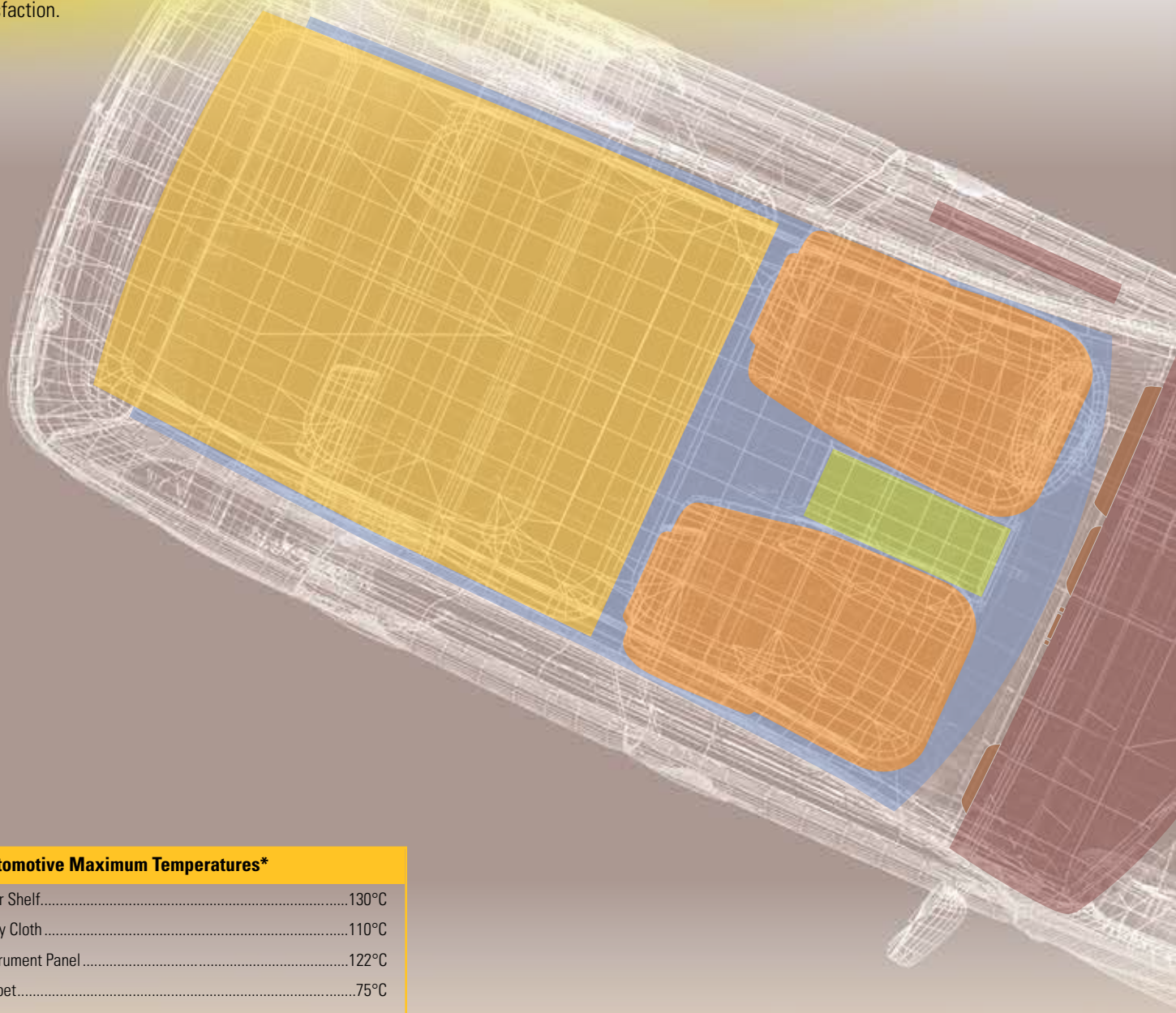
- Cracking
- Seal failure
- Embrittlement

Engine Components

- Corrosion
- Seal failure
- Fastener integrity

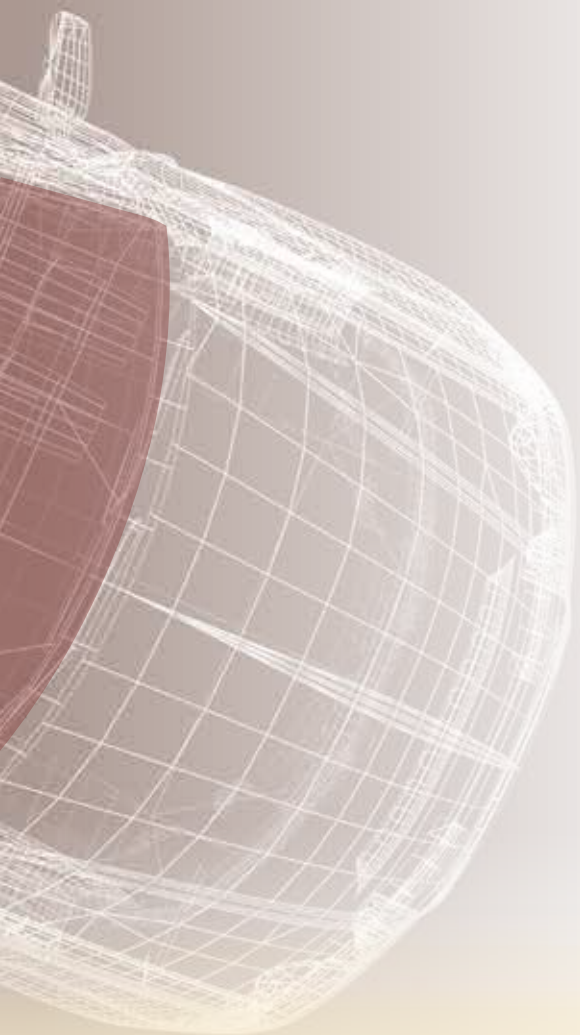
ATLAS TESTING WILL DETERMINE HOW LONG VEHICLE INTERIOR COMPONENTS WILL LAST

As thorough as we are with the car's exterior, we put just as much care and attention to detail in testing the interior. Ensuring a long lifespan of these materials and components is critical for implementing a cost-efficient design and maintaining high user satisfaction.



Automotive Maximum Temperatures*	
Rear Shelf	130°C
Body Cloth	110°C
Instrument Panel	122°C
Carpet	75°C
Interior Ambient	85°C

* based upon outside ambient temp. of ....52°C



INTERIOR WEATHERING

Instrument and Door Panels/Airbag Covers

- Color change (fade, shift, chalking)
- Cracking
- Scratch and mar
- Delamination of skin to substrate
- Embrittlement

Hard Trim

- Color change (fade and shift)
- Embrittlement
- Delamination
- Thermal failure of control knobs

Seats

- Color change (fade and shift)
- Cracking
- Fiber deterioration

Carpets and Fabrics

- Color change (fade and shift)
- Fiber deterioration
- Adhesion loss/delamination

Center Consoles/ Overhead Console

- Color change (fade and shift)
- Coating delamination
- Scratch and mar

Headliners

- Color change (fade and shift)
- Adhesive failure

YOUR NEEDS DETERMINE THE DIRECTION OF YOUR TESTING PROGRAM

Atlas offers design and implementation of complete testing and durability solutions to help you meet your quality goals, validate warranty statements, avoid premature failures, save time and money, and strengthen your market position.

Our four-step approach will help you develop the right weathering testing solution for your products:

1. Needs assessment
2. Development of test methods and strategies
3. Failure Mode and Effects Analysis
4. Management of test programs

OUR COMPLETE OFFERING OF SERVICES INCLUDES:

Test Method Development

- Test Method Review and Design
- Test Method Implementation
- Weathering Experiments

Education and Training

- Technical Seminars
- Workshops
- In-House Programs
- Online Seminars

HIERARCHY OF AUTOMOTIVE WEATHERING TESTING

LABORATORY WEATHERING TESTING USING XENON ARC

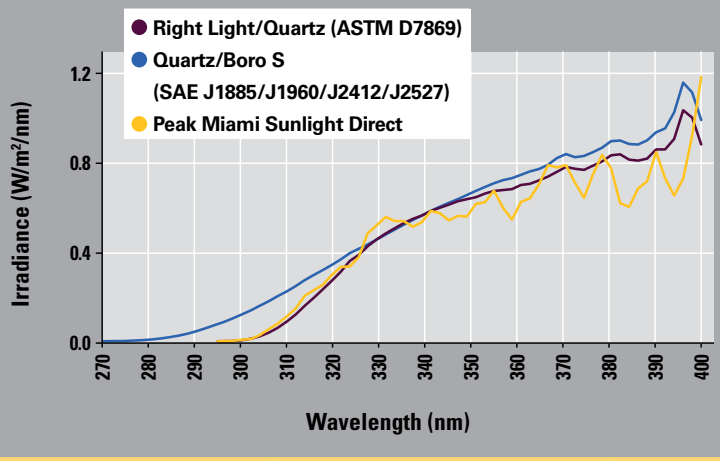
Higher irradiance, better filters for maximum acceleration and correlation

"Water Cooled" Xenon Arc Lamp

- Best simulation of natural sunlight available
- 340 nm up to 1.8 W/m^2*
- 420 nm up to 3.34 W/m^2*
- 300-400 nm up to 180 W/m^2*
- More than 10 filter combinations available

*Maximum irradiance values using Right Light™/Quartz in a Ci3000

SUNLIGHT VS. XENON (RIGHT LIGHT™) VS. XENON ARC



AUTOMOTIVE STANDARD TEST METHODS*

✔ = equipment meets requirements of test method
✘ = equipment not applicable for test method

TESTING FOR INTERIOR MATERIALS

OEM	Test Method	Weather-Ometer®				Xenotest®	
		Ci3000+	Ci4400	Ci4000	Ci5000	Beta+	440
General Motors	GMW 3414	✔	✔	✔	✔	✔	✘
	GMW 14162	✔	✔	✔	✔	✔	✔
	SAE J1885/J2412	✘	✔	✔	✔	✘	✘
GM Opel	GME 60292	✔	✔	✔	✔	✔	✔
Ford	FLTM BO 116-1	✔	✔	✔	✔	✘	✘
	SAE J1885/J2412	✘	✔	✔	✔	✘	✘
Chrysler	PF-11365	✘	✔	✔	✔	✘	✘
Volkswagen	PV1303	✘	✔	✔	✔	✔	✔
	PV1306	✔	✔	✔	✘	✔	✘
Hyundai	MS-210-05	✔	✔	✔	✔	✘	✘
PSA (Peugeot, Renault)	D47 1431	✔	✘	✘	✘	✘	✘
BMW	VDA 75202	✔	✔	✔	✔	✔	✔
Porsche	DIN 75202	✔	✔	✔	✔	✔	✔
SAAB	STD 3159	✔	✔	✔	✔	✘	✘
Daimler	DBL 5555	✔	✔	✔	✔	✔	✔
	DIN 75202	✔	✔	✔	✔	✔	✔
Volvo	STD 423-0047	✔	✔	✔	✔	✘	✘
	STD 1026, 82439	✔	✔	✔	✔	✔	✔
	STD 1027, 359	✔	✔	✔	✔	✘	✘
International	ISO 105-B06	✔	✔	✔	✔	✔	✔
	ISO 4892-2	✔	✔	✔	✔	✔	✔
	JASO M346	✔	✔	✔	✔	✔	✔
	JIS D0205	✔	✔	✔	✔	✔	✔
	SAE J1885/J2412	✔	✔	✔	✔	✘	✘

TESTING FOR EXTERIOR MATERIALS

OEM	Test Method	Weather-Ometer®				Xenotest®	
		Ci3000+	Ci4400	Ci4000	Ci5000	Beta+	440
Ford	ASTM D7869	✔	✔	✔	✔	✘	✘
	SAE J1960/J2527	✔	✔	✔	✔	✘	✔
General Motors	GMW 14650	✔	✔	✔	✔	✔	✔
	SAE J1960/J2527	✔	✔	✔	✔	✘	✘
	ISO 4892-2	✔	✔	✔	✔	✔	✔
	GMW 14170	✔	✔	✔	✔	✔	✔
Volkswagen	PV3929	✔	✔	✔	✔	✔	✔
	PV3930	✔	✔	✔	✔	✔	✔
Hyundai	MS-300-31	✔	✔	✔	✔	✘	✘
PSA (Peugeot, Renault)	D27 1389	✘	✔	✔	✘	✘	✘
	D27 1911 / --D (2007)	✘	✔	✔	✘	✘	✘
Porsche	DIN 53387-1-A	✔	✔	✔	✔	✔	✔
Daimler	DBL 7399	✔	✔	✔	✔	✔	✔
	DBL 5555, 110_97	✔	✔	✔	✔	✔	✔
	DBL 5555, DIN 53231	✔	✔	✔	✔	✔	✔
SAAB	STD 3159	✔	✔	✔	✔	✘	✘
Volvo	STD 1027, 337	✔	✔	✔	✔	✘	✘
International	ISO 16474-2	✔	✔	✔	✔	✔	✔
	ISO 4892-2	✔	✔	✔	✔	✔	✔
	ASTM D7869	✔	✔	✔	✔	✘	✔
	JASO M351	✔	✔	✔	✔	✔	✔
	JIS D0205	✔	✔	✔	✔	✔	✔
	SAE J1960/J2527	✔	✔	✔	✔	✘	✘

*standards and instrument approvals subject to change

XENON WEATHERING INSTRUMENTS

Ci WEATHER-OMETER® AND XENOTEST®

Atlas, the pioneer of xenon weathering, has been manufacturing xenon weathering test equipment for more than 65 years. Initially starting with smaller air-cooled designs (Xenotest) and later extending the portfolio with larger water-cooled models (Ci).

Common Features

- Atlas Right Light® technology for most accurate outdoor Daylight simulation
- Rotating racks for most uniform irradiance, temperature, and humidity control
- ASTM BPT (uninsulated) and ISO BST (insulated) to comply with all industry standards
- Variety of specimen holders for great flexibility in specimen preparation
- Easy-to-use touch screens coming with all industry standards already pre-programmed
- DAQ through Ethernet (WXView, Add-ons)

Ci Series Specials

- Unique dual wavelength monitoring options 340/420 nm; 340/300-400 nm
- Unique S^{3}T (Specific Specimen Surface Temperature) option for real-time temperature data
- High irradiance up to 3 sun irradiance levels for acceleration
- Sealed lamp for very fast and easy lamp and filter replacements
- Optional LiquiAir DI water recirculation system saves thousands of gallons of water per year

Xenotest 440 Specials

- Patented XenoLogic™ twin lamp technology for lamp service-life ~ 4000 hours up to 60 W/m^2
- Integrated water recycling to save > 6000 L of DI water over a 1000 h weathering test
- Compact, economic design

CORROSION AND SOLAR TESTING INSTRUMENTS

SALT FOG AND CYCLIC CORROSION CHAMBERS

- Most sophisticated and versatile lab corrosion testing cabinet available
- Replicate up to 15 environmental conditions such as:
  - + Salt Fog (or complex electrolytes)
  - + Immersion
  - + Ambient
  - + -30°C to 90°C temperatures
  - + Solution Spray
  - + Controlled RH
  - + Other customized solutions
  - + SO_2 injection and CASS testing capabilities

SOLAR SIMULATION CHAMBERS

- Test individual components' ability to withstand solar radiation
- Metal Halide sunlight simulation
- Evaluation of both heat load and long-term aging
- Ensure long-term component durability

FULL VEHICLE SYSTEMS AND CRASH TEST LIGHTING

FULL VEHICLE TESTING

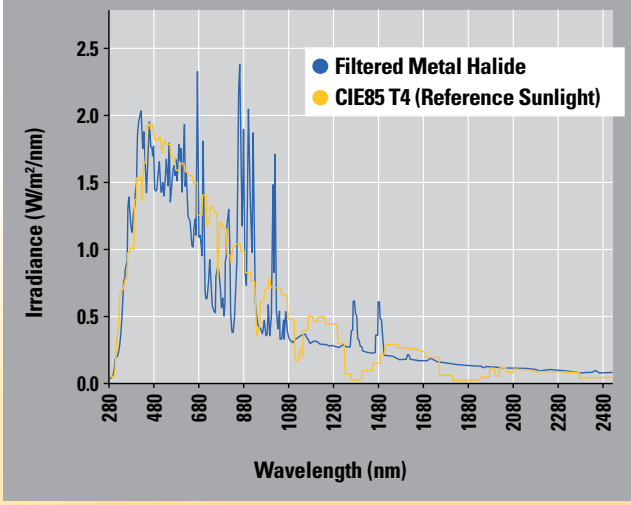
Applications

- Solar simulation systems for material exposure testing
- High speed lighting systems for crash test photography
- Fit and finish, occupant comfort, heating/AC analysis

Features

- Excellent full-spectrum match to sunlight, especially in IR region
- Efficient light source for large-scale testing
- Custom-designed for specific applications

FILTERED METAL HALIDE VS. DAYLIGHT



GLOBAL SUPPORT & WEATHERING EXPOSURE SITES

PHOENIX, ARIZONA

- Recognized benchmark desert weathering site with high levels of UV radiation and temperature.
- EMMAQUA®/UA-EMMAQUA®/LT-EMMAQUA®, IP/DP Box®, car carousel and static testing.

MIAMI, FLORIDA

- Recognized benchmark subtropical weathering site with high levels of UV radiation, temperature and humidity.
- Testing of full size automobiles, exterior coatings and interior components.

Main Climate	Precipitation	Temperature
A: equatorial	W: desert	h: hot arid
B: arid	S: steppe	k: cold arid
C: warm temperature	f: fully humid	a: hot summer
D: snow	s: summer dry	b: warm summer
E: polar	w: winter dry	c: cool summer
	m: monsoonal	d: extremely continental
		F: polar frost
		T: polar tundra

Source: Köppen-Geiger Climate Classification Map, koeppen-geiger.vu-wien.ac.at

SANARY SUR MER, FRANCE

- Benchmark Mediterranean site for European made products.
- Warm temperate climate providing the most severe weathering conditions on the European continent.

HAINAN, CHINA

- Popular Chinese test site for automotive testing with high levels of UV radiation, temperature and humidity.
- Testing of full size automobiles, IP/DP and exterior coatings.

CHENNAI, INDIA

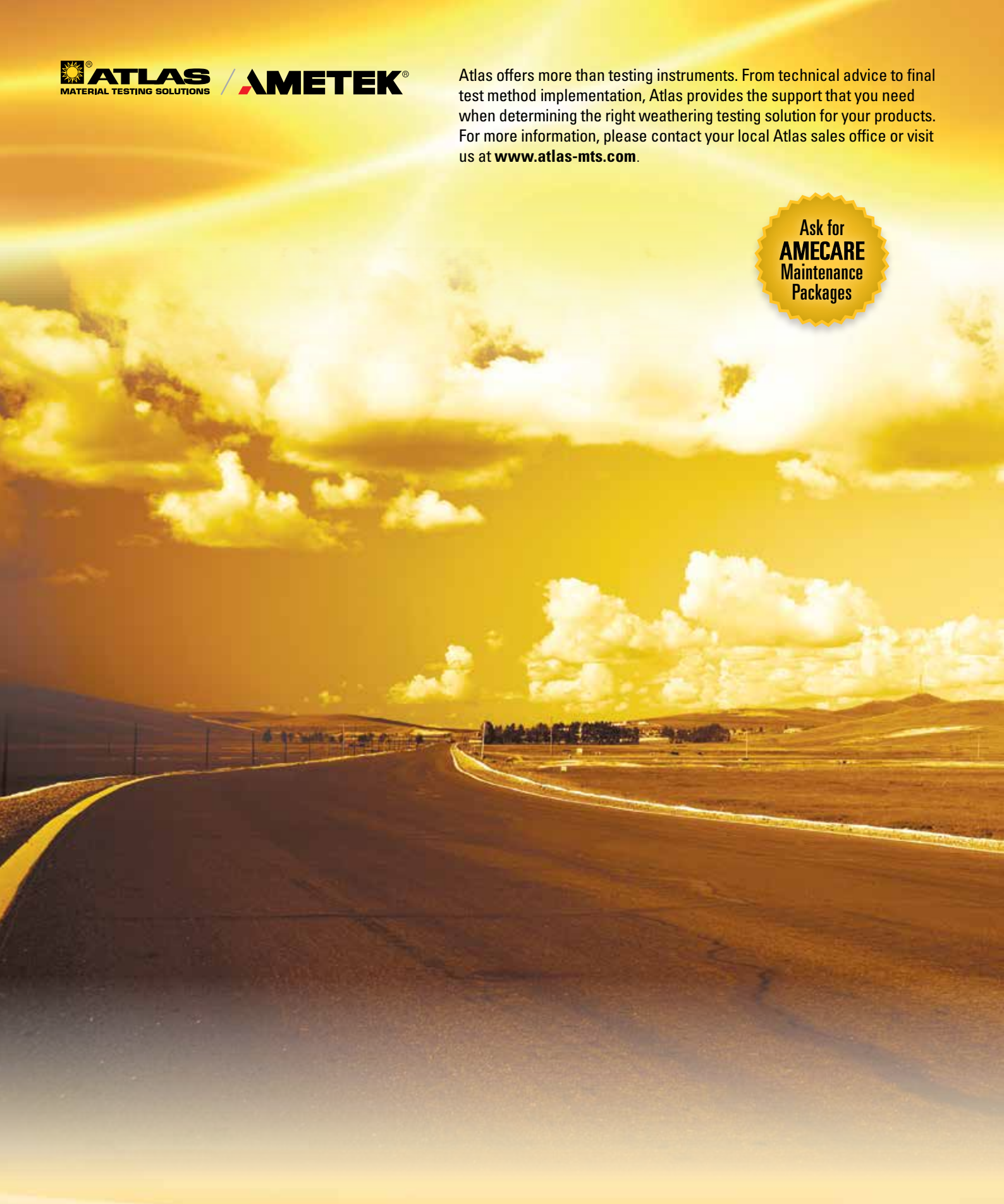
- Becoming a recognized benchmark subtropical weathering site in India with high levels of UV radiation, temperature and humidity.
- Testing of full size automobiles, exterior components and coatings.

Cwb Cwc Dfa Dfb Dfc Dfd Dsa Dsb Dsc Dsd Dwa Dwb Dwc Dwd EF ET

ATLAS MATERIAL TESTING SOLUTIONS / AMETEK®

Atlas offers more than testing instruments. From technical advice to final test method implementation, Atlas provides the support that you need when determining the right weathering testing solution for your products. For more information, please contact your local Atlas sales office or visit us at **www.atlas-mts.com**.

Ask for **AMECARE** Maintenance Packages



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