element

WEATHERING TESTING

EXPLAINING DIN 75 220. ACCELERATED SOLAR RADIATION EXPOSURE OF AUTOMOTIVE COMPONENTS

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INTRODUCTION

Climate exposure can have adverse effects on materials, often starting and accelerating the degradation process of a product.

Automotive parts and vehicles are susceptible to the damaging influences of cold, heat, solar radiation, and moisture. Exposure to these elements can lead to discoloration, surface crazing, cracking, embrittlement, and rust. These exposures, in turn, can result in premature product failure, warranty expenses, and damage to your brand reputation.

Before new products can be delivered to market, materials and components need to be tested to assess their operational performance and determine their durability to the environment. Testing to simulate end-use conditions allows identifying failure modes that may occur during the service life of a product.

A thorough understanding of how material properties change when products become subjected to accelerated climate exposure is essential in product development, quality control, and material certification. Accelerated aging testing provides critical insight that helps you assess and improve product quality and durability. It also ensures that products and components meet the highest regulatory requirements of the automotive industry.

THE INDUSTRY STANDARD

Extreme weather conditions around the globe create a need for weathering testing. To properly evaluate the lifetime of materials, years of outdoor exposure was traditionally required, which is not only costly but time-consuming as well.

As the need for rapid evaluation of materials is crucial, artificial light sources have been developed to accelerate material degradation and ultimately condense years of outdoor exposure down to months.

Automotive manufacturers and their suppliers began adopting DIN 75 220 in the early ‘90s as the industry standard for full spectrum solar simulation of automobile components.

The automotive industry represents a complex mixture of materials, each one being sensitive to a particular group of environmental parameters. Rain, humidity, and salt spray can cause corrosion of metals. Ultraviolet radiation, temperature, and moisture can initiate degradation of plastics and coatings.

DIN 75 220 applies to polymer-based automobile parts such as side mirrors, grills, light housing, instrument panels, steering wheels, weather seals and interior switches which are primarily comprised of plastics, rubbers, and simulated leathers. This specification applies to complex assemblies or whole vehicles and is suitable for revealing interactions between different materials within one or several components.

DIN 75 220 is a commonly requested testing requirement of many automotive manufacturers including Ford, GM, Jaguar, Nissan, Tesla, Toyota, Volkswagen and many others.

Specifically, it focuses on three primary accelerated weathering factors:

- Solar Radiation
- Moisture
- Temperature

These factors, in conjunction with other environmental conditions such as airborne gas and pollutants or acid rain, act together to cause unwanted and premature product failures.

PERFORMING THE TESTS

DIN 75 220 combines the variables of solar radiation intensities with thermal and moisture cycling. This process is done to simulate the extreme exterior or interior climate conditions that a vehicle may be subjected to in real life.

The standard utilizes metal halide lamps in conjunction with a variety of glass optical filters and representative interior and exterior temperature and humidity conditions to substantially reproduce vehicle conditions.

Materials or products that you find on an external surface of a vehicle such as weather seals, antennas, or even headlights would require simulated outdoor climate exposure conditions.

Indoor conditions simulate light transmittance through a 4mm thick window glass in conjunction with internal cabin conditions. This includes materials or products that you find in an enclosed vehicle interior such as trim components, fabrics, switches, or steering wheels.

DIN 75 220 includes a variety of climate conditions and exposure durations that represent various global climates ranging from freezing to tropical or desert environments. The test designations of these conditions are divided into two categories: Cycle Testing (Z) or Long-term Testing (D).

CYCLE TEST (Z)

A standard cycle test consists of 15 days of dry climate cycles followed by ten days of humid climate cycles performed in sequence. The cycle test is also subdivided into three specific climate conditions and sequences, as shown in the tables below. The cycles can be performed depending on your particular requirements.

OUTDOOR CYCLE TEST (Z-OUT)					
CYCLE	FILTER	STEP CONDITIONS (°C / %RH)	IRRADIANCE (W/M²)	STEP DURATION (HOURS)	CYCLE DURATION (DAYS)
Dry Climate	Outdoor	42±3 / <30	1000±100	8	15
		10±3 / >55	None	3.5	
		42±3 / <30	1000±100	8	
		10±3 / >55	None	3.5	
Humid Climate	Outdoor	23±5 / 50±5	None	1	10
		-10±3 / Ambient	None	5	
		42±3 / >60	1000±100	12	
		-10±3 / Ambient	None	6	
		23±5 / 50±5	None	1	

OUTDOOR CYCLE TEST (Z-IN-1)					
CYCLE	FILTER	STEP CONDITIONS (°C / %RH)	IRRADIANCE (W/M²)	STEP DURATION (HOURS)	CYCLE DURATION (DAYS)
Dry Climate	Indoor	80±3 / <30	830±80	8	15
		10±3 / >55	None	3.5	
		80±3 / <30	830±80	8	
		10±3 / >55	None	3.5	
Humid Climate	Indoor	23±5 / 50±5	None	1	10
		-10±3 / Ambient	None	5	
		80±3 / >40	830±80	12	
		-10±3 / Ambient	None	6	
		23±5 / 50±5	None	1	

OUTDOOR CYCLE TEST 2 (Z-IN-2)					
CYCLE	FILTER	STEP CONDITIONS (°C / %RH)	IRRADIANCE (W/M²)	STEP DURATION (HOURS)	CYCLE DURATION (DAYS)
Dry Climate	Indoor	65±3 / <30	830±80	8	15
		10±3 / >55	None	3.5	
		65±3 / <30	830±80	8	
		10±3 / >55	None	3.5	
Humid Climate	Indoor	23±5 / 50±5	None	1	10
		-10±3 / Ambient	None	5	
		65±3 / >50	830±80	12	
		-10±3 / Ambient	None	6	
		23±5 / 50±5	None	1	

LONG-TERM TEST (D)

A long-term test is performed under constant climatic and irradiation conditions, traditionally for 240 hours. Similar to the cycle test, the long-term test is subdivided into six distinct climate conditions, as shown in the following table.

TEST NAME	FILTER	IRRADIANCE (W/M²)	CONDITIONS (°C / %RH)	DURATION (HOURS)	COMMENTS
D-OUT-T	Outdoor	1000±100	42±3 / <30	240	Outdoor Long-term Test, Daytime Dry Climate
D-OUT-F	Outdoor	1000±100	42±3 / >60	240	Outdoor Long-term Test, Daytime Humid Climate
D-IN1-T	Indoor	830±80	80±3 / <30	240	Indoor Long-term Test 1, Daytime Dry Climate
D-IN1-F	Indoor	830±80	80±3 / >40	240	Indoor Long-term Test 1, Daytime Humid Climate
D-IN2-T	Indoor	830±80	65±3 / <30	240	Indoor Long-term Test 2, Daytime Dry Climate
D-IN2-F	Indoor	830±80	65±3 / >50	240	Indoor Long-term Test 2, Daytime Humid Climate

CONCLUSION

All materials used outdoors are exposed to the influences of solar radiation, temperature, water, and other environmental factors that contribute to product degradation.

The automotive industry has a requirement to evaluate the effects of severe environmental conditions on the performance of materials and components to prevent deterioration and premature product failure. Performing weathering testing is essential to assess the resistance of vehicle components to the stresses caused by climate exposure, thus ensuring the performance of a product over time.

Element is a global provider of testing, inspection and certification services for a diverse range of materials and products in sectors where failure in service is not an option. Everything we do is designed to deliver one thing for our customers – certainty that the materials and products we test, inspect and certify are safe, quality, compliant, and fit for purpose.

REFERENCE

DIN 75 220. Aging automobile components in solar simulation units 1992-11.

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