Non-Metallic Materials
Weather Aging in Dry, Hot Climate

Konzernnorm

Descriptors: Kalahari, Kalahari test, weathering, weather fastness, weather resistance, climate

Changes
The following changes have been made as compared to Test Specification PV 3929, 1993-06:
- Referenced standards updated
- Standard restructured

Previous issues
1993-06

1 Scope
This standard describes the procedure for testing the aging behavior (e.g., change in color and gloss) of plastics, elastomers and folding-top cloths that are subjected to weather and daylight. Testing is carried out by means of artificial weathering in dry heat (e.g., Kalahari, South Africa and Arizona).

The test is used for sample and standard production monitoring.

NOTE: For certain applications, the aging criterion may be a change in mechanical properties or cracking; for this reason, additional tests may be required along with the visual evaluation and color and glossiness measurements. These tests may include tensile tests, determination of impact resistance, determination of hardness and microscopic examinations, for example.

2 Designation
Weather resistance according to PV 3929

3 Requirements
The number of required year-long cycles, as well as deviations from this test standard, are set out in the Technical Supply Specifications, VW standards and drawings depending on the installation position of the component or material.

4 Test method

4.1 Principle
Specimens are irradiated using Xenon arc light. Filters are used to adapt the Xenon arc light to the global irradiation with its spectral distribution of ultraviolet and visible radiation.

The test shall be performed in equipment according to DIN EN ISO 4892-2 and DIN EN ISO 11341.

The test conditions each describe a year-long cycle, referred to the average dose of UV radiation (300 to 385 nm) in dry heat areas, e.g., Kalahari, South Africa and Arizona.
4.2 Test equipment

Weathering equipment with which the increased intensity of irradiation can be achieved and controlled shall be used. To ensure that the test results of the suppliers and customer are comparable, the make to be used for the test must be agreed with the responsible test laboratory in the VW Group.

4.3 Weathering conditions

See Table 1. In order to comply with the test temperatures, it is recommended to set up the test equipment in a test room which is kept at a constant temperature.

<table>
<thead>
<tr>
<th>Make</th>
<th>Weather-O-Meter</th>
<th>Xenotest 1 200 CPS</th>
<th>Xenotest alpha</th>
<th>Beta LM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ci 35 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ci 65 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ci 3 000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filters</td>
<td>Pyrex S/Pyrex S Replace according to manufacturer's instructions</td>
<td>3 Suprax UV special filters Replace according to manufacturer's instructions</td>
<td>Xenochrom 300 Replace according to manufacturer's instructions</td>
<td></td>
</tr>
<tr>
<td>Specimen rotation</td>
<td>Only non-turning mode is possible</td>
<td>Non-turning mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black standard temperature (°C)</td>
<td></td>
<td>90 ± 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specimen chamber temperature in the dry phase (°C)</td>
<td></td>
<td>50 ± 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative humidity</td>
<td></td>
<td>20 ± 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensity of irradiation (W/m²) (nm)</td>
<td>0.6</td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>340</td>
<td>300 – 400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test duration (approximate value) (h)</td>
<td></td>
<td>1500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation dose (1 year-long cycle) (MJ/m²)</td>
<td>3,200</td>
<td>400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.4 Specimen

4.4.1 Specimen preparation

The specimens are taken from a representative portion of the finished part to be tested or from a specimen sheet manufactured under standard production conditions. They should be as flat as possible. As long as the apparatus-dependent specimen carrier size is not exceeded, complete components may also be tested. However, it is important to ensure here that the surface to be tested does not project more than 10 mm (or 5 mm in the case of the Xenotest alpha) over the specimen carrier plane toward the source of the irradiation. The specimen is secured on the specimen carrier. Half of one side of each specimen is covered with sheet masks.

In order to test the change in mechanical properties, e.g., by means of tensile tests and determination of the impact resistance, the specimens are made in a size that is required for the respective test procedure or that is prescribed in standards.
4.4.2 Specimen size

The specimen size is in accordance with the max. clampable test surfaces in the original specimen carriers. Thus, the following would apply:

- Xenotest 1 200 CPS (175 x 60) mm
- Xenotest alpha (140 x 40) mm
- Weather-O-Meter Ci 35 A, Ci 65 A and Ci 3 000 (145 x 45) mm
- Beta LM (350 x 80) mm

The specimen must at least be sufficiently large to ensure that proper evaluation can be performed with the designated procedures.

4.4.3 Specimen carrier

Only for Xenotest 1 200 CPS: Bent non-turning carriers shall be used in order to achieve an even intensity of irradiation over all three specimen carrier planes.

4.5 Weathering test

4.5.1 Cleaning the filters

The filter systems shall be checked and cleaned at regular intervals. Deposits on the glass can be removed using a 20% solution of citric acid.

4.5.2 Replacing the irradiator

The operating duration of the irradiator is 1,500 h for Xenotest devices and 2,000 h for Weather-O-Meters. The manufacturer’s instructions shall be observed.

4.5.3 Weathering cycle

The end of a weathering cycle is reached at a specified intensity of UV irradiation and radiation dose after a specific test duration (approximate value; see Table 1).

In devices with controlled intensity of irradiation, the radiation dose can be pre-selected as the switch-off criterion.

4.6 Evaluating the specimens

4.6.1 Visual evaluation

Changes in color and gloss are compared against the previously covered surface or an unexposed reference specimen with the gray scale to evaluate the “change in color” according to DIN EN 20105-A02 under lighting according to DIN EN ISO 105-A01 or indirect daylight by several proficient normal-sighted people (at least two).

Changes which do not have to be evaluated by means of measurement are described according to DIN EN ISO 4628-1.
4.6.2 Colorimetric evaluation

In addition to the visual evaluation, a colorimetric evaluation using a spectrophotometer according to CIELAB (DIN 6174), but excluding the gloss value, shall be conducted according to a procedure specified in DIN 53 236.

If required, the result shall be converted to gray-scale levels according to DIN EN 20105-A02 and for yellowing, to yellow values according to DIN 6167.

For single-color and homogenous surfaces, at least three measurements must be averaged. For multicolored, structured specimens or anisotropically scattering specimens, the number of measurements to be averaged shall be increased.

4.6.3 Evaluating the gloss

The gloss is measured as a reflectometer value according to DIN 67530 and the change after weathering is expressed in %.

4.7 Test report

If required in the corresponding Technical Supply Specification/VW standard/drawing, the following information must be specified in the test report with reference to this test standard:

a) Test apparatus
b) Total test duration
c) Color change: gray-scale level/dE/dL/da/db
d) Any color shift
e) Yellow value according to DIN 6167
f) Change in gloss
g) Further tested properties and test methods of the appropriate test standard
h) Additional observations and changes such as cracks, spotting, exudations, chalking, etc.
i) Any agreed conditions that deviate from this test specification.
5 Referenced standards

<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN 6174</td>
<td>Colorimetric Evaluation of Colour Differences of Surface Colours According to the CIELAB Formula</td>
</tr>
<tr>
<td>DIN 6167</td>
<td>Description of Yellowness of Near-White or Near-Colourless Materials</td>
</tr>
<tr>
<td>DIN 53236</td>
<td>Testing of Colouring Materials; Conditions of Measurement and Evaluation for the Determination of Colour Differences for Paint Coatings, Similar Coatings and Plastics</td>
</tr>
<tr>
<td>DIN 67530</td>
<td>Reflectometer as a Means for Gloss Assessment of Plane Surfaces of Paint Coatings and Plastics</td>
</tr>
<tr>
<td>DIN EN 20105-A02</td>
<td>Textiles – Tests for Colour Fastness – Part A02: Grey Scale for Assessing Change in Colour</td>
</tr>
<tr>
<td>DIN EN ISO 105-A01</td>
<td>Textiles – Tests for Colour Fastness – Part A01: General Principles of Testing</td>
</tr>
<tr>
<td>DIN EN ISO 4892-2</td>
<td>Plastics – Methods of Exposure to Laboratory Light Sources – Part 2: Xenon-Arc Sources</td>
</tr>
<tr>
<td>DIN EN ISO 11341</td>
<td>Paints and Varnishes – Artificial Weathering and Exposure to Artificial Radiation – Exposure to Filtered Xenon-Arc Radiation</td>
</tr>
</tbody>
</table>

1 In this section, terminological inconsistencies may occur as the original titles are used.