VOLKSWAGEN AG	**Non-Metallic Materials** Exposure Test of Passenger Compartment Components	**PV 1303**
Konzernnorm		

Descriptors: High-temperature light exposure, color fastness, lightfastness

Contents

Changes

The following changes have been made as compared to PV 1303: 1993-12:

- Device selection updated
- Standard restructured
- Notes on entry in the technical supply specifications and drawings added

Previous Issues

1987-05; 1989-11; 1993-12

1 Scope

This standard describes the testing of planar fabrics, plastic parts, rubber parts, paints, leather, decorative wooden parts as well as textile and film-laminated components of the vehicle interior trim with respect to their color fastness and resistance to light and heat as well as the assessment of parts that have been exposed to light for sample and standard production monitoring.

It refers exclusively to the exposure of samples/specimens to a filtered xenon arc lamp in the test apparatus.

Exposed specimens can furthermore be used to determine the residual tear strength, residual elongation at tear and residual abrasion resistance.

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Fachverantwortung/Responsibility				Normung/Standards (EZTN, 1733)		
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2 Definitions

2.1 Non-Turning Mode

In "non-turning mode", the specimens and light fastness scales are constantly facing the light source during the test, i.e. no light-dark change (turning mode) takes place during this test.

2.2 Dry Exposure

In this test the specimens are not sprayed with water.

3 Designation

High-temperature light exposure per PV 1303

4 Requirements

The number of required periods is specified in the technical supply specifications depending on the position of the component (see Appendix A.1).

Requirements and deviations from the test methods per VW, TL and/or drawing or release.

In order to assess the light fastness of the material, additional tests may also be required during interim controls and after completion of the light exposure (e.g. brushing, Crockmeter or Martindale abrasion test).

5 Test

5.1 Principle

The specimens are irradiated subject to the “Non-Turning“ and “Dry Exposure“ device conditions. The high heat stress on the equipment materials in the vehicle interior is simultaneously taken into consideration (high-temperature light exposure).

The specified test conditions each describe one exposure period (according to DIN 75202, specification 1991).

5.2 Test Equipment

Light exposure test devices, which comply with DIN 75202 (e.g. Xenotest 1200, 1200 CPS, Xenotest Alpha, Alpha HE and Xenotest Beta from Heraeus or Weather-Ometer CI 35A, Fade-Ometer CI 3000, 4000 and 5000 from Atlas), shall be used.

To ensure that the test results of the supplier and customer are comparable, the choice of device type to be used in special cases must be coordinated with the responsible test laboratory in the VW Group.

It is recommended that the test equipment be set up in a conditioned room. Otherwise the use of a connected cooling unit may be required.

5.3 Light Exposure Conditions

The filter systems described below feature a filter cut-off of 320nm in the UV range.

5.3.1 Light Exposure in Non-Turning Mode with the Xenotest 1200

Black standard temperature	(100 ± 3)° C,
Specimen room temperature	(65 ± 3)° C,
Relative humidity	(20 ± 10) %.

Filter systems: Internal filter (quartz glass cylinder) with an IR-reflective layer, additional filter composed of 3 shells of window glass.

The operating duration of the Xenon irradiator is max. 1500 h, i.e. once the oldest of the three irradiators is replaced, the operating hours of both other irradiators will be 500 h and 1000 h respectively.

For further details see DIN 75202 with Appendix B.

5.3.2 Light Exposure In Non-Turning Mode with the Xenotest 1200 CPS (Radiation Strength Regulated)

Black standard temperature	(100 ± 3)° C,
Specimen room temperature	(65 ± 3)° C,
Relative humidity	(20 ± 10) %,
Radiation strength (measured at 300 - 400 nm)	60 W / m².

Filtering and procedure as for Xenotest 1200 (section 5.3.1).

The irradiator shall be replaced when it is no longer adjustable (after approximately 1,500 h).

5.3.3 Light Exposure in Non-Turning Mode with the Xenotest Alpha and Alpha HE) (Radiation Strength Regulated)

Black standard temperature	(100 ± 3)° C,
Specimen room temperature	(65 ± 3)° C,
Relative humidity	(20 ± 10) %,
Radiation strength (measured at 300 - 400 nm)	60 W / m²,
Alpha filter system	Xenochrom 320,
Alpha HE filter system	10 window glass.

Procedure as for Xenotest 1200 (section 5.3.1).

The irradiator shall be replaced when it is no longer adjustable (after approximately 1,500 h).

5.3.4 Light Exposure in Non-Turning Mode with the Xenotest Beta (Radiation Strength Regulated)

Black standard temperature	(100 ± 3)° C,
Specimen room temperature	(65 ± 3)° C,
Relative humidity	(20 ± 10) %,
Radiation strength (measured at 300 - 400 nm)	60 W / m²,
Filtering system	Xenochrom 320.

Procedure as for Xenotest 1200 (section 5.3.1).

The irradiator shall be replaced when it is no longer adjustable (after approximately 1,500 h).

5.3.5 Light Exposure In Non-Turning Mode with the Weather-Ometer CI 35A (Radiation Strength Regulated)

Black standard temperature	(100 ± 3)° C,
Specimen room temperature	(65 ± 3)° C,
Relative humidity	(20 ± 10) %,
Radiation strength (measured at 420 nm)	1.2 W / m²,
Filtering system	Borosilicate/Soda lime.

The irradiator shall be replaced when it is no longer adjustable (after approximately 2,000 – 4,000 h).

Filter replacement: External filter after 2,000 h, internal filter after 400 h.

For further details see DIN 75202 with Appendix A.

5.3.6 Light Exposure in Non-Turning Mode with the Fade-Ometer CI 3000, CI 4000 and CI 5000, (Radiation Strength Regulated)

Black standard temperature	(100 ± 3)° C,
Specimen room temperature	(65 ± 3)° C,
Relative humidity	(20 ± 10) %,
Radiation strength (measured at 420 nm)	1.2 W / m²,
Filtering system	Borosilicate/Soda lime.

The irradiator shall be replaced when it is no longer adjustable (after approximately 2,000 – 4,000 h).

Filter replacement: External filter after 2,000 h, internal filter after 400 h.

For further details see DIN 75202 with Appendix A.

5.4 Specimen Preparation

5.4.1 Test Strip Size

The test strip dimensions shall preferably be in accordance with the max. clampable test surfaces in the original specimen carriers.

- Xenotest 1200 and 1200 CPS 170 X 60 mm,
- Xenotest Alpha and Alpha HE 130 X 40 mm,
- Xenotest Beta 300 X 80 mm,
- Weather-Ometer CI 35A 130 X 40 mm,
- Fade-Ometer CI 3000 145 X 45 mm,
- Fade-Ometer CI 4000 140 X 70 mm,
- Fade-Ometer CI 5000 140 X 70 mm,

For the color fastness test, the minimum specimen size is dependent on the evaluation procedure.

Specimens that are smaller than the relevant specimen carrier surface shall be attached to white cardboard.

For yarn tests a continuous thread is closely wound along the length of a white piece of cardboard (min 5 cm wide) and fixed at the back or in the non-exposed area.

5.4.2 Specimen Thickness

The specimens exposed shall have the same thickness as the finished part in its fitting condition; laminates shall, where possible, be exposed in the original thickness of the composite material.

The maximum thickness for all device types is set to 15 mm by the design of the specimen carrier.

5.4.3 Specimen Backing

If textile specimens are not laminated, a backing of a white, non-woven polyester (PET) (gross density 60 kg/ m³) is applied.

5.4.4 Specimen Carrier

All specimen carriers are equipped with full-surface non-rusting carrier panels (0.7 to 0.1) mm.

In the Xenotest 1200, Xenotest Alpha / Alpha HE and the Weather-Ometer, both standard specimen carriers and special specimen carriers are used for a recessed specimen setup.

Special specimen carrier:

- Xenotest Alpha / Alpha HE	Order No. 56077987
- Weather-Ometer CI35A	Order No. 19-1640-00

In the Xenotest 1200 / 1200 CPS and Xenotest Beta the design of the standard specimen carriers allows them to be used for all specimens.

5.4.4.1 Use of Standard Specimen Carriers

These specimen carriers are used to test all non-laminated textiles and films as well as non-bound felt materials.

Due to their lack of inherent stability, these specimens with dimensions according to section 5.4.1 are each secured, stress-free, to a white piece of cardboard on their narrow sides, with backing if required according to section 5.4.3, after which they are mounted on the specimen carriers.

5.4.4.2 Use of Special Specimen Carriers

These specimen carriers are used to test all materials, the thickness of which exceeds 5 mm or which cannot be secured in the standard specimen carriers due to their design.

If the specimens are too small or have insufficient inherent stability, they are attached to a piece of white cardboard (for textile samples that are too small, proceed according to section 5.4.3).

5.4.5 Strip Tensile Test on Textiles after Exposure to Light

The specimens shall be cut to size for the strip tensile test; knit items shall be cut parallel with the courses and woven items parallel with the threads.

After the exposure to light, any unexposed edge areas that may have been covered by the specimen carrier are removed from the specimens before the tensile test.

The strip tensile test is conducted according to EN 29073-3, however with a free specimen length (gage length) of 100 mm and a traverse speed of 100 mm/min after prior specimen aging for at least 24 h in the standard climate per DIN 50014 - 23/ 50-2.

The determined tear strengths are converted for a specimen width of 50 mm.

5.4.6 Tensile Test on Plastic Films (e.g. Decorative Films) after Light Exposure

For this test, specimens from both material directions are exposed to light.

The specimens are removed from the exposed film surface as a standard test specimen according to the relevant material or component specification. As much material shall be exposed to light as required to provide 5 specimens in the length and 5 in the width.

The tensile test is performed at a traverse speed of 100 mm/min.

5.5 Conducting the Exposure Test

5.5.1 Basic Procedure

To maintain a proper device status, regular visual controlling and cleaning of the filter system is required if the radiation strength drops by more than 15% in non-regulated devices. The filter systems of all devices named under section 5.3 shall be cleaned at least once weekly. The radiation strength must likewise be measured on all devices once weekly at least for a period of 30 min, e.g. with the UV measuring device, Radialux or Xenocal from Atlas.

5.5.2 Exposure Periods

The end of an exposure period is determined in the specification to DIN 75202. To this end, standard depth dyeing 6 of the light fastness scale (blue scale level) is simultaneously exposed to light with every collective of samples, whereby the blue scale levels are, like the specimens, covered with a sheet mask. The end is reached when the standard depth dyeing 6 achieves a contrast between the exposed and unexposed surface equal to the total color change dE 4.3. The end of an exposure period shall be stipulated precisely and strictly adhered to.

The total color change shall preferably be determined colorimetrically, as described under section 6.3, using a spectral photometer. The end of an exposure periods is thus reached once a CIELAB value of 4.3 ± 0.3 (dE* for D 65/ 10°) is determined.

The end of an exposure period (blue scale level 6 : dE* 4.3 ± 0.3) is normally reached, under the device conditions described, in the regulated light exposure apparatuses after the following radiation doses (see Table 1):

Table 1

Unit	**Radiation Dose**	**Filter System**
Xenotest 1200 CPS	10 MJ/ m²	3 shells of window glass
Xenotest Alpha	10 MJ/ m²	Xenochrom 320.
Xenotest Alpha HE	10 MJ/ m²	10 window glass
Xenotest Beta	10 MJ/ m²	Xenochrom 320.
Weather-Ometer CI 35A	280 kJ/ m²	Borosilicate/Soda lime
Fade-Ometer CI 3000	280 kJ/ m²	Borosilicate/Soda lime
Fade-Ometer CI 4000	280 kJ/ m²	Borosilicate/Soda lime
Fade-Ometer CI 5000	280 kJ/ m²	Borosilicate/Soda lime

These specifications are only guideline values and must be checked in each individual case.

5.5.3 Multiple Exposure

For multiple exposures it must be ensured that the end nominal values at the end of the exposure periods do not exceed the following values e.g.:

3	periods	12.9 ± 0.4
5	periods	21.5 ± 0.8
10	periods	43.0 ± 0.8

This means that in the case of multiple exposure, the relevant lower and upper limits for the individual periods may not be fully utilized over the entire number of periods.

Example
1st period dE = 4.0
2nd period dE = 4.0
3rd period must be dE > 4.3

5.5.4 Source of Supply for Blue Scale Levels

Beuth Verlag GmbH
Burggrafenstraße 6
10787 Berlin
Telephone: 030/ 2601-2260
Fax: 030/ 2601-1260

6 Evaluation

6.1 Evaluation Principles

The exposed specimens are evaluated with respect to the color change (e.g. fading) both visually and/or colorimetrically using an unexposed specimen as reference. The requirements are set out in the corresponding technical supply specifications and the drawings/releases.

6.2 Visual Evaluation

The exposed specimens are each assessed at least twice, with the aid of the gray-scale level to evaluate the change in color (EN 20105-A02) by several trained, normal-sighted people under suitable lighting as described in DIN 5033-3. The results of exposure are generally indicated as gray-scale level "GM" according to EN 20105-A02.

6.3 Colorimetric Evaluation

In order to avoid the relatively large deviations between the individual assessors and repeat assessments, a colorimetric evaluation according to VW 501 90 shall, where possible, be conducted in addition to the visual evaluation.

7 Test Report

The following information must be specified in the test report with reference to this test specification, if required in the corresponding technical supply specification:

a) Test apparatus
b) Number of exposure periods
c) Radiation dose
d) Gray-scale level / GM
e) Color change / dE*
f) Color changes of the blue scale levels in the individual exposure periods

For specimens with color shift only the direction is indicated.

The discoloration of the blue scale level standard depth dyeing 6, which was exposed along with the specimens, shall be indicated as follows: Blue scale level standard depth dyeing / exposure periods / exposure period duration / color change according to gray-scale level GM (EN 20105-A02), color change according to CIELAB Δ E*/.

Example:

a) Test in Xenotest 1200 CPS
b) 4 periods
c) Radiation dose = 10 MJ
d) GM = 4
e) dE* = 1.8

8 Referenced Standards

VW 501 90	Components of the Vehicle Interior Trim; Colorimetric Evaluation
DIN 5033-3	Colorimetry; Colorimetric Measures
DIN 50 014	Climates and Their Technical Application; Standard Climates
DIN 75 202	Determination of Color Fastness of Interior Materials in Motor Vehicles, Xenon Arc Lamp Test.
DIN EN 20 105-A02	Textiles; Tests for Color Fastness, Part A02: Gray Scale for Assessing Change in Color
DIN EN 29073-3	Textiles; Test Method for Nonwoven Fabrics, Part 3: Determining the Maximum Tensile Strength and the Maximum Tensile Strength Elongation

Appendix A (informative)

A.1 Guideline for Specifying Requirements in Technical Supply Specifications and Drawings

This appendix does not replace any technical supply specifications, drawings or releases with respect to material/component requirements to be mentioned. It is only used as an informative guide for when requirements are to be formulated in technical supply specifications, drawings or releases.

A.1.1 Basic Quality Criterion for Passenger Compartment Components

Open-air weathering for one year in a vehicle with untinted glazing in dry heat (Arizona or the Kalahari). A color change (mostly fading) is permitted for all components according to the gray scale as per EN 20105-A02 of GM ≥ 4.0, a color shift is not permissible. Additional requirement: No cracks or holes may appear after two years of open-air weathering in dry-heat.

The open-air weathering test of passenger compartment components is simulated in the laboratory by conducting the exposure test per PV 1303 (high-temperature light exposure). The weathering stress is applied, according to this test method, in the form of exposure periods (approx. 45 hours / periods and at approx. 10 MJ / period). The position-dependent loading of the components in the vehicle is taken into consideration by means of the number of periods.

A.1.2 Number of (Minimum) Required Periods per PV 1303 for a Vehicle with Untinted Glazing (Table A.1)

Table A 1

Component	**Periods**
Parcel shelf (slanted rear window, notchback)	10
Load compartment cover Combi/Avant variant	8
Trim on trunk Combi/Avant variant (open) Short-rear (removable parcel shelf, e.g. Golf)	 8 2
Trunk, add-on parts Short-rear Variant	 8 5
Dashboard (ASSY and film)	5 10 *)
Steering column, switch and trim	5
Steering wheel	5
Interior mirror	5
Door trim, Upper, *direct* radiation, textiles and film *indirect* radiation, textiles and film	 5 3
Pillar linings, *direct* radiation *indirect* radiation	 5 3

Component	**Periods**
Sun visor Film Mirror cassette	 5 3
Seat belts	4
Seat covers	3
Molded headlining (ASSY with decorative variants)	3
Floor carpets	3

*) Requirement: two years open-air weathering without cracks.

For vehicles, which are offered exclusively with green glazing, the test requirement can be reduced to 60% of the number of periods.

Restriction: For components, which are only to be tested with 2 or 3 periods in any case, a reduction in the number of periods is *not* permitted. The internal components of *Cabrios* shall be tested as for vehicles with untinted glazing and a normal roof, even if the glass in the vehicle is 100% green glass.