

**MATERIALS AND PARTS FOR PASSENGER COMPARTMENT
COLOUR FASTNESS TO ARTIFICIAL LIGHT
AT HIGH AND MEAN TEMPERATURES**

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NO USE RESTRICTION*This is a translation, the French original shall be used in all cases of litigation**Date of translation : 24/01/2001***FOREWORD**

This document is equivalent to the RENAULT document D47 1431.

It must not be modified without prior consultation with the Normalisation Department of this Group.

It is in conformity with the agreement reached between this Group and PSA PEUGEOT CITROËN in JULY 2000.

1. OBJECT AND FIELD OF APPLICATION

The object of this méthode is to assess the colour fastness of certain materials to the action of a light source at high temperature (standard test specimen holders) or mean temperature (modified test specimen holders with infrared filter KG1). The mean temperature shall only be used if specified in the standard documents.

This test method concerns :

- materials and parts for passenger compartment such as woven and knitted textiles,
- textile-cellular material composites,
- textile floor coverings subjected to special conditions,
- plastic sheets,
- self-pigmented or self coloured plastics, for example transparent or opalescent plastic materials,
- hide trims,
- plastic coated textiles (TEP),
- non woven textiles,
- steering wheel foam materials,
- etc.

2. PRINCIPLE

To expose a test specimen of the material to the filtered rays and heat of a xenon arc lamp.

3. EQUIPMENT

Two ageing test apparatus may be used, Xenotest 150 S (3.1) within the context of Quality Control, or Fade-Ometer Ci 3000 (3.2) for approval and acceptance. Restriction in the use of either of these apparatus may be specified in the documents.

3.1. AGEING TEST APPARATUS XENOTEST 150 S

Supplied by ATLAS.

3.1.1. ACCESSORIES

3.1.1.1. Stainless steel test specimen holder and masking devices.

3.1.1.2. White support cards,
which are used as test specimen supports.

3.1.1.3. Black panel thermometer (TPN)
in sheet metal, able to reach at least 110°C.

3.1.1.4. Electronic black panel thermometer
in sheet metal onto a plastic support with the sensitive element placed in the hottest part of the chamber; this thermometer is used for limited periods, for example one hour per cycle.

3.1.1.5. External cylinder
in special U.V. Duran glass, 2,5 mm thick allowing rays of $\lambda \geq 310$ nm to pass through.

3.1.1.6. KG1 Infrared filters.

3.1.1.7. Plates of window glass
of dimensions and thickness identical to those of infrared filters.

3.1.1.8. Radialux measuring equipment
for the energy control of light sources comprising of a U.V. sensor for the spectrum band 300 nm – 400 nm.

3.1.2. INSTALLATION

- The apparatus must be installed in a clean room, preferably with a slight overpressure, if possible at a temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $50\% \pm 5\%$ relative humidity. This apparatus must be calibrated regularly by the Manufacturer.

- Supply of distilled or demineralised water.
- Resistivity $\geq 1 \text{ M}\Omega\text{cm}$.
- Effective discharge of vapours to the outside.

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3.1.3. MAINTENANCE

- Xenon lamp : check that the electric power supplied to the lamp is $1500\text{ W} \pm 50\text{ W}$; replace the lamp every 1500 hours.
- Turn the selector switch to position III.
- Internal and external cylinders : clean thoroughly every 1500 hours and change every year.
- Filter glass (KG1 and window glass) must be replaced successively every 600 hours, which means changing each element every 4200 hours.
- Air filters : clean at least once a year and replace after every three cleaning operations.
- Air conditioning nozzles : monitor their operation.
- Black panel thermometer (3.1.1.3.) :
 - Repaint the black panel if its appearance has deteriorated (infrared emitting paint $\varepsilon = 0,93$ black paint at high temperature : 800°C : 'JULIEN' paint manufactured by ICI).

3.1.4. CALIBRATION AND SETTINGS

The apparatus is set to "intermittent exposure" so that the test specimens are subjected to alternate periods of light and darkness.

3.1.4.1. Humidity

When commissioning the apparatus, the Manufacturer must ensure that the water flow rate from the ultrasonic spray gun is $25\text{ ml/min} \pm 5\text{ ml/min}$.

Set the relative humidity to 45% on the hygrometer

3.1.4.2. Temperature

Calibration when changing the lamp consists of adjusting the Xenotest so that the temperature reaches 90°C ($-2^{\circ}\text{C} / 0^{\circ}\text{C}$) on the thermometer surface (3.1.1.4.).

In order to achieve this, position four infrared filters (3.1.1.6.) alternating with three glass plates (3.1.1.7.). Fill the Xenotest with eight test specimen holders (3.1.1.1.) containing the cards (3.1.1.2), the thermometer (3.1.1.3.) and the thermometer (3.1.1.4.).

Switch on the apparatus. After operating for 30 minutes, adjust the temperature setting. If required, alter the number of infrared filters.

Record the corresponding temperature from the black panel thermometer (3.1.1.3.).

This temperature is used as reference for this thermometer until the next calibration.

In these conditions, the test chamber temperature does not exceed 45°C .

3.1.4.3. Luminous energy

To check the energy to illuminate the lamp, operate the Xenotest for 1 hour, then stop.

Remove one test specimen holder and replace it with the U.V. sensor of the Radialux measuring equipment (3.1.1.8.) that has been initialised immediately before.

Place the sensitive area of the sensor facing the operator and operate for 6 minutes. Stop the Xenotest and remove the U.V. sensor. Connect it to the reading equipment and read off the measurement recorded in Wh/m².

The equivalent energy for one hour exposure, Wh/m², is obtained by multiplying the previous result by a factor of 10.

To obtain the luminous energy of the lamp, it is necessary to take into account the rotation of the carousel and therefore multiply the previous result by a factor of 2.

Finally, depending on the filtering system used, it is appropriate to allocate a correction coefficient C obtained by means of the following formula :

$$C = [(N_1 \times C_1) + (N_2 \times C_2)] / N_1 + N_2$$

in which : N_1 = number of filters with coefficient C_1 ,

N_2 = number of filters with coefficient C_2 ,

C_1 = coefficient of KG1 filter = 1,09,

C_2 = coefficient of window glass = 1,25.

Values C_1 and C_2 are given for the U.V. sensor used in Xenotests 150 and 150 S.

Example : Xenotest 150 with 3 KG1 and 4 window glasses.

Value read off the U.V. sensor after 6 minutes : E (Wh/m²).

The luminous energy of the lamp is :

$$E \times 10 \times 2 \frac{(3 \times 1,09) + (4 \times 1,25)}{7} \text{ (Wh/m}^2\text{)}$$

The luminous energy of the lamp must be greater than 130 Wh/m².

Otherwise check the various settings according to paragraph 3.1.3. and proceed with the required corrections to achieve conformity. If necessary, increase the duration of exposure as shown in paragraph 5.

This check must be carried out before each test.

Note : Value established with the RADIALUX measuring equipment calibrated after January 1994.

3.2. AGEING FADE-OMETER CI 3000 APPARATUS

with Xenon arc from ATLAS.

3.2.1. ACCESSORIES**3.2.1.1. Test specimen holders,**

- Stainless steel test specimen holders and masking devices 145 mm x 45 mm (supplier : ATLAS Ref. : 39-1867).
- Modified test specimen holders and masking devices to support infrared filters KG1 so that a temperature of 85°C (- 3°C / 0°C) may be obtained on the surface of the test specimens, see description in Appendix 2.

Note : *Unless otherwise specified in the standard documents, use standard test specimens holders and masking devices.*

3.2.1.2. White support cards

which are used as test specimen supports.

3.2.1.3. Internal filter in borosilicate glass type S

(Commercial reference, ATLAS : 20.2773.000).

3.2.1.4. External filter in clear glass

(Commercial reference, ATLAS : SODALIME 20.2797.000).

3.2.1.5. Standard black thermometer (TSN)

in sheet metal onto plastic support, used continuously.

3.2.1.6. Infrared filter KG1,

dimensions 45 mm x 100 mm and 2 mm thick.

3.2.2. INSTALLATION

- The apparatus must be installed in a clean room, preferably with a slight overpressure, if possible at a temperature of 23°C ± 2°C and 50% ± 5% relative humidity. This apparatus must be calibrated regularly by the Manufacturer.
- Supply of distilled or demineralised water. The resistivity must be greater than 2 MΩ.cm and the conductivity must be less than 0,5 µS/cm. The pH must be between 6 and 8. The amount of dry particles must be less than 1 ppm of which SiO₂ is less than 0,5 ppm.
- Supply of filtered and oil free compressed air, with a pressure between 2 and 3 bar.

3.2.3. MAINTENANCE

- Water-cooled Xenon lamp : 4500 W; replace the lamp every 2400 hours or less.
- Internal filter : change every 450 hours.
- External filter : change every 2100 hours.
- Standard black thermometer (TSN) : to be cleaned with polish every 300 hours and replaced once a year or after 8000 hours of use.
- Regulating cell (quartz pipe) : to be cleaned with ethanol every 300 hours and before calibration.
- In the specific use of modified test specimen holder with filter KG1 :
 - clean with ethanol at the beginning of each filter test,
 - change the filters after every 4200 h of testing.

3.2.4. CALIBRATION AND SETTINGS

Display the following settings.

3.2.4.1. Humidity

Set the relative humidity to 30% on the display panel.

3.2.4.2. Temperature of the chamber

Set the temperature of the chamber to 66°C and check that the temperature shown on the thermometer (3.1.1.4.) is 100°C (-2°C / 0°C), if required, adjust the ventilation speed in order to obtain the temperature of 100°C (-2°C / 0°C).

3.2.4.3. Luminous energy of the lamp

To be set to 1,4 W/m² for a wavelength of 420 nm.

3.2.4.4. Calibration of the regulating cell

Use a standard lamp supplied by the Manufacturer, adjust if required the value of the irradiation read off the display panel.

Carry out the calibration in the empty carousel at a constant temperature obtained after 30 minutes of operation.

Operation to be carried out every 450 hours.

3.3. BLUE SCALE STANDARDS

The standards are woollen fabrics dyed blue in conformity with norme NF EN ISO 105-B02; they range from No.1 (very poor colour fastness) to No. 8 (very good colour fastness). Use only standards No. 4, 5, 6, 7 sufficiently large to take test specimens 20 mm wide placed onto the support (3.1.1.2.) without being bonded. After each test, level 6 from the blue scale standards must be graded according to § 6.2.

3.4. GREY SCALE FOR THE ASSESSMENT OF DETERIORATIONS

This scale is defined by norme NF EN 20105-A02. Use preferably the 9 degree scale.

3.5. MASKING DEVICES

Masking devices are used for assessing the contrast in colour on the different aged test specimens. These masking devices consist of neutral grey cards in which windows of dimensions 40 mm x 20 mm are made; the neutral grey colour is approximately that of the lightest band on the grey scale for the assessment of deterioration (3.4.) (for example CHARTE neutral grey card from KODAK).

4. PREPARATION OF TEST SPECIMENS

- Test specimens must be cut out in the longitudinal direction of the material.

Note 1 : *To identify the direction, cut out the lower right corner of the test specimen.*

Note 2 : *In the case of textiles, the cut must be made in the weaving or knitting direction.*

- In the specific case of velours, check that the pile is orientated downwards.
- In the case of steering wheels, take a test specimen from the foam, of maximum surface with a thickness less than 3 mm.
- Take test specimen of suitable dimensions for test specimen holders, in the case of composite materials, take test specimens of dimensions 133 mm x 45 mm \pm 2 mm.
- For tests on composite materials (textiles/cellular materials), produced in the apparatus (3.1), split the test specimen so that the thickness is at least 5 mm, textile included.
- Fix the test specimens to the support cards (3.1.1.2.) or (3.2.1.2.) with a clip at the top and bottom for composite materials, or any other heat resistant fixing methods for other materials.
- Cut out pieces of approximately 40 mm x 20 mm from the blue standards No. 4, 5, 6, 7 (3.3.).
- Clip the pieces side by side onto a support card (3.1.1.2.) or (3.2.1.2.) in the following order (see Appendix 1) :
 - 7 in the highest part of the exposed area,
 - 6 under the blue standard No. 7, at the hottest level,
 - 5 approximately in the middle of the support card,
 - 4 below, which is at approximately 40 mm from the lower end of the support card.

Place the test specimens and the standards on the test specimen holders (3.1.1.1.) or (3.2.1.1.) and place the masking devices vertically so as to hide half the test specimens and blue standards. The observation window must be located to the right of the test specimen by agreement.

Note : *Produce as many test specimens as required in order to expose all the colours of the material to be tested.*

- In the specific case of transparent or opalescent plastic materials, arrange a support card (3.1.1.2.) on the reverse side of the test specimen without bonding.

5. METHOD OF OPERATION

5.1. AGEING TEST APPARATUS XENOTEST 150 S (3.1.)

- Place the test specimen holders and the black panel thermometer (3.1.1.3.) in the ageing test apparatus; ensure that each test specimen holder contains a test specimen or failing that a white support card (3.1.1.2.)
- Switch on the apparatus and record the number of hours on the counter.
- Leave the test specimens in the ageing test apparatus for 150 hours or any other duration specified in the documents.
- During the test, check regularly that the temperature displayed on the thermometer (3.1.1.3.) corresponds to the value determined in paragraph 3.1.4.2.
- Remove the test specimens and standards from the ageing test apparatus. Before assessing the colour deterioration, rest the materials in darkness at ambient temperature for 2 hours in order to avoid a false grading due to phototropy.

5.2. AGEING TEST APPARATUS FADE-OMETER CI 3000 (3.2.)

- Wipe the filter (3.2.1.4.) with “kitchen paper” soaked in ethanol to remove any possible deposits.
- Place the test specimen holders in the ageing test apparatus; ensure that each test specimen holder contains a test specimen or failing that a support card (3.2.1.2.) used as test specimen supports.
- For the specific use of modified test specimen holders with filter KG1 for material exposure, arrange also for a blue scale standard to be positioned behind a KG1 filter.
- Switch on the apparatus and check the display of all parameters.
- Leave the test specimens in the ageing test apparatus for 150 hours or any other duration specified in the documents.
- Examine the recordings and check that the parameters conform to the set requirements.
- During the test, after 1 hour operation, check the parameters mentioned in paragraphs 3.2.4.1, 3.2.4.2. and 3.2.4.3.
- After the test, remove the test specimens and standards from the ageing test apparatus. Before assessing the colour deterioration, rest the materials in darkness at ambient temperature for 2 hours in order to avoid a false grading due to phototropy.

6. EXPRESSION OF RESULTS

Examine the materials aged in the lighting conditions defined in méthode d'essai D15 1343.

To assess the differences in colour, cover the test specimens and standards with the masking devices (3.5.) in order to compare identical surfaces and reduce the effect of nearby colours.

6.1. COMPARISON OF CONTRAST

The contrast is defined by the variation in luminance ΔL and the variation in chromaticity ΔC , see méthode d'essai D15 5084. In all cases, record the change in colour, namely the change in luminance, chromaticity or brilliance. To achieve this, the assessment must be followed by one or more of the following observations according to paragraph 6.2.

- | | | |
|----------------------------|------------------|----------------|
| - Change in luminance : | - lighter | C |
| | - darker | F |
| - Change in chromaticity : | - redder | R) for example |
| | - yellower | J) for example |
| - Change in brilliance : | - more matt | Ma |
| | - more brilliant | Br |

6.2. COMPARISON WITH THE GREY SCALE

6.2.1. ASSESSMENT OF THE COLOUR DETERIORATION

- To seek the degree of colour deterioration on the test specimen, manipulate the test specimen under the light while remaining on the floor level of the enclosure (D15 1343) in all directions and under every angle in order to identify the most discoloured zone. When this zone has been identified, place the grey scale next to the test specimen and move the grey scale until a contrast has been found against the grey scale which corresponds to the contrast observed on the test specimen between the exposed zone and the masked zone. Record the degree read off the grey scale (eg. :3/4).
- Check that the unexposed zone of the test specimen has not changed when compared to a new sample of the material tested. If it has changed, assess according to the method described in § 6.2.1. masking the unexposed zone by placing it on top of the new sample.

6.2.2. EXPRESSION ON DOCUMENTS

The degree of deterioration shall be recorded in relation to the grey scale (6.2.) followed by the comparison of the contrast (6.1.) (example : 3/4 J).

6.3. OTHER OBSERVATIONS

Record also any visible fissures or cracks, etc.

7. TEST REPEATABILITY

Check the repeatability of the test by checking the blue scale against a blue scale from another test (eg. : test n-1) carried out in the same setting conditions. If this is not the case, the test specimens that have been subjected to the ageing cycle must not be graded. Check on the plotting paper that all the parameters are valid. If applicable, calibrate (3.2.4.4.). Carry out a counter-test. If the problem persists, contact S.A.V. ATLAS.

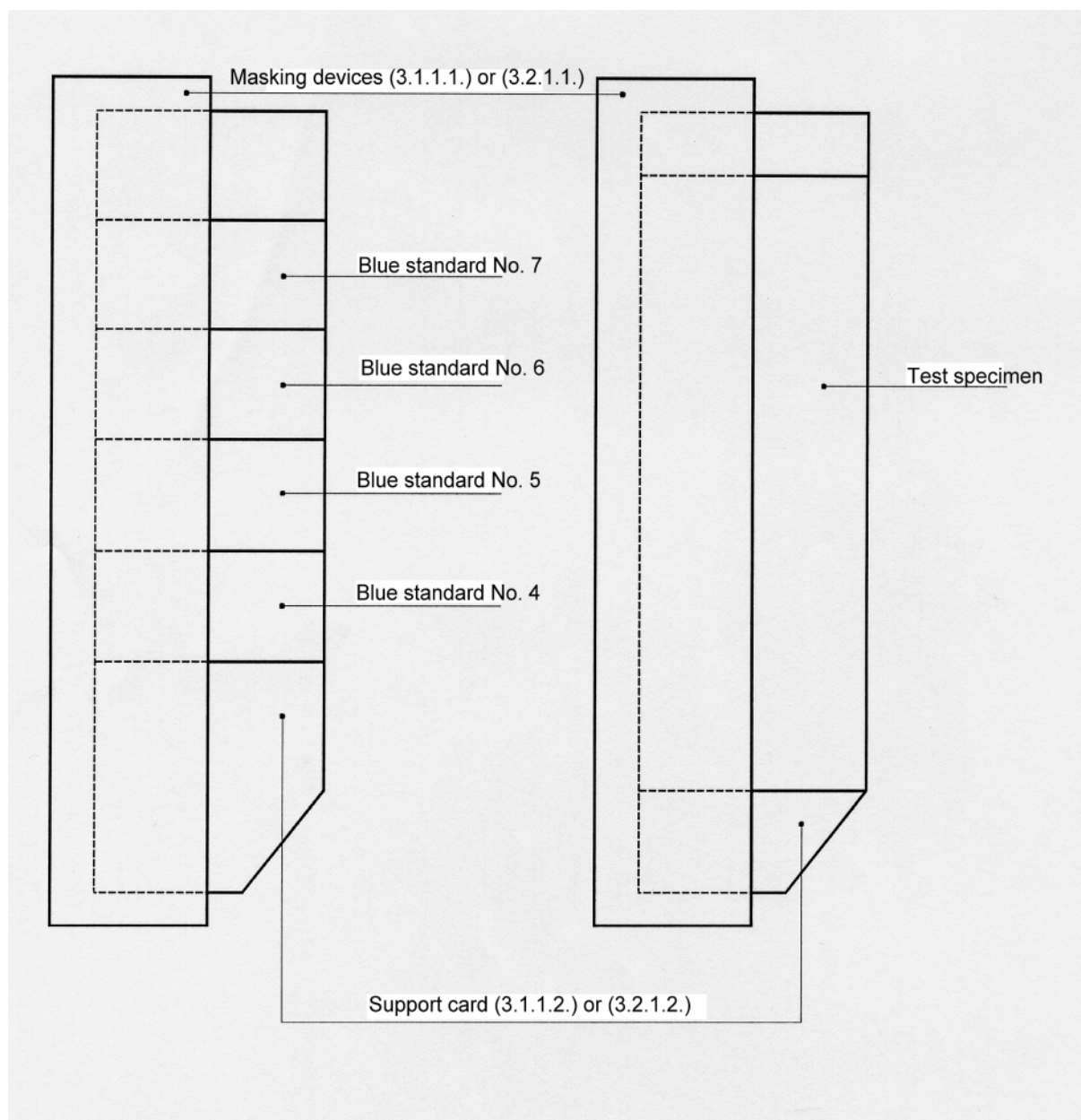
8. TEST REPORT

As well as the results obtained, the test report must indicate :

- the reference to this méthode,
- the type of ageing test apparatus used,
- the references of the material or part tested and the name of the supplier,
- the duration of exposure,
 - the age and luminous energy of the lamp may be requested according to each case,
- the particular test conditions, for example :
 - modified test specimen holder with filter KG1.
- the **mandatory** recording of the change in colour such as : luminance, chromaticity or brilliance,
- any other observation on the aspect of the test specimen,
- the operating details not specified in the method as well as any possible incidents likely to have affected the results.

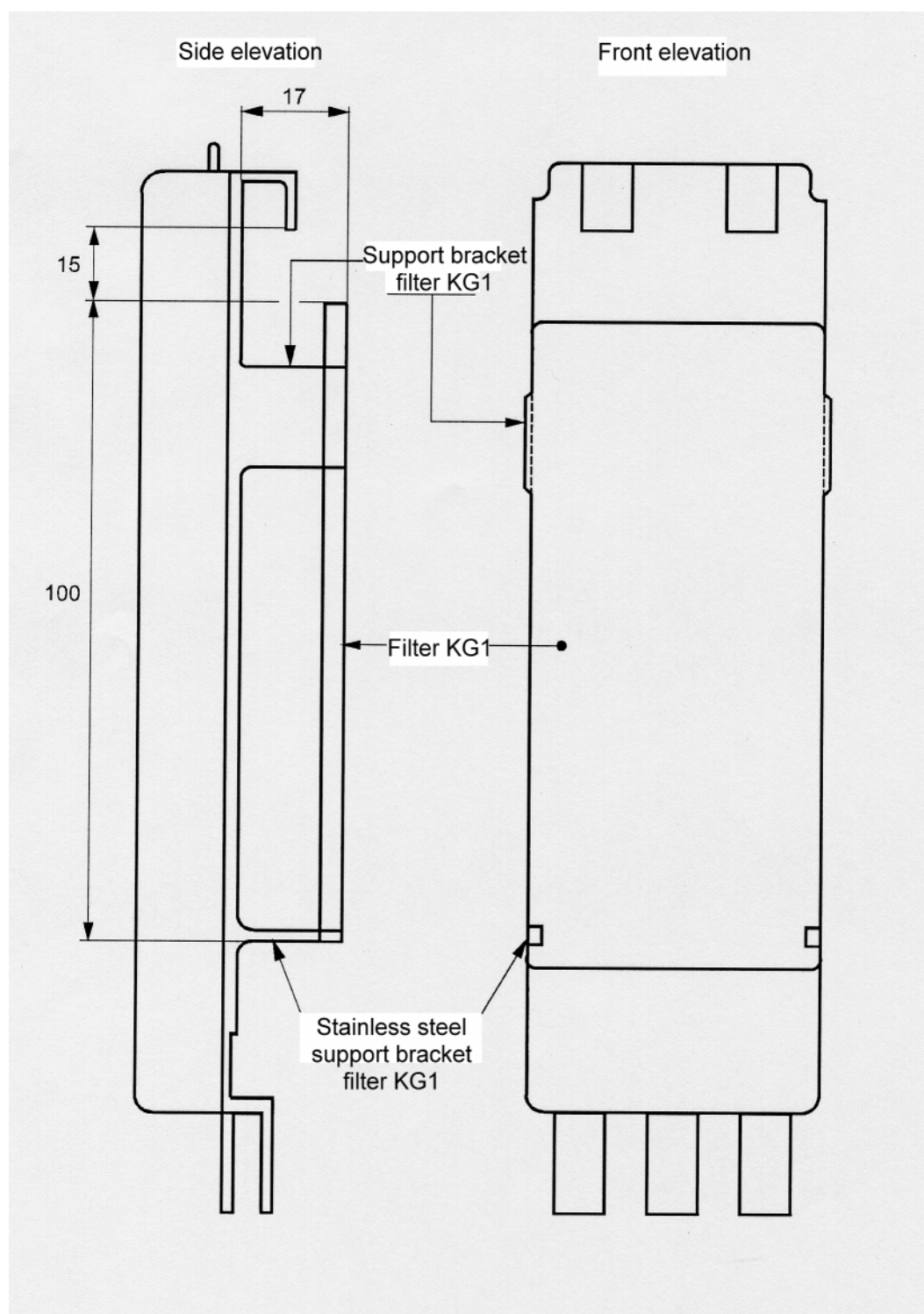
Appendix 1

BLUE STANDARDS AND TEST SPECIMEN ASSEMBLY



APPENDIX 2

PRINCIPLE DRAWING OF MODIFIED TEST SPECIMEN HOLDERS



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9. RECORDS AND REFERENCE DOCUMENTS

9.1. RECORDS

9.1.1. CREATION

- OR : 01/10/1977 – CREATION OF THE NORME.

9.1.2. SUBJECT OF THE MODIFICATION

- J : 15/09/2000 – MODIFICATION to TEST SPECIMEN HOLDERS and SURFACE TEMPERATURE LOWERED
- H : 25/01/2000 – UP-DATING OF THE NORME

9.2 REFERENCE DOCUMENTS

9.2.1. PSA DOCUMENTS

9.2.1.1 Normes

- D15 1343. COLOURED MATERIALS – VISUAL COMPARISON OF COLOURS IN A LIGHT CHAMBER
- D15 5084 OPAQUE AND TRANSPARENT COLOURED PRODUCTS – CALCULATIONS OF COLORIMETRIC VARIATIONS (CIE LAB 1976 SYSTEM).

9.2.1.2. Others

9.2.2. EXTERNAL DOCUMENTS

- NF EN 20105-A02 TEXTILES – COLOUR FASTNESS TESTS – PART A02 : GREY SCALE FOR THE ASSESSMENT OF DETERIORATIONS
- NF EN ISO 105-B02 TEXTILES – COLOUR FASTNESS TESTS – PART B02 : COLOUR FASTNESS TO ARTIFICIAL LIGHT : XENON ARC LAMP

9.3. EQUIVALENT TO : REND471431

9.4. CONFORMS TO :

9.5. KEY-WORDS