

**PAINT COATINGS  
RUBBERS AND PLASTICS  
ARTIFICIAL AGEING BY WEATHER-OMETER**

Page 1/13

**This norme REPLACES norme D47 5160***This is a translation, the French original shall be used in all cases of litigation**Date of translation : 24/05/2004***CONTENTS***This document is equivalent to the document from the RENAULT SA Group of reference D27 1911.**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 June 2003.***1.OBJECT AND FIELD OF APPLICATION**

The object of this method is to define the conditions to be observed to determine the resistance of a material to the action of an artificial light source in defined conditions of water spray and temperature.

It aims at reproducing the ageing of materials exposed to light and the elements.

It applies to paint coatings as well as self coloured rubber and plastic exterior parts, paint coated or not.

It also applies to mastics, canvas covers and glass.

**2.PRINCIPLE**

The test consists of subjecting one or more test specimens of the material to a cycle of simulated sunlight by means of a filtered Xenon lamp, in combination with an intermittent spray simulating rain.

The deterioration is then assessed either visually or by colorimetric measurements or other methods, in comparison with a non exposed reference test specimen.

**3.EQUIPMENT****3.1.WEATHER-OMETER (WOM) TYPE CI 4000 OR CI 35A FROM THE ATLAS COMPANY**

The equipment must be installed in a clean conditioned room at the temperature of  $20\text{ °C} \pm 5\text{ °C}$  and relative humidity  $< 80\%$ , with an efficient venting system to the outside.

**3.1.1.XENON LAMP 3500 WATT,**

usually, the lamp is fitted with internal and external filters in borosilicate S, in general (radiance curves in Appendices 1 and 2).

**Note:**

- *For varnish cracking tests, use quartz filters.*
- *Use lamps previously aged by the Supplier or carry out a 24 hour ageing in the WOM in the conditions described in this method.*
- *Filters are pre-aged by the Supplier.*

**3.1.2.THERMOMETER,**

with a black panel BPT (Black Panel Temperature), installed in the place of a test specimen at the centre of the drum.

MATERIALS – ARTIFICIAL AGEING BY WEATHER-OMETER	D27 1389	2/13
---	----------	------

**3.1.3.SPRINKLER RAIL,**

in stainless steel, consisting of three nozzles directed at the exposed face of the test specimens.  
Ensure that the nozzle orifices do not get clogged or are obstructed.

**3.1.4.ROTARY TEST SPECIMEN DRUM,**

in stainless steel, three row type.

**3.1.5.LAMP COOLING SYSTEM,**

with demineralised water (4.2.).

**Note :** *The periodic maintenance of the equipment is carried out in accordance with the details in Appendix 3.*

**3.2.GLOSS METER,**

in conformity with the equipment described in test method D25 1413.

**3.3.SPECTROCOLORIMETER,**

for determining the trichromatic co-ordinates according to test method D15 5083.

**Note :** *The use of a colorimeter, for instance of the type MINOLTA CR300, may also be considered to determine the change in colour in comparison with the reference sample.*

**3.4.BLUE SCALE STANDARD**

The standards are woollen fabrics dyed blue, complying with the specifications of the standard NF EN ISO 105-B02.

They range from n° 1 – very low colour fastness - to n° 8 – very high colour fastness -.

**3.5.GREY SCALE,**

for assessing the deteriorations, in conformity with the standard NF EN 20105-A02.

Use the nine degree scale with a black border.

**Note :** *The grey scale may be obtained from ADSOL, 37-39, rue de Neuilly - 92110 CLICHY.*

**3.6.LIGHT CHAMBER,**

in conformity with test method D15 1343.

**3.7.PAPER WIPES,**

in absorbent, lint free white cotton.

**3.8.HARD BRISTLE BRUSH,**

only used by RENAULT for thermoplastics.

**3.9.LONG SOFT BRISTLE BRUSH,**

50 mm wide for rubbers only.

## 4. REAGENTS

### 4.1. POLISHING WATER,

for instance type FINESSE IT from 3M, only used by RENAULT, according to Appendix 5.

### 4.2. DEMINERALISED WATER,

for cleaning test specimens and spraying.

- Spray pressure : 2,5 bar  $\pm$  0,5 bar.
- Resistivity :  $\geq 10 \Omega \cdot \text{cm}$ .
- Silica content :  $\leq 0,02 \text{ ppm}$ .
- Dry extract :  $< 10 \text{ ppm}$ .
- Water temperature :  $18^\circ\text{C} \pm 4^\circ\text{C}$ .
- pH :  $7 \pm 0,5$ .

## 5. PREPARATION OF TEST SPECIMENS

### 5.1. GENERAL

The dimensions of test specimens are 68 mm x 46 mm minimum and 68 mm x 145 mm maximum according to the type of test specimen holders used. The exposed face of test specimens must be directed towards the lamp, like the face of the black panel (PBT).

Prepare two test specimens, one is intended for exposure and the other is to be kept as a reference away from light and humidity and protected by a non abrasive packaging.

Materials likely to be decomposed in light, heat or humidity must not be exposed in the equipment, or likely to release products detrimental to the correct operation of the test.

Each test specimen is marked in an indelible manner in an area which does not obstruct the test.

### 5.2. PAINTED SUPPORTS

Painted sheet plates must be fully protected on their edges and on their front and reverse sides with a primer for instance.

The type of support material, its surface finish as well as the type of sub-layers and the conditions of application of the substrate must be those corresponding to the use of the products to be examined.

#### Note :

- For PSA PEUGEOT CITROËN, the specimens to be tested as well as the reference test specimens are measured before exposure with the spectrophotometer (3.3.), according to test method D15 5083. The colorimetric variation between the test specimen and the reference is called  $\Delta E_{\text{new}}$ . The variation is calculated according to test method D15 5084. If  $\Delta E_{\text{new}}$  is greater than 0,5, select another test specimen, according to Appendix 4 - § 1.1 COLOUR CHANGE MEASUREMENT.
- The measurements must be carried out using a template so that they are always made at the same location before and after ageing.
- Measure the gloss on the specimen to be tested according to test method D25 1413, according to Appendix 4 - § 1.2. GLOSS CHANGE MEASUREMENT.

MATERIALS – ARTIFICIAL AGEING BY WEATHER-OMETER	D27 1389	4/13
---	----------	------

### 5.3.RUBBERS

**Note :**

- For PSA PEUGEOT CITROËN, the sample or the reference part shall be kept in darkness at the temperature of  $4\text{ °C} \pm 2\text{ °C}$  individually enveloped in aluminium film.
- For RENAULT, the sample or the reference part shall be kept in darkness at the temperature of  $4\text{ °C} \pm 2\text{ °C}$  individually enveloped in Joseph paper.

Clean the parts or the samples with a 50/50 solution in volume of demineralised water-ethanol, applied onto a white, lint free, cotton cloth.

During cleaning, the cloth must be well impregnated but without excess and the samples or parts must not be subjected to specific stresses (rubbing).

The purpose of this cleaning is to obtain a uniform appearance on samples or parts and to eliminate all traces of pollution.

Wipe with a white, lint free, cotton cloth without rubbing.

Note if a colour transfer has occurred or if traces are left on the cloth.

## 6.METHOD OF OPERATION

### 6.1.TEST CONDITIONS

- Exposure to a continuous light obtained by means of the Xenon lamp (3.1.1.) and suitable filters.
- Energetic lighting of  $0,55\text{ W/m}^2$  at 340 nm.
- Temperature indicated on the thermometer (3.1.2.) :  $70\text{ °C} \pm 2\text{ °C}$  during the non spraying period.
- Temperature indicated on the dry bulb :  $50\text{ °C} \pm 2\text{ °C}$ .

**Note :** Temperatures on the thermometer (3.1.2.) and on the dry bulb are continuously regulated (automatic mode).

- Spraying frequency (only on the exposed face of the test specimens) : 18 minutes spraying followed by 102 minutes without spraying.
- Relative humidity :  $50\% \pm 5\%$  outside the spraying period ( $\Delta T = 10,5\text{ °C}$ ) – ( $\Delta T = T\text{ °C}_{\text{dry bulb}} - T\text{ °C}_{\text{humid}}$ ).

## 6.2.TEST PROCEDURE

- Place the test specimens on suitable test specimen holders.
- Place the test specimen holders and the thermometer (3.1.2.) in the Weather-Ometer (3.1.) ensuring that the thermometer is in the middle row, in vertical position.
- Fill all the test specimen holders and, if required, fill the vacant places with fictitious test specimens, with the exclusion of highly reflective surfaces of the mirror type.
- Record the number of hours on the counter and start the equipment.
- The duration of the test is defined in the documents.
  - For RENAULT : by the number of hours.
  - For PSA PEUGEOT CITROËN : by the number of cycles.

One cycle corresponding to the time required to deteriorate the bleu woollen standard n°7 to  $\Delta E = 2,5 \pm 0,15$ . This time corresponds to 168 hours of testing in the Weather-Ometer (3.1.), set as in § 6.1., without spraying.

### Note :

- *During the exposure cycle, the equipment must not be stopped more than once a day (for instance : by opening the door). If such a stop occurs, it must preferably occur at the end of the dry period.*
- *During an exposure cycle, on test specimens of self coloured material, there must no stop in the operation of the equipment with a duration greater than 3 consecutive days (72 heures). If such a stop should occur, the cycle is restarted with new test specimens.*
- *Remove the test specimens and determine the characteristics of their aspect according to Appendix 4.*

### 6.2.1.PLASTICS

For RENAULT only : after removing the test specimens from the Weather-Ometer (3.1.), the test specimens shall be rinsed, if required, with demineralised water (4.2.) and dried using paper (3.7.) without rubbing.

### 6.2.2.RUBBERS

#### 6.2.2.1.Before the start of exposure

According to § 5.3.

#### 6.2.2.2.Grading according to the grey scale

**Note :** *The sample or the reference part shall be kept in darkness at the temperature of  $4\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  individually wrapped in aluminium film.*

Remove the test specimens from the Weather-Ometer.

**Rough grading :** Do not clean the samples. The grading is assessed according to the grey scale (3.5.).

**Grading after cleaning :** Clean the samples or the parts with the mixture (4.2.) and the brush (3.9.), then the grading is assessed according to the grey scale (3.5.).

## 7.EXPRESSION OF RESULTS

- Express the change in colour :
  - by recording the colorimetric variations before and after polishing or brushing,
  - by allocating to the contrast between the exposed material and the non exposed material, the nearest grading from the grey scale, before and after polishing or brushing.
- Record the loss of gloss in %, after polishing or brushing.
- Record any other change in aspect.
- Record the variations in mechanical and/or physical characteristics adopted as ageing criteria.

**Note :** *The procedures for determining the characteristics are defined in Appendix4 for PSA PEUGEOT CITROËN and in Appendix 5 for RENAULT.*

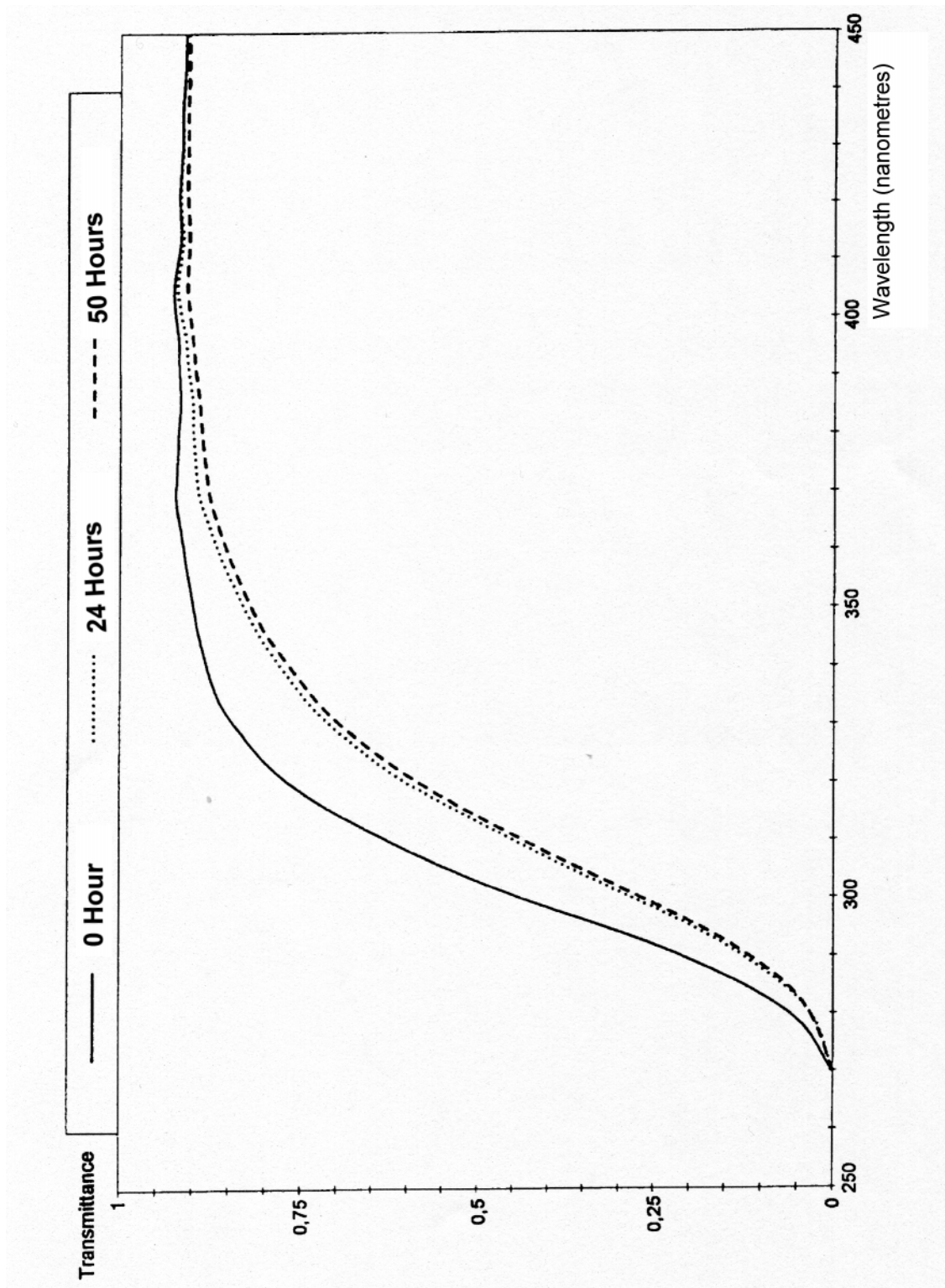
## 8.TEST REPORT

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

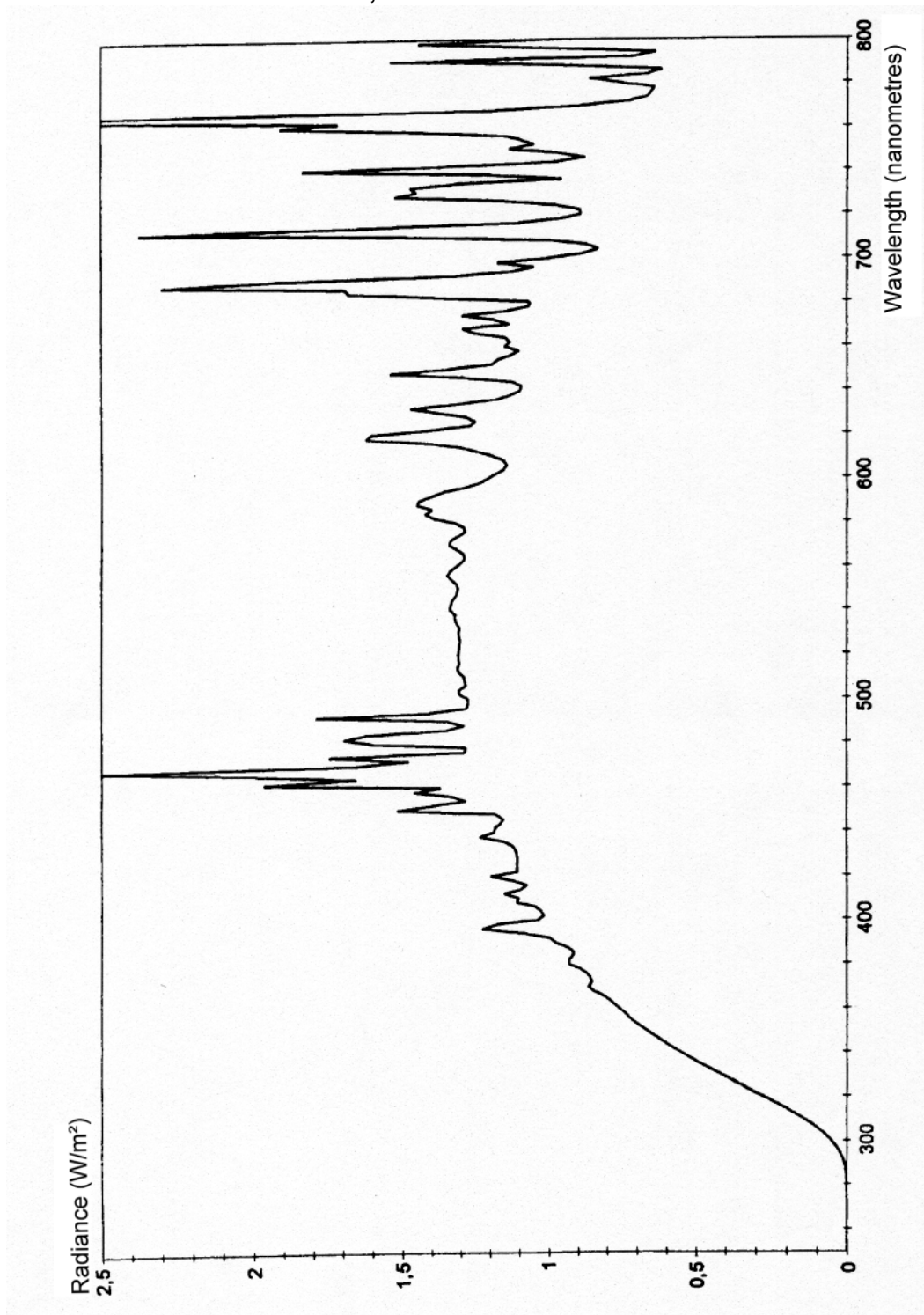
- the reference to this method,
- the type of Weather-Ometer used,
- the exact reference of the paint used and the name of the Supplier,
- the complete references of materials and/or parts examined, the name of the Supplier,
- the type of test carried out : normal cycle or crack test for PSA PEUGEOT CITROËN,
- the mean value of energetic lighting during the exposure time considered,
- the test duration,
- the operating details not specified in the method as well as any possible incidents likely to have affected the results.

## Appendix 1

## SPECTRUM CHARACTERISTICS OF FILTERS IN BOROSILICATE S IN TERMS OF EXPOSURE TIME



## Appendix 2

**SPECTRUM CHARACTERISTICS OF A XENON ARC BURNER WITH  
INTERNAL AND EXTERNAL FILTERS IN BOROSILICATE S**0,55 W/m<sup>2</sup> to 340 nm



## Appendix 3

### MAINTENANCE AND CONTROL OF THE WEATHER-OMETER (3.1.)

Maintenance and calibration of the equipment are carried out in accordance with the manufacturer's recommendations.

- MAINTENANCE CALL for the equipment by the Atlas Company, a minimum of once a year.
- CHANGING THE BURNER approximately every 2 500 hours, depending on the required test conditions.
- CHANGING THE INTERNAL FILTER every 500 hours.
- CHANGING THE EXTERNAL FILTER every 2500 hours.
- CALIBRATION OF THE EQUIPMENT (temperature and illumination power) every 15 days.  
After stabilisation, the frequency may be reduced to a minimum of once a month.
- CALIBRATION CERTIFICATE to be renewed every 2 years.
- OPERATING PARAMETERS
  - 3 times/week, inspect the various operating parameters on the recording equipment.
  - The acceptable tolerances are :
    - temperature at the thermometer (3.1.2.) :  $70\text{ °C} \pm 2\text{ °C}$
    - temperature at the dry bulb :  $50\text{ °C} \pm 2\text{ °C}$
  - Inspect the test specimens, if required.
  - Refill the burner cooling tank with water.
- BLACK STANDARD THERMOMETER (3.1.2.)  
Approximately every 15 days, check its surface condition and a minimum of once a month, rinse with distilled water, wipe with a soft cloth and, if necessary, buff with a polish (Johnson Renovator type).  
The black panel is to be replaced when its surface becomes metallic grey or is cracked (life expectancy between 6 and 12 months).
- AQUADEM SYSTEM FOR DEMINERALISED WATER (4.2.)  
The bottle change frequency is given for information :
  - TYPE G BOTTLES (demineralisation) approximately every 2 months.
  - TYPE C BOTTLES (anti-silica) : every 3 months.
  - DEMINERALISATION CARTRIDGE : every 4 months.
  - FILTERS UPSTREAM OF THE BOTTLES : every month.
  - FILTERS DOWNSTREAM OF THE BOTTLES : every 4 months.
 Weekly water consumption :  $1\text{ m}^3$  approximately.
- OTHER WATER TREATMENT SYSTEMS (4.2.)  
Follow the maintenance recommendations for the equipment given by the Supplier.

**Appendix 4 (1/2)****PSA PEUGEOT CITROËN PROCEDURES FOR DETERMINING THE CHARACTERISTICS****1. PAINT COATINGS**

The test specimens must not be polished, they may be washed with water (4.2.) and dried with an air jet without any other intervention.

**1.1. COLOUR CHANGE MEASUREMENT**

Measure the aged test specimens and the reference test specimens in the same location as the measurements carried out before exposure, as recommended in § 5. The difference between the aged test specimen and the reference test specimen is called  $\Delta E$ , the difference in colorimetric variations is given by the expression :

$$\Delta E_{\text{aged}} = \Delta E - \Delta E_{\text{new}}$$

Where  $\Delta E_{\text{new}}$  is greater than  $\Delta E$ ,  $\Delta E_{\text{aged}}$  is considered as nil.

The difference in colorimetric variations is calculated according to test method D15 5084.

**1.2. GLOSS CHANGE MEASUREMENT**

Measure the gloss on the aged test specimen, according to test method D25 1413.

The gloss variation in percentage is calculated by means of the following formula :

$$\text{Loss of gloss (\%)} = \frac{B_i - B_v}{B_i} \cdot 100$$

in which :

$B_i$  = initial gloss, expressed in units of gloss,

$B_v$  = gloss on the test specimen subjected to ageing, expressed in units of gloss.

**1.3. CRACKING TEST (FOR VARNISH)**

Express the change in aspect of the test specimen according to the grading scale defined below :

0 – No change.

1 – Loss of gloss  $\leq 30$  %.

2 – Slight chalking :  $30\% < \text{loss of gloss} \leq 60$  %.

3 – Significant chalking : loss of gloss  $> 60$  %.

4 – Cracks or partial disappearance of the paint film.

**1.4. VISUAL OBSERVATION**

Examine under the microscope the surface of the test specimen. Record whether any cracks have been detected, the corresponding duration of their appearance and the type of deterioration according to test method D15 5362.

Record any specific change in aspect.

**Appendix 4 (2/2)****PSA PEUGEOT CITROËN PROCEDURES FOR DETERMINING THE CHARACTERISTICS  
(continued)****2. RUBBERS AND PLASTICS****2.1. GRADING ACCORDING TO THE GREY SCALE**

Examine the test specimens under several angles using the light chamber (3.6.), in conformity with test method D15 1343, and look for the angle which gives the most unfavourable contrast.

Determine the grading index using the grey scale (3.5.), by comparing the exposed test specimen with the reference test specimen.

Record also any special modification such as loss of gloss, appearance of cracks, porosity or stiffening, change in colour, etc.

**2.2. COLOUR CHANGE MEASUREMENT**

Measure the trichromatic co-ordinates of aged test specimens and those of the reference test specimens using the spectrophotometer (3.3.) at the same location as the measurements carried out before exposure, as recommended in § 5.0. The difference between the aged test specimen and the reference test specimen is called  $\Delta E$ , the difference in colorimetric variation is given by the expression :

$$\Delta E_{\text{aged}} = \Delta E - \Delta E_{\text{new}}$$

Where  $\Delta E_{\text{new}}$  is greater than  $\Delta E$ ,  $\Delta E_{\text{aged}}$  is considered as nil.

The difference in colorimetric variations is calculated according to test method D15 5084.

**Note :** *This measurement is a guidance in the assessment of the deterioration but is not adopted as an acceptance criterion.*

## Appendix 5

### RENAULT PROCEDURES FOR DETERMINING THE CHARACTERISTICS

#### 1.DETERMINATION OF THE ASPECT CHARACTERISTICS

##### 1.1.SELF COLOURED PLASTIC MATERIALS AND PAINT COATED MATERIALS WITH A GLOSS LOWER THAN 20 % AT 60 °C according to test method D25 1413

##### 1.1.1.Determination of the characteristics without cleaning

Inspect the surface of the test specimen in a light chamber according to test method D15 1343, by comparing it with the surface of the reference test specimen.

The contrast is graded using the grey scale. Record the changes in aspect such as mattness, chalking, erosion, micro-cracks, etc.

**Note :** *For hygroscopic materials, these various determinations must be carried out after the test specimens have been left for 24 hours minimum in a temperature controlled room.*

##### 1.1.2.Determination of the characteristics after cleaning

Brush the inspected face of the test specimen with the brush (3.8.), rinse carefully with demineralised water (4.2.) and dry with the paper (3.7.).

Proceed with all the determinations described in § 1.1.1. and record the changes in the results.

Determine, if possible, the change in trichromatic co-ordinates between the aged test specimen and the reference test specimen according to the conditions in test methods D15 5083 or D17 1736, as well as the gloss according to test method D25 1413.

#### 1.2.MATERIALS PAINTED IN BODY COLOUR

##### 1.2.1.Determination of the characteristics before polishing

Proceed as described in § 1.1.1. and determine also the change in gloss according to test method D25 1413.

##### 1.2.2. Determination of the characteristics after polishing

Polish the aged face of the test specimen using the polishing water (4.1.).

Proceed again with the determinations as described in § 1.1.2.

#### 2.OTHER DETERMINATION OF CHARACTERISTICS

On aged test specimens, it is possible to determine the change in certain characteristics, for example mechanical characteristics such as resistance to impact.

## 9.RECORDS AND REFERENCE DOCUMENTS

### 9.1.RECORDS

#### 9.1.1.CREATION

- OR : 01/05/1980 – CREATION OF TEH NORME

#### 9.1.2.SUBJECT OF THE MODIFICATION

- F : 17/06/2003 – MODIFICATION TO THE TEST METHOD FOR THE INTRODUCTION OF RUBBERS INTO THE SECTION PREPARATION OF TEST SPECIMENS
- E : 15/09/1999 – MODIFICATION TO VALUES IN § 3.1.2, 4.2, 6.2 AND APPENDIX 3.

### 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 5083	OPAQUE COLOURED PRODUCTS – POINT OF COLOUR (SPECTROCOLORIMETRY)
D15 5084	OPAQUE OR TRANSPARENT COLOURED PRODUCTS – CALCULATIONS OF COLORIMETRIC VARIATIONS (CIE LAB 1976 SYSTEM)
D15 5362	PLASTIC AND PAINT COATINGS – CRACKING AND FLAKING PHENOMENA – REFERENCE STANDARD
D25 1413	PAINT COATINGS – RUBBERS AND PLASTICS – MEASUREMENT OF GLOSS

##### 9.2.1.2.Others

#### 9.2.2.EXTERNAL DOCUMENTS

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

### 9.3.EQUIVALENT TO :

REND271911

### 9.4.CONFORMS TO :

### 9.5.KEY WORDS