BS EN 513:1999

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Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of the resistance to artificial weathering

The European Standard EN 513:1999 has the status of a British Standard

ICS 83.080.20; 91.060.50

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National foreword

This British Standard is the English language version of EN 513:1999.

The UK participation in its preparation was entrusted by Technical Committee B/538, Doors, windows, shutters, hardware and curtain walling, to Subcommittee B/538/1, Windows, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

This British Standard forms part of a package of standards on window and doors which will not become fully effective until all standards on the package have been published. The effective date of publication will be agreed within CEN and will be notified.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Summary of pages

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EN 513

July 1999

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English version

Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of the resistance to artificial weathering

Profilés de polychlorure de vinyle non plastifié (PVC-U) pour la fabrication des fenêtres et des portes — Détermination de la résistance au vieillissement artificiel

Profile aus weichmacherfreiem Polyvinylchlorid (PVC-U) zur Herstellung von Fenstern und Türen — Bestimmung der Wetterechtheit und Wetterbeständigkeit duch künstliche Bewitterung

This European Standard was approved by CEN on 7 June 1999.

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 33, Doors, windows, shutters and building hardware, the Secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2000, and conflicting national standards shall be withdrawn at the latest by January 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

The requirements are incorporated in the appropriate Product Standard.

This draft European Standard is based on the results of extensive research and inter-laboratory testing comparing artificial and natural weathering. From the results it was concluded that the requirements for the retention of mechanical properties after long term artificial weathering were best defined using one method, and Charpy impact strength testing was chosen. In addition, the spray cycles for moderate and severe climates have been chosen.

Annex A, which is informative, gives the reasons for the choice of exposure conditions.

This standard reflects the state of the art at the time of publication. Further research may necessitate amendments to this standard.

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1 Scope

This European Standard specifies a method for exposing test pieces from an unplasticized polyvinylchloride (PVC-U) profile for the fabrication of windows and doors to a Xenon arc laboratory light source, in order to assess changes in impact strength and colour. The method given in **8.10** (b) is the reference method of colour measurement.

2 Normative references

This European Standard incorporates by dated or undated references, provisions from other publications listed hereafter. These normative references are cited in the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 20105-A03	Textiles — Tests for colour fastness — Part AO3: Grey scale for assessing staining (ISO 105-A03:1993).
EN ISO 179	Plastics — Determination of Charpy impact strength (ISO 179:1993).
ISO 4892-1: 1994	Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance.
ISO 4892-2	Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc sources.
ISO 7724-1	Paints and varnishes — Colorimetry — Part 1: Principles.
ISO 7724-2	Paints and varnishes — Colorimetry — Part 2: Colour measurement.
ISO 7724 - 3	Paints and varnishes — Colorimetry — Part 3: Calculation of colour differences.
CIE Publication 15.2	Colorimetry.

3 Principle

Test pieces taken from the sight surface of the profiles are exposed in a Xenon arc artificial weathering apparatus at a specified irradiance, Black and White Standard Temperatures, relative humidity and spray cycle.

After specified radiation doses, the changes in Charpy impact strength and colour of the test pieces are determined.

4 Apparatus

4.1 Artificial weathering apparatus with a Xenon arc light source

The apparatus shall comply with ISO 4892 Part 1 and 2 and with the requirements of this standard. Accordingly, each apparatus shall include the following.

4.1.1 **Xenon arc source** in accordance with method A of ISO 4892 Part 2 with a spectral irradiance in the band pass of 280 nm to 800 nm of (550 ± 55) W/m^2 and a spectral irradiance in the band pass of 280 nm to 400 nm of (60 ± 12) W/m^2.

4.1.2 **Test enclosure** which contains a frame carrying test piece holders.

4.1.3 **Spray nozzles** to provide uniform and continuous wetting of the exposed test pieces for defined periods of time.

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NOTE : The intention of the spraying is not to scour loosely bound solid material. It is important, therefore, that the combination of droplet size and velocity is chosen to minimize the removal of solid material.

4.1.4 A means of providing controlled humidity at the defined level.

4.1.5 A means of controlling air temperature within the test chamber.

4.1.6 A Black Standard Thermometer in accordance with **4.1.5.1.1** of ISO 4892 Part 1: 1994 with a response time less than 1 min and a means of recording maximum temperatures during one cycle.

4.1.7 A White Standard Thermometer in accordance with **4.1.5.1.1** of ISO 4892 Part 1:1994 with a response time less than 1 min and a means of recording maximum temperatures during one cycle.

4.1.8 A device to determine the UV radiant exposure in the wavelength region between 280 nm and 400 nm expressed in joules per square metre (J/m^2).

4.1.9 A device to determine the radiant exposure in the UV and visible wavelength region between 280 nm and 800 nm expressed in joules per square metre (J/m^2).

NOTE : It is recognized that not all the above parameters can be met on all apparatuses at the present moment but these requirements apply to all apparatuses from 1 January 2000.

4.2 Grey scale

For the assessment of changes in colour in accordance with EN 20105-AO3.

NOTE : This grey scale can be obtained from:

British Standards Institution
389 Chiswick High Road
London W4 4AL

AATCC
1 Davis Drive
PO Box 12215
Research Triangle Park
North Carolina 27709
USA

Beuth - Verlag GmbH
Burggrafenstr. 6
D - 10787 Berlin

4.3 Colour change measurement apparatus

In accordance with ISO 7724 : Parts 1 and 2 with the following features :

1) employing CIE Publication 15.2 illuminant D65;

2) measuring condition 8/d or d/8 including specular reflectance (*without* gloss trap for both).

4.4 Charpy impact apparatus

Generally in accordance with EN ISO 179 but with the distance between supports equal to 40 mm. The pendulum energy shall be 1J or 2 J.

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5 Test pieces

5.1 Number of test pieces

For the assessment of the change in colour, two test pieces, one of which is a reference, of dimensions specified in **5.2.1** shall be used.

For the determination of the change in Charpy impact strength, two series each of six pieces, one of which is a reference series, of dimensions as specified in **5.2.2** shall be used.

*NOTE : Due to the possibility of discarding defective test pieces (see **5.3.2**), it may be advisable to increase the initial number of test pieces in the light of particular experience.*

5.2 Dimensions of the test pieces.

5.2.1 Test pieces for the assessment of the change in colour shall be of minimum dimensions 50 mm x 40 mm.

5.2.2 Test pieces for the determination of the change in Charpy impact strength.

The test pieces are prepared in two stages :

Stage 1 - two series each of six test pieces with a length of (50 ± 1) mm, a width of (6 ± 0,2) mm and a thickness equal to the wall thickness of the profile are prepared for weathering or storage.

Stage 2 - after storage or weathering, all test pieces are notched generally in accordance with EN ISO 179 designation EN ISO 179/1fA but with a residual width between the notches of (3 ± 0,1) mm.

5.3 Preparation of the test pieces

5.3.1 The test pieces shall be taken from the sight surface of a profile such that the longitudinal direction of the test pieces and the profile are the same. The test pieces shall be of the dimensions specified in **5.2.1** and **5.2.2**.

5.3.2 All test pieces for the determination of the change of Charpy impact strength shall be inspected for imperfections such as crazes in the machined surface. When imperfections are found, those test pieces are discarded.

6 Conditioning

6.1 Conditioning is not required before exposure in the artificial weathering apparatus.

6.2 Before impact testing the test pieces shall be conditioned at (23 ± 2) ^{o}C and (50 ± 5) % R.H. for at least 16 h.

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7 Weathering test conditions

7.1 General

For the simulation of the different climates in Europe there are two different methods of exposure defined :

Method 1 for simulation of moderate climate (**M**);

Method 2 for simulation of severe (hot and dry) climate (**S**).

In annex A reasons for the choice of test conditions are given.

7.2 Test conditions for method 1

7.2.1 The Black Standard Temperature (BST) shall be (60 ± 3) ^{o}C. The air temperature in the test enclosure shall be controlled to a constant value such that the BST equals the required value at the end of the dry period.

7.2.2 The White Standard Temperature (WST) shall be (40 to 45) ^{o}C.

NOTE : The WST is predetermined by the procedure in 7.2.1. It should lie within the specified range, otherwise the manufacturer of the weathering apparatus should be contacted.

7.2.3 The spray cycle used shall be 18/102 in accordance with ISO 4892 Part 1

NOTE : Sample surfaces have to be continuously sprayed during the spray period otherwise the manufacturer of the weathering apparatus should be contacted.

7.2.4 The relative humidity during the dry period shall be (65 ± 5) % RH.

7.3 Test conditions for method 2.

7.3.1 The Black Standard Temperature (BST) shall be (65 ± 3) ^{o}C. The air temperature in the test enclosure shall be controlled to a constant value such that the BST equals the required value at the end of the dry period.

7.3.2 The White Standard Temperature (WST) shall be (45 to 50) ^{o}C.

NOTE : The WST is predetermined by the procedure in 7.3.1. It should lie within the specified range, otherwise the manufacturer of the weathering apparatus should be contacted.

7.3.3 The spray cycle used shall be 6 min spray period and 114 min dry period.

NOTE : Sample surfaces have to be continuously sprayed during the spray period otherwise the manufacturer of the weathering apparatus should be contacted.

7.3.4 The relative humidity during the dry period shall be (65 ± 5) % RH.

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8 Procedure

8.1 Expose the test pieces for the weathering tests with the sight surface towards the light source in the artificial weathering apparatus for a radiation dose as specified in the appropriate Product Standard.

8.2 The remaining reference test pieces are stored in the dark. The test pieces for the determination of the retention of Charpy impact strength which are exposed in the artificial weathering apparatus and those which are stored in the dark shall be notched with the same tool at the same time.

8.3 Before placing the test pieces in the test enclosure, prepare the apparatus as follows.

1) Select the appropriate filter arrangement to achieve the irradiance regime in accordance with method A of ISO 4892 Part 2.

2) Install the devices for the determination of the radiant exposures in accordance with **4.1.8** and **4.1.9**.

3) Install the Black Standard and the White Standard Thermometers.

4) Set the test enclosure relative humidity to 65 % RH.

5) Set the spray cycle in accordance with **7.2.3** or **7.3.3** as appropriate.

6) Set the test enclosure air temperature to a constant value to achieve the Black Standard Temperature (BST) in accordance with **7.2.1** or **7.3.1** as appropriate.

7) Check the White Standard Temperature (WST) in accordance with **7.2.2** or **7.3.2** as appropriate.

8.4 Mount the test pieces in accordance with ISO 4892 Part 2.

8.5 During the exposure:

1) control and record the air temperature in the test enclosure;

2) record the BST;

3) record the WST.

NOTE : It is difficult to specify minimum recording intervals due to differences in equipment and laboratory procedures. The test laboratory should record at intervals that are appropriate to maintain the test conditions in the particular laboratory on a particular machine.

8.6 At regular intervals check and record the irradiances in accordance with **4.1.1**.

8.7 The exposure is completed when the specified amount of radiant exposure is reached.

8.8 Take the frame out of the test enclosure and the test pieces out of the frame. Do not clean the test pieces.

8.9 Prepare the test pieces for the determination of the change in Charpy impact strength in accordance with **5.2.2**.

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8.10 Determine the difference in colour between the exposed sample and the unexposed reference sample not more than 24 h after removing the test sample from the exposure chamber. Use either of the following methods :

a) determine the colour difference in terms of the grey scale conforming to EN 20105 - AO3; or

b) determine the colour difference, ΔL^*, Δa^*, Δb^*,ΔE^*, in accordance with ISO 7724 Parts 1, 2 and 3.

Record the difference in colour.

8.11 Determine the Charpy impact strength of both series of test pieces in accordance with **4.4** and EN ISO 179 mounting the test pieces in such a way that the exposed surface is in tension during the test.

Record each value in kilojoules per square metre.

Calculate for both series the mean Charpy impact strength and the standard deviation in kilojoules per square metre. Calculate the difference between the mean values of Charpy impact strength of the two series as a percentage.

9 Test Report

The test report shall include the following information:

a) reference to this European Standard and the method of exposure;

b) laboratory of testing;

c) full identification of the profile;

d) period of testing;

e) apparatus with Xenon arc lamp:

1) type of apparatus;

2) type of light source and filter system used;

3) mean value and variation of the BST during exposure;

4) mean value and variation of the WST during exposure;

5) set value of the relative humidity in the test chamber;

6) mean value of the air temperature in the test chamber;

7) spray cycle used;

8) rotation of the test piece holder, if applicable;

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9) radiant exposure in gigajoules per square metre (GJ/m^2);

10) exposure time in hours (h);

f) type of instrumental colour measurement apparatus, if applicable;

g) energy of pendulum on Charpy impact apparatus;

h) differences of colour either by an instrumental method at intervals specified in the appropriate Product Standard or in terms of the grey scale.

j) the change in the mean value of Charpy impact strength of the two series as a percentage.

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Annex A (informative)
Reasons for the choice of exposure conditions

A.1 Scope

This annex, A, gives reasons for the choice of exposure conditions in artificial weathering tests to more accurately simulate natural weathering conditions in moderate and severe (hot and dry) climates in Europe.

A.2 Moderate climates

Method 1 in accordance with **7.2** with a BST of 60 °C and a spray cycle of 18 min / 102 min has proven to be an appropriate simulation for moderate climates.

A.3 Severe (hot and dry) climates

For the simulation of severe (hot and dry) climates temperatures are higher than in moderate climates, therefore BST is set at 65 °C instead of 60 °C for moderate climates.

If radiant exposure in a severe (hot and dry) climate is 50 % higher than in a moderate climate, the exposure time in an artificial weathering apparatus has to be increased by a factor of 1,5.

Increased exposure time at a constant spray cycle would simultaneously increase the total wet time of the test pieces which is an unintentional secondary effect. To compensate for this effect, the spray time has to be reduced by the same factor, 1,5.

To take into account that in severe (hot and dry) climates wet time is shorter than in moderate climates (say 50%) the spray time has to be further reduced by a factor of 2.

Therefore the spray cycle for severe (hot and dry) climates is set at 6 min / 114 min instead of 18 min / 102 min for moderate climates.

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