SLOVENSKI STANDARD
oSIST prEN 1096-5:2011

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Steklo v gradbeništvu - Steklo z nanosi - 5. del: Metode preskušanja in klasifikacija za samočistilne lastnosti površine stekla z nanosom

Glass in building - Coated glass - Part 5: Test method and classification for the self-cleaning performances of coated glass surfaces

Glas im Bauwesen - Beschichtetes Glas - Teil 5: Prüfverfahren und Klasseneinteilung für das Selbstreinigungsverhalten von beschichteten Glasoberflächen

Verre dans la construction - Verre à couche - Partie 5: Méthode d'essai et classification des performances autonettoyantes des surfaces de verre à couche

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Contents

Page

Foreword

This document (prEN 1096-5:2011) has been prepared by Technical Committee CEN/TC 129 “Glass in building”, the secretariat of which is held by NBN.

This document is currently submitted to the CEN Enquiry.

1 Scope

This draft defines a test method to establish the self-cleaning performances and classes for coatings on glass which utilise sun, rain or a combination of sun and rain to enhance the cleanliness of the glass.

The draft applies to coated glass for use in outdoor building applications. The test is designed to be applicable for coatings on glass which use hydrophilic or photocatalytic active functionalities to enhance the cleanliness of the glass.

The test procedure does not specifically address the durability of the coatings self cleaning functionality.

The test method is designed to be run on monolithic samples of the products. In cases where dual coated products (that is, a glass presenting self cleaning coating on one side and another coating on the other side) exist it would be necessary to obtain the equivalent glass with only the self cleaning coating on one side (or to remove the back side coating by polishing, providing it does not damage the self cleaning coating on the opposite side). If not possible, adapted protection of back side coating should be added (such as protective film with electrostatic or low adhesive charge,or DGU assembly)

For tinted glass and absorbing layers (a self cleaning or dual coatings) the luminous absorption might affect the haze measurements. The test has to be runned on clear glass and extrapolation will be made for tinted glass and absorbing layers.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN1096-1:1998, *Glass in Building – Coated Glass – Part 1: Definitions and classifications*

EN1096-2:2001, *Glass in Building – Coated Glass – Part 2: Requirements and test methods for class A, B and S coatings*

ISO 4892-1:2000, *Plastics – Methods of exposure to laboratory light sources – Part 1: General guideline*.

ISO 4892-3:2006, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*.

3 Terms and definitions

For the purposes of this document, the following definitions apply, and when not conflicting, the definitions of EN 1096-1 apply.

3.1
coated glass
glass substrate as defined in 3.2 to which has been applied a coating, as defined in 3.3 in order to modify one or more of its properties

3.2
glass substrate
a basic glass, thermally toughened safety glass, heat-strengthened glass

3.3
coating
one or more thin solid layers of inorganic materials applied onto the surface of a glass substrate by various methods of deposition as described in EN 1096-1

3.4
dual coating
glass substrates as defined in 3.2 to which have been applied coatings as defined in 3.3 on both sides

3.5
self cleaning coating
coating or surface treatment of glass substrates allowing obtaining or maintaining a cleaner surface as compared to untreated glass in time

3.6
hydrophilic coating
coating allowing maintaining a water contact angle of less than 20 °

3.7
photocatalytic coating
coating containing a substance that performs one or more functions based on oxidation and reduction reactions under photoirradiation, inducing decomposition and removal of contaminants

3.8
secondary coating
coating deposited on the opposite side of a self cleaning coating, in case of dual coatings

3.9
definition of haze
incident light on glass samples with dirt deposit is diffused scattered and the effect in transmission is seen as reduction of contrast of objects observed through the glass. Haze is the percentages of the total transmitted lights which in passing through the glass deviate from the incident beam more than 2.5 degree. Haze is wide angle scattering of light.

4 Principle of the test

The principle of the test consists in applying a model dirt on the glass with a spray, then simulate natural weather action by applying UV irradiation (to simulate sun) then water spray (to simulate rain). This cycle is repeated twice to ensure better stability of results. The criterion would be the degree of sample cleanliness after the second cycle.

The cleanliness perception is evaluated by measurement of the haze of the sample, more especially the difference of haze between initial and final stage of the test:

$$\Delta H = H_{final} - H_{initial}$$

Thus measurements of initial haze (after cleaning) and final haze (at the end of the second cycle) are the only compulsory measurements. However, it is strongly recommended to measure haze at each step of the test (as explained in paragraph 9) in order to check that there is no deviation of the test.

General observation: the test and all handling of the product to be tested shall be performed in a clean environment, that is, exempt from any source of contamination (organics, silicones, dust) which could modify the surface, affect the functionality, the test conditions or the haze measurements (an example of contamination test is given in Annex C).

5 Instrumentation

5.1 UVA-Illumination chamber

The UV illumination should be performed in a clean environment. A closed chamber is recommended. The chamber shall be equipped with UVA-340 lamps, such as described in table 1 in standard EN ISO 4892-3:2006 (“type I” lamps).

The irradiation power is set to 0.68 W/m²/nm at 340 nm on the surface of the samples, which is the maximal irradiance of solar light according to CIE 85 table 4. The irradiation level has to be maintained constant and has to be uniformly distributed such as to ensure a same level of irradiation on all the samples (check tolerances in EN ISO 4892-3). The irradiation level can be monitored with a radiometer. The intensity of the lamp can be controlled continuously and adjusted to balance aging of the lamps.

Relative Humidity shall be maintained between 15 and 30% inside the chamber during the irradiation period. The air temperature in the chamber is set to the minimum: the UVA cabinet shall be placed in a well-ventilated area, where the temperature doesn’t exceed 27 °C, and its vents shall be fully opened, to ensure that the temperature inside the cabinet remains between 25 °C and 35°C. The temperature and RH should be monitored and given in the test report.

NOTE Standardized equipment UV2000 or UVCon from Atlas or QUV from Q panel have been used during the Round Robin tests.

The cabinet shall be clean and exempt of any contamination source, especially silicone source.

5.2 Sample support

For the spraying steps, the sample shall be installed on a support, with an inclination of 10° from vertical. The full description of support is shown in Annex A.

5.3 Spraying nozzle

The spraying nozzle is fixed horizontally and aligned with the centre of the haze measurement area on the glass samples. The distance between the nozzle tip and the glass sample is 300 mm, as described in Annex A. The nozzle used shall be a full cone airless nozzle with a large spray angle (120°).

NOTE Nozzle SSD-VKL-1-120°-1.4571, from Spraying Systems Germany has been used during the Round Robin tests.

5.4 Dirt mixture pressure tank

The dirt mixture shall be placed in a dedicated pressure vessel equipped with a mechanical or magnetic stirrer. Pressure vessel shall be made of inert material and should not contain any silicone contamination source.

NOTE 1 Commercial equipment 83S-211-AT SS pressure tank with direct rotary agitation from ITW-Binks has been used for Round Robin tests.

NOTE 2 Attention shall be paid to ensure sufficient height of liquid in the container in order to avoid air bubbles in the pulverisation system, which can strongly affect final results. The section of container can be lowered by using a narrower container inside the pressure tank to reduce necessary solution volumes

5.5 Water pressure tank

The water pressure tank can be a simple clean pressurized tank. Same precautions against air bubbles should be taken as described in 5.4.

5.6 Timer for spray

It is recommended to use an automatic timer (such as a solenoid valve) to obtain better precision on pulverisation time, thus on sprayed volumes.

6 Preparation of the glass samples

6.1 Tested sample

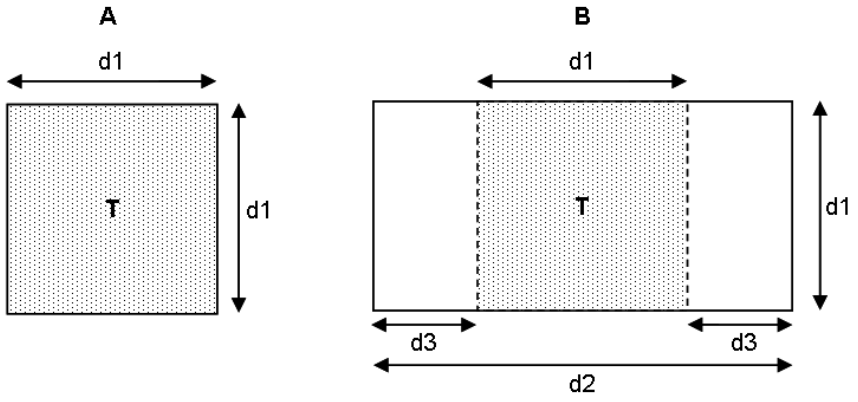
The minimum number of samples to be tested for a given product is at least 6 samples. The chosen number of samples will be indicated as "*n*".

Cut *n* glass samples of 150 mm x150 mm.

In case the product to be tested shall be toughened to become active, the test shall be run on toughened samples. In this case, one can use a 150 mm x 300 mm sample, but the analysed area will be the central zone and the sample will be positioned with the larger side horizontally, as described in figure 1.

Engrave the sample references on the upper left corner of the opposite side from the side to be tested i.e. non coated side.

All dimensions in mm



Key
1 annealed sample, test zone
2 toughened sample
3 test zone on toughened sample

Figure 1 — Description of test samples (annealed and toughened)

6.2 Reference

The use of a reference is recommended. The reference can be chosen by the laboratory. It shall present a behaviour known in advance. For instance, a commercial product can be used. The use of clear float glass as a reference should be avoided, due to the sensibility of its surface to its history. Criteria of choice for the reference are:

— stability of performances and homogeneity

— availability

— low visible absorption

— low initial haze

Examples of references are:

— silica sheets

— float glass coated with a given oxide layer, resistant to corrosion (such as silica or photocatalytic coating)

— commercially available photocatalytic self cleaning glass

At least 6 samples of reference per batch should be tested.

7 Principle of haze measurement

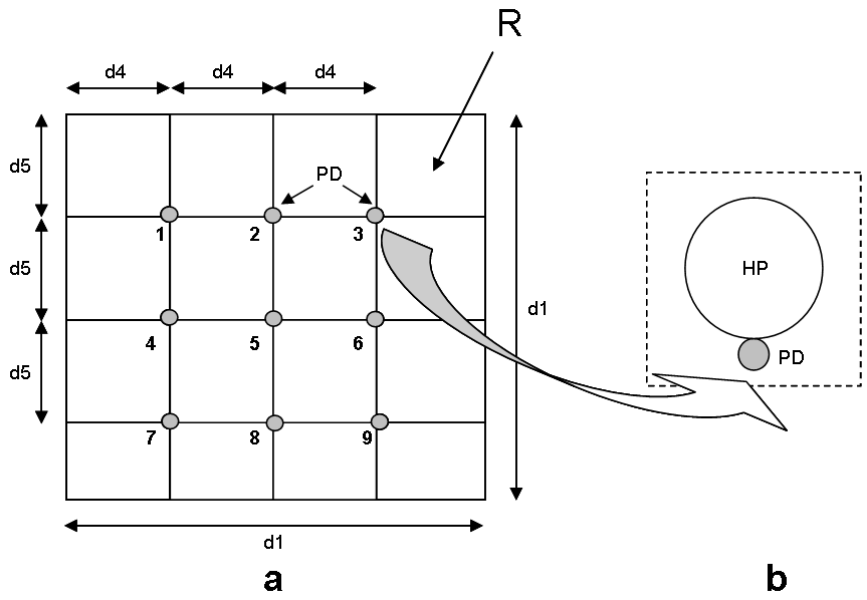
7.1 Back side cleaning

Before each haze measurement, it should be ensured that the back side contamination cannot affect haze measurement. The back side shall be cleaned before haze measurement. The back side can be cleaned with a commercial glass cleaner and clean new soft paper tissue. Avoid touching the measurement side when cleaning the back side.

7.2 Position of haze measurements on the samples

Haze measurements shall be performed on each sample in 9 positions, identical at each step of the test. To achieve identical positioning for each haze measurement steps, it is recommended to mark the haze measurement points with a felt-tip (or diamond pen) on the opposite side from the tested side of the samples, as described in figure 2.

All dimensions are in mm



Key

1 sample
2 positioning dots
3 haze meter port

Figure 2 — Haze measurement - location of the 9 positioning dots and location of the haze meter port above the positioning dots

7.3 Measurement of Transmission Haze

Measure the total luminous transmission, T_t, and the wide-angle scattered transmission, T_d , each of the nine points marked by means of the model (figure 2), according to the procedure described in Annex B. The reference of the sample should always be on the top right corner viewed from the coating side. The haze measurements will be made just above the marked point, with the surface to be tested facing opposite to the measurement port to avoid contact of the side to be tested with the measurement equipment.

The haze value, H, is expressed as the ratio of scattered transmission to total luminous transmission, in percent:

$$H = \frac{T_d}{T_t} 100$$

The value of haze for each measurement point shall be registered as "H^{ij}".

where:

i is the number of haze measurement point as described in figure 2 (i = 1 to 9)

j is the number of the sample (j = 1 to n).

8 Preparation of dirt mixture

8.1 Stearic acid solution

In a wide-necked bottle with a plastic cork equipped with a magnetic stirrer,

— put 500 ml of absolute ethanol

— dissolve 2.5 of stearic acid (CAS N° 57-11-4, purity > 90%) in the ethanol

— stir the solution until complete dissolution of the acid, which may take 10 to 45 min at standard laboratory temperature (i.e. temperature between 20 and 23°C).

8.2 Adipic acid solution

In a wide-necked bottle with a plastic cork equipped with a magnetic stirrer:

— put 10 g of 99,6 % pure adipic acid

— add 200 ml propan-2-ol

— then add 200 ml deionised water

— stir the solution until complete dissolution of the adipic acid, which may take 15 to 20 min and may require heating via a water bath.

8.3 Solid compound suspension

Put into a 3l wide-necked bottle with a plastic cork the following amounts of products:

— Soluble components:

0.15 g copper nitrate trihydrate ($Cu(NO_3)_2$, $3H_2O$, CAS N°- 10031-43-3, purity=99%)

0.15 g zinc nitrate hexahydrate (N_2O_6Zn, $6H_2O$, CAS- N°10196-18-6,-purity=99%)

0.80 g calcium nitrate tetrahydrate (CaN_2O_6, $4H_2O$, CAS N°-13477-34-4, purity=98%)

0.30 g sodium chloride (CAS N°-7647-14-5, purity= 99%)

0.40 g potassium sulphate (CAS N°-7778-80-5, purity=99%)

0.30 g sodium sulphate (CAS N°-7757-82-6, purity=99,5%)

— Non soluble components:

0.50 g kaolin (CAS N° 1332-58-7) (d_{50}=2,5 µm)

0.30 g calcium sulphate dihydrate ($CaSO_4$, $2H_2O$, CAS N°-10101-41-4, purity=98%)

— Add to the solid compounds 50 ml deionised water and stir.

— Then add 50 ml propan-2-ol. Stir vigorously this mixture;

NOTE in case that the solid compound visibly tends to aggregate, a light grounding (to break aggregates) is recommended.