SLOVENSKI STANDARD
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Preskušanje naravnega kamna - Ugotavljanje odpornosti marmorja proti cikličnim toplotnim in vlažnostnim obremenitvam

Natural stone test methods - Determination of resistance of marble to thermal and moisture cycles

Prüfverfahren für Naturstein - Bestimmungen der Beständigkeit von Marmor bei zyklischer Belastung mit Wärme und Feuchtigkeit

Méthodes d'essai pour pierres naturelles - Détermination de la résistance du marbre aux cycles thermiques et d'humidité

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91.100.15	Mineralni materiali in izdelki	Mineral materials and products

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English Version

Natural stone test methods - Determination of resistance of marble to thermal and moisture cycles

Méthodes d'essai pour pierres naturelles - Détermination de la résistance du marbre aux cycles thermiques et d'humidité

Prüfverfahren für Naturstein - Bestimmungen der Beständigkeit von Marmor bei zyklischer Belastung mit Wärme und Feuchtigkeit

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 246.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 16306:2021) has been prepared by Technical Committee CEN/TC 246 “Natural stones”, the secretariat of which is held by UNI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 16306:2013.

In comparison with the previous edition, the following technical modifications have been made:

— Inclusion of a more detailed description of the test procedure and several clarifications.

— Annex C has been amended with the recommendation to increase the number of measurement points in heterogeneous marble.

1 Scope

This document specifies a laboratory method for determining the resistance to thermal and moisture cycling of marble intended for the external cladding of building facades.

For scientific definition of marble, reference is made to EN 12670 Terminology: 2.1.243 a.

NOTE Bowing and rapid strength loss is known to occur in some marbles when used as exterior cladding.

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.

EN 12372, *Natural stone test methods — Determination of flexural strength under concentrated load*

EN 12670, *Natural stone — Terminology*

EN 14146, *Natural stone test methods — Determination of the dynamic modulus of elasticity (by measuring the fundamental resonance frequency)*

EN 14579:2004, *Natural stone test methods — Determination of sound speed propagation*

ISO 4892-1:2016, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
bowing
change in shape from flat and planar to a curved or dished shape in a convex or concave direction

Note 1 to entry: Other terms commonly used for the same phenomenon are dishing and warping.

Note 2 to entry: Convex bowing is quantified by positive values, concave bowing by negative values.

3.2
convex
centre part of the specimen is bowing upwards, away from the moist substratum

3.3
concave
centre part of the specimen is bowing downwards, away from the applied heat

4 Symbols

T Temperature

H_0 Initial height of the specimen at the measuring point [mm]

H Difference between the initial height and the height after a defined number of cycles [mm]

H_N The normalized height difference, related to L_N = 1 m [mm]

B H_N / L_N = The normalized bowing value [mm/m]

B_n Bowing values after n cycles [mm/m]

L Distance between the supports under the specimen = 0,35 [m]

L_N Normalized length = 1 [m]

5 Principle

Bowing is measured on test samples placed within a test chamber, exposed to cycles of heat applied to one face while the reverse face is subjected to moisture. The temperature interval is from 20 °C to 80 °C, one cycle lasts 24 h. The temperature is measured on a black reference plate, placed on the surface of one specimen, to control the climate within the test chamber.

The strength loss shall be measured according to EN 12372 on reference and exposed specimens (Annex A) and the results compared.

6 Apparatus

All measuring equipment shall be calibrated.

6.1 A non-corrosive test chamber (Figure 1) of sufficient capacity to hold the required number of specimens, laid horizontally. The container shall be designed in a way that specimens receive continuous moisture from one side (the underside) and are exposed to cyclic heating on the other side (the upper side). The container shall be furnished with a device that ensures a constant water level for the duration of the test. Lying on the bottom of the container is a grating, which is covered by a sheet of heat stable filter cloth.

6.2 A non-corrosive grating that fits within the length and width of the container and has a height of at least 1 cm. The function of the grating is to ensure a water reservoir beneath the filter cloth.

6.3 A soft, heat stable, dimensionally stable, non-hygroscopic needle filter cloth of thickness approximately 5 mm and without any water soluble substances or chemicals. The cloth (e.g. Polyester or PTFE (Polytetrafluoroethylene (PTFE)) needle felt) is to be placed on top of the grating. The function of the cloth is to deliver moisture to and a uniform support for the specimen.

6.4 Heating panels of sufficient sizes/and numbers to cover the container. The panels shall be capable of providing a uniform heat flow, heating the black reference plate from 20 °C to 80 °C at average rate of 0,25 °C ± 0,1 per minute. The maximum permissible temperature difference within the test chamber, during heating exposure, is 3 °C. Panels of insulating material should preferably be placed around the container (Figure 1), to avoid unwanted cooling or air circulation. Before the system is approved for use, trial measurements of the temperature shall be performed at 9 surface points widely distributed within the heating frame (Figure 2). The temperature is measured on a uniform surface preferably with an infrared thermometer or a surface measuring thermometer. The temperature readings shall be taken on the surface of the black reference plate.

The heating rate may be adjusted by changing the distance between the heating device and the samples, or by controlling the effect of the heater. The heating curve is displayed in Figure 5.

6.5 A black reference plate, according to ISO 4892-1 (Figure 3), to ensure proper temperature development and the maximum surface temperature at 80 °C. A thermocouple (cable type K), attached to the black reference plate, is connected to a high stability temperature and process controllers. A simple data logger is also possible.

NOTE The black reference plate is placed on the surface of a sample, preferably near the middle of the container. The temperatures for the experimental exposure are programmed in advance. The heating elements are controlled by the process controller. The temperature of the black reference plate is read and the signal is sent to the process controller that adjusts the heating. The whole system can thus be computer controlled and the surface temperature can be monitored online.

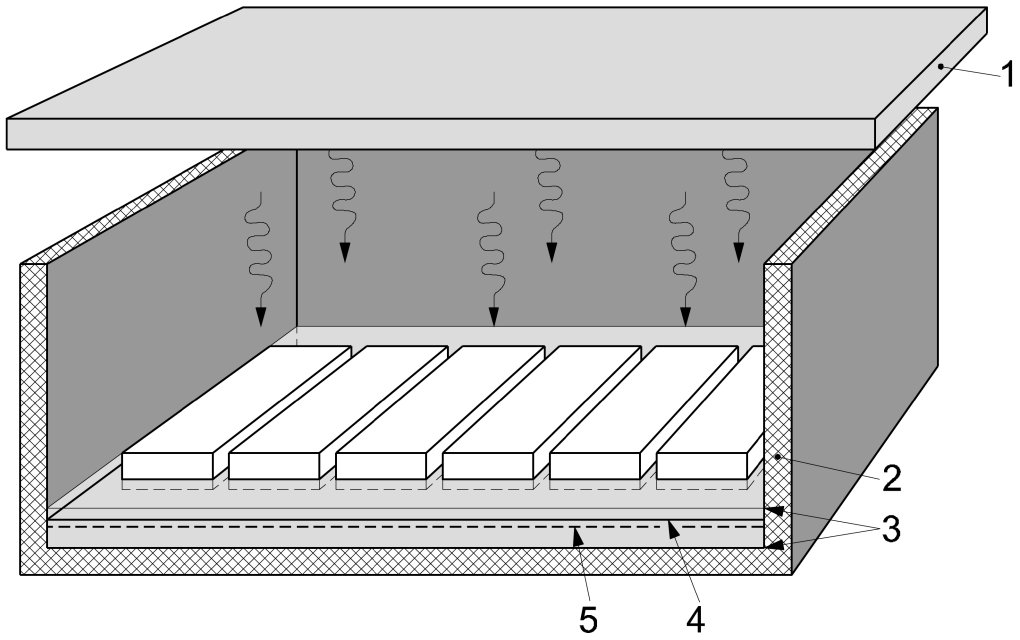
6.6 An infrared thermometer or other thermometer capable of measuring the surface temperature of the specimens. If an infrared thermometer is used it shall be checked against a material similar to marble, since the response of such a thermometer is influenced by the density and other parameters of the measured surface.

6.7 A bow-test rig for bowing measurements (Figure 4). The rig comprises a steel plate, having three supporting points upon which the specimen is placed, and three cylinders which guide the edges of the specimen. The supporting points are situated (350 ± 5) mm apart from each other and shall be well rounded and smooth in order to accommodate for eventual irregularities in the sawn surface of the specimens. Above the centre of the specimen a gauge is mounted, which shall be readable to 0,001 mm. The whole system shall have an accuracy better than ± 0,01 mm.

6.8 A reference cylinder (co-planar bases with an accuracy better than ± 0,005 mm) consisting of a material with a low linear expansion coefficient (e.g. quartz glass or invar steel).

6.9 A ventilated oven capable of maintaining a temperature of (40 ± 5) °C.

6.10 A weighing instrument which has an accuracy of at least 0,01 % of the mass to be weighed.



Key

1 Heating device
2 Insulation
3 Water level
4 Filter cloth
5 Grating

NOTE The front wall is omitted here for a better view of the interior.

Figure 1 — Principle sketch and an example of exposure equipment for testing the potential bowing properties of marble

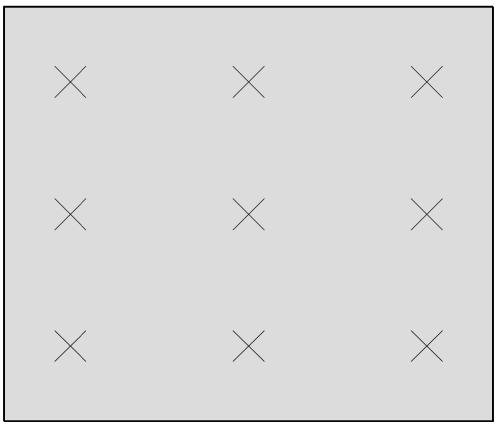
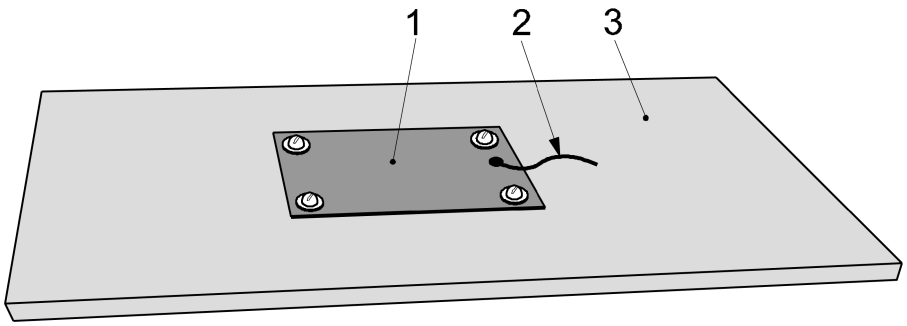


Figure 2 — Location of temperature control points

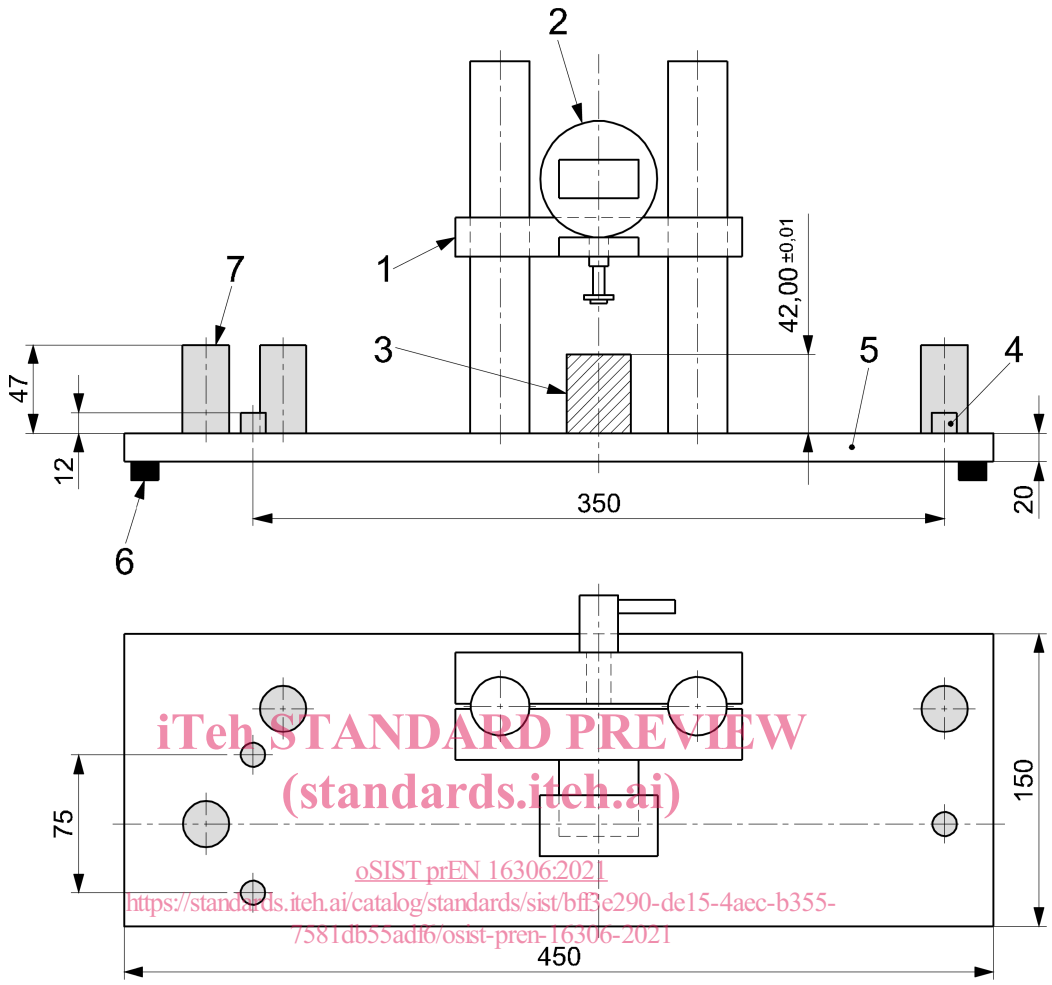


Key

1 Black reference plate
2 Thermocouple
3 Test specimen

Figure 3 — Black reference plate (ISO 4892-1:2016) for T-measurements

Dimensions in millimetres



Key

1 Stand
2 Gauge
3 Reference piece
4 Support
5 Steel plate (corrosion resistant)
6 Rubber or polychloroprene studs
7 Guide

Figure 4 — Schematic drawing of the bowing test rig