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BSI Standards Publication

Natural stone test methods — Determination of sensitivity to changes in appearance produced by thermal cycles

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee B/545, Natural stone.

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

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English Version

Natural stone test methods - Determination of sensitivity to changes in appearance produced by thermal cycles

Méthodes d'essai pour pierres naturelles - Détermination de la sensibilité aux changements d'aspect induits par des cycles thermiques

Prüfverfahren für Naturwerkstein - Bestimmung der Empfindlichkeit gegen Änderungen des äußeren Erscheinungsbildes durch thermische Zyklen

This European Standard was approved by CEN on 13 February 2011.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword

This document (EN 16140:2011) has been prepared by Technical Committee CEN/TC 246 “Natural stones”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by September 2011, and conflicting national standards shall be withdrawn at the latest by September 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This draft standard is one of the series of draft standards for tests on natural stone.

Test methods for natural stone consist of the following standards:

— EN 1925, *Natural stone test methods — Determination of water absorption coefficient by capillarity*;

— EN 1926, *Natural stone test methods — Determination of uniaxial compressive strength*;

— EN 1936, *Natural stone test methods — Determination of real density and apparent density, and of total and open porosity*;

— EN 12370, *Natural stone test methods — Determination of resistance to salt crystallisation*;

— EN 12371, *Natural stone test methods — Determination of frost resistance*;

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

— EN 12407, *Natural stone test methods — Petrographic examination*;

— EN 13161, *Natural stone test methods — Determination of flexural strength under constant moment*;

— EN 13364, *Natural stone test methods — Determination of the breaking load at dowel hole*;

— EN 13373, *Natural stone test methods — Determination of geometric characteristics on units*;

— EN 13755, *Natural stone test methods — Determination of water absorption at atmospheric pressure*;

— EN 13919, *Natural stone test methods — Determination of resistance to ageing by SO2 action in the presence of humidity*;

— EN 14066, *Natural stone test methods — Determination of resistance to ageing by thermal shock*;

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

— EN 14147, *Natural stone test methods — Determination of resistance to ageing by salt mist*;

— EN 14157, *Natural stone test methods — Determination of the abrasion resistance*;

— EN 14158, *Natural stone test methods — Determination of rupture energy*;

— EN 14205, *Natural stone test methods — Determination of Knoop hardness*;

— EN 14231, *Natural stone test methods — Determination of the slip resistance by means of the pendulum tester*;

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

— EN 14580, *Natural stone test methods — Determination of static elastic modulus*;

— EN 14581, *Natural stone test methods — Determination of linear thermal expansion coefficient*.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies a method to assess possible alterations of natural stones (mainly visible sensitivity to oxidation processes) under the effect of sudden changes in temperature (thermal shock).

2 Normative references

Not applicable.

3 Symbols and abbreviations

e Thickness of the test specimens, in mm

4 Principle

The specimens are subjected to successive cycles, each formed by drying at (105 ± 5) ºC followed by immediate immersion in water at (20 ± 5) ºC.

5 Apparatus

5.1 A ventilated oven capable of maintaining a temperature of (105 ± 5) ºC.

5.2 A covered tank with a flat base, comprising small non-oxidising and non-absorbent supports for the specimens.

5.3 A digital camera of 2.5 MPixels, or scanner, with a sufficient resolution.

5.4 A magnifying glass of at least five increases.

6 Preparation of specimens

6.1 Sampling

The sampling is not the responsibility of the test laboratory except where specially requested. At least seven specimens shall be selected from a homogeneous batch. One of these specimens is used as reference specimen and is not subjected to any tests.

6.2 Test specimens

6.2.1 Surface finish

As a standard reference (identification test) surface finish of the faces of the specimens shall be sawn.

In case of necessity as required for application (technological test), other surface finishes (e.g. honed, polished, flamed, sandblasted, splitting) may be tested.

6.2.2 Dimensions

As a standard reference (identification test) the test specimens shall be (200 × 200) mm ± 10 mm × e.

In case of necessity as required for application (technological test), other dimensions may be used. In this case, test specimens may be final products or sawn from final products.

7 Test procedure

7.1 Control measurements before cycling

The dried specimens are submitted to a thorough visual inspection, with the aid of a magnifying glass of at least five increases. All relevant features of its texture and also all visual and structural alterations of each specimen shall be noted, such as cracks, holes, swelling, spots, oxidations, or presence of metallic minerals or other sensitive minerals (e.g. biotite, hornblendes, etc.). A photographic (or scanner) record of all specimens to be tested shall be made.

7.2 Description of the cycles

As a standard reference (identification test) the specimens are subjected to changes of temperature according to the following procedure: (18 ± 1) h in a ventilated oven at (105 ± 5) ºC, immediately followed by (6 ± 0,5) h of complete submersion in distilled or demineralised water, whose temperature before the immersion of the specimens is (20 ± 5) ºC.

Both in the oven and in the water container, the specimens are placed in vertical position on the supports at a distance of at least 50 mm from one another and from the wall. In the water container, the specimens are placed on supports located at the bottom of the container which has been filled with water to such a height that its level above the specimens is (60 ± 10) mm. The procedure described above constitutes one cycle. If the test is to be interrupted at anytime, other than for testing, then the specimens are to be immersed in water at (20 ± 5) ºC. The test consists in a total of 20 cycles.

7.3 Control measurements after cycling

After the 20^{th} cycle the specimens are visually inspected and compared general aspect or colour with the reference specimen. All alterations are noted. A photographic (or scanner) record shall be made, which includes both tested specimens and reference specimen placed next to one another.

8 Expression of results

For each specimen:

Describe the modifications observed visually or with the aid of a magnifying glass, by comparison with the reference specimen, such as:

— in general, changes in the colour of the stone or spots in their surface, and evaluation of the oxidations of metallic minerals and biotite;

— structural changes as swelling, cracking, microcracking or exfoliations.

A photographic (or scanner) record shall be made, which includes all tested specimens before and after the test and reference specimen placed next to one another.

The oxidations are evaluated according to Table 1.

Table 1 — Evaluation codes for oxidations

CODES	T1	T2	T3
Description of the alterations	No oxidations Only changes in colour of the metallic minerals for loss of sheen	Oxidation, only around minerals, without discolouration spreading [a]	Oxidation with discolouration spreading
[a] Occasionally small spots of oxide of punctual character may appear, which are related with the presence of metallic particles from the cutting process.			

Further details are listed/shown Annex A.

9 Test report

The test report shall contain the following information:

a) unique identification number of this report;

b) the number, title and date of issue of this European Standard (i.e. EN 16140:2011);

c) the name and address of the test laboratory and the address where the test was carried out if it is different from the test laboratory;

d) the name and address of the client;

e) it is the responsibility of the client to give the following information:

   1) the petrographic name of the stone;

   2) the commercial name of the stone;

   3) the country, region and geo-coordinates of extraction;

   4) the name of the supplier;

   5) the direction of any existing plane of anisotropy (if relevant to the test) to be clearly indicated on the sample or on each specimen by means of two parallel lines;

   6) the name of the person or organisation which carried out the sampling;

   7) the surface finish of the specimens (if relevant to the test);

f) the date of delivery of the sample or of the specimens;

g) the date when the specimens were prepared (if relevant) and the date of testing;

h) the number of specimens in the sample;

i) the dimensions of the specimens;

j) any observed alteration for each specimen, according to Clause 8;

k) the evaluation CODE, according to Table 1;

l) a photographic (or scanner) record shall be made, which includes both tested specimens and reference specimen placed next to one another, only if any alterations are produced during the cycles only if they take place during the test, some of the alterations described in Clause 8;

m) any deviations from the standard and their justification;

n) remarks.

The test report shall contain the signature(s) and role(s) of the responsible(s) for the testing and the date of issue of the report.

It shall also state that the report shall not be partially reproduced without the written consent of the test laboratory.

Annex A
(informative)

Examples of evaluation codes for oxidations

This informative annex gives some schematic examples for classification according to the evaluation codes for oxidations, when metallic minerals, or biotites are present (see Figures A.1 to A.4).

Key

micas

metallic minerals

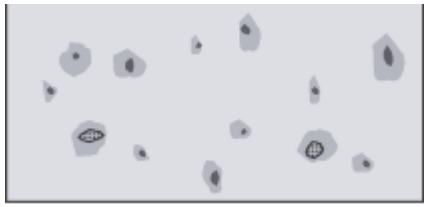
Figure A.1 — Reference sample with metallic minerals or biotities

Key

micas

metallic minerals

Figure A.2 — Change in colour for loss of sheen



Key

micas

metallic minerals

Figure A.3 — CODE T2 - Oxidation only around minerals without runs of oxidations

Key

micas

metallic minerals

Figure A.4 — CODE T3 - Aspect changes of inclusion with runs of oxidations

Annex B
(informative)

Adapted thermal shock test

For stones with finely dispersed, non visible iron bearing minerals, like some white marbles, an adapted thermal shock test is proposed: 20 cycles consisting in 6h in a alkaline solution (1M and pH = 9, obtained by dissolving $NaHCO_3$ in water), followed by 18 h in a oven at (55 ± 5) ºC.

Bibliography

[1] EN 12407, *Natural stone test methods — Petrographic examination*

[2] EN 12440, *Natural stone — Denomination criteria*

[3] EN 12670, *Natural stone — Terminology*

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