SLOVENSKI STANDARD
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Naravni kamen - Ugotavljanje odpornosti proti obrabi

Natural stone test methods - Determination of the abrasion resistance

Prüfverfahren für Naturstein - Bestimmung des Widerstandes gegen Verschleiß

Pierres naturelles - Détermination de la résistance a l'usure

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English version

Natural stones - Determination of abrasion resistance

Méthodes d'essai pour pierres naturelles - Détermination de la résistance à l'usure

Prüfverfahren für Naturstein - Bestimmung des Widerstandes gegen Verschleiß

This European Standard was approved by CEN on 9 July 2004.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 14157:2004) 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of an identical text or by endorsement, at the latest by April 2005, and conflicting national standards shall be withdrawn at the latest by April 2005.

This draft document is one of the series of draft documents for tests on natural stone.

Test methods for natural stone consist of the following parts:

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

EN 1926, *Natural stone test methods - Determination of 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 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 SO_2 action in the presence of humidity*

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

EN 14147, Natural stone test methods - Determination of resistance to ageing by salt mist

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

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

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

prEN 14579, *Natural stone test methods - Determination of sound speed propagation*

prEN 14580, *Natural stone test methods - Determination of static elastic modulus*

prEN 14581, *Natural stone test methods - Determination of linear thermal expansion coefficient*

It is intended that other ENs should call up this EN 14157 as the basis of evaluation of conformity. Nevertheless it is not intended that all natural stones products should be subjected regularly to all the listed tests. Specifications in other documents should call up only relevant test methods.

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

1 Scope

This document specifies three test methods to determine the abrasion resistance of natural stones used for flooring in buildings. One of the methods – the 'wide wheel abrasion method' is defined as the reference method.

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 10025, *Hot rolled products of structural steels - Technical delivery conditions*

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

EN ISO 4288, *Geometrical Product Specifications (GPS) -- Surface texture: Profile method -- Rules and procedures for the assessment of surface texture (ISO 4288:1996)*

EN ISO 6506-1, *Metallic materials -- Brinell hardness test -- Part 1: Test method (ISO 6506-1:1999)*

FEPA 42F1984, FEPA Fédération des Fabricants de Produits Abrasifs. *Corundum*

3 Method A – Wide Wheel Abrasion Test

3.1 Principle

The test is carried out by abrading the face of a specimen which will be exposed in use with an abrasive material under standard conditions.

3.2 Abrasive material

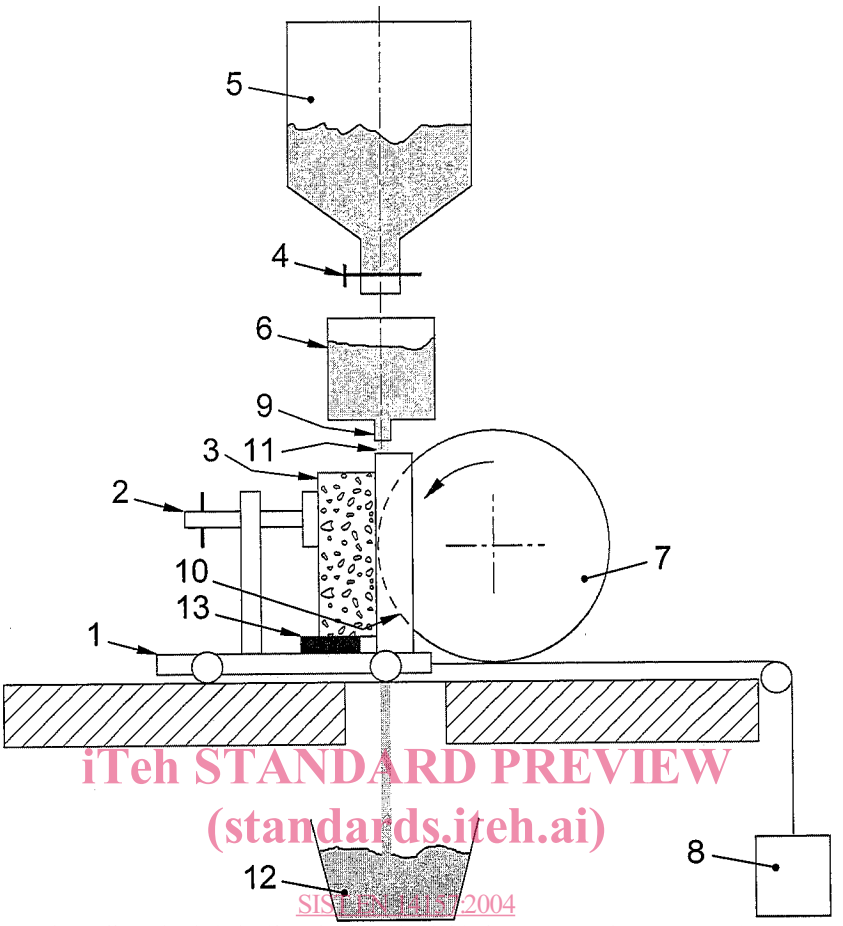
The abrasive required for this test is corundum (white fused alumina) with grit size of 80 in accordance with standard FEPA 42 F 1984. It shall not be used for more than three times.

3.3 Apparatus

3.3.1 The 'wearing' machine

The wearing machine (see Figure 1) is essentially made of a wide abrasion wheel, a storage hopper with one or two control valves to regulate the output of the abrasive material, a flow guidance hopper, a clamping trolley and a counterweight.

When two valves are used, one shall be used to regulate the rate of flow and can be permanently set while the other is used to turn the flow on and off.



Key

1 Clamping trolley
2 Fixing screw
3 Specimen
4 Control valve
5 Storage hopper
6 Flow guidance hopper
7 Wide abrasion wheel
8 Counterweight
9 Slot
10 Groove
11 Abrasive material flow
12 Abrasive collector
13 Wedge

Figure 1 — Principle of the wearing machine

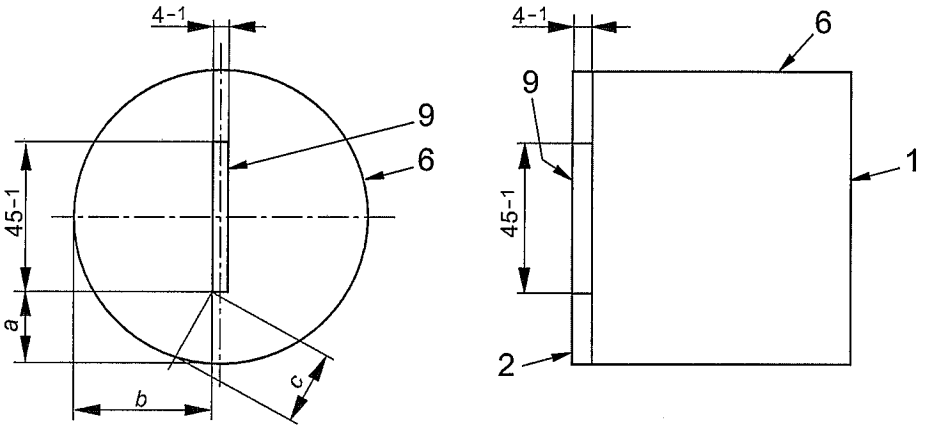
The wide abrasion wheel shall be made of steel Fe 690 according to EN 10025. The hardness of the steel shall be between 203 HB and 245 HB. Its diameter shall be (200 ± 1) mm and its width shall be (70 ± 1) mm. It shall be driven to rotate 75 revolutions in (60 ± 3) seconds.

A mobile clamping trolley is mounted on bearings and forced to move forwards to the wheel by a counterweight having a mass of (14 ± 0,01) kg.

The storage hopper containing the abrasive material feeds a flow guidance hopper.

The flow guidance hopper may have a cylindrical or rectangular cross-section and shall have a slotted outlet. The length of the slot shall be (45 ± 1) mm and the width shall be (4 ± 1) mm. The body of the flow guidance hopper shall be at least 10 mm bigger than the slot in all directions. In the case of a hopper with a rectangular cross

section and at least one of the sides inclined down to the length of the slot, these dimensional limitations are not necessary (see Figure 2).



For key see Figure 1

1 Inclined side

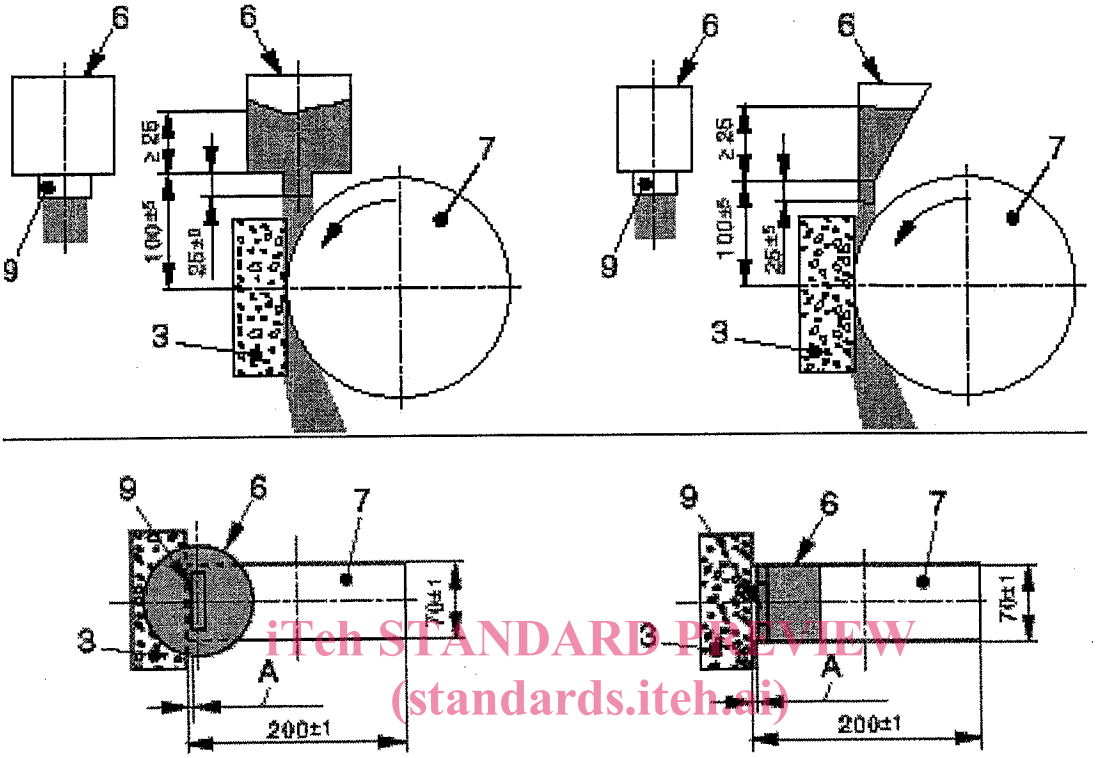
2 Vertical side

a,b,c > 10

Figure 2 — Position of the slot at the base of the flow guidance hopper in case of cylindrical cross section (left) and of rectangular cross section (right)

The distance of the fall between the slot and the axle of the wide abrasion wheel shall be (100 ± 5) mm and the flow of abrasive shall be (1-5) mm behind the leading edge of the wheel (see Figure 3).

Dimensions in millimetres



Top front view, bottom plan view

For key see Figure 1

A distance of the flow of abrasive from the leading edge of the wheel (from 1 to 5).

Figure 3 — Position of the slot relative to the wide abrasion wheel for a cylindrical cross section of the flow guidance hopper (left) and for a rectangular cross section of the flow guidance hopper (right)

The flow of the abrasive material from the flow guidance hopper shall be at a minimum rate of 2.5 litres per minute onto the wide abrasion wheel. The flow of abrasive shall be constant and the minimum level of the abrasive in the flow guidance hopper shall be 25 mm (see Figure 3).

3.3.2 Magnifying glass

A magnifying glass having at least 2 x magnification and preferably equipped with a light.

3.3.3 Ruler

A steel ruler.

3.3.4 Calliper

A digital calliper, having an accuracy of at least 0,05 mm

3.4 Calibration

The apparatus shall be calibrated after grinding 400 grooves or every two months which ever is sooner and every time there is a new operator, a new batch of abrasive, or a new abrasion wheel.

The abrasive flow rate shall be verified by pouring the material from a height of approximately 100 mm into a pre-weighed rigid container with a smooth rim, of height (90 ± 10) mm and of known volume when filled to the top, this shall be approximately 1 litre. As the container fills, the pourer shall be raised to approximately maintain the 100 mm fall. When the container is filled, the top shall be struck off level and weighed to determine the mass of abrasive for a known volume, i.e. the density. The abrasive shall be run through the wearing machine for (60 ± 1) s and collected below the abrasion wheel in a pre-weighed container of at least 3 litres capacity. The filled container shall be weighed and from the density determined above, the rate of abrasive flow can be verified as not less than 2,5 litres per minute.

The apparatus shall be calibrated against a reference sample of "Boulonnaise Marble" using the procedure in 3.6.1 and the counterweight adjusted so that after 75 revolutions of the wheel in (60 ± 3) seconds the length of the groove produced is (20,0 ± 0,5) mm. The counterweight shall be increased or decreased to increase or decrease the groove length respectively. The clamping trolley/counterweight assembly shall be checked for undue friction.

NOTE The "Boulonnaise Marble" reference is: Lunel demi-clair, thickness: 5 cm, c/passe 2 faces ground with a diamond grit size 100/120, with a rugosity class Ra = (1,6 ± 0,4) µm in accordance with EN ISO 4288.

The groove shall be measured using the procedure in 3.6.2 to the nearest 0,1 mm and the three results averaged to give the calibration value.

An alternative material may be used for the reference sample if a good correlation (that is where the r^2 is greater than 0,8 has established with the reference material "Boulonnaise Marble".

At every calibration of the apparatus the squareness of the sample supports shall be checked.

The groove on the reference sample shall be rectangular with a difference between the measured length of the groove at either side not exceeding 0,5 mm. If necessary check that:

The sample has been held square to the wheel.

The clamping trolley and the slot from the flow guidance hopper are parallel to the wheel axle.

The flow of abrasive is even across the slot.

The friction in the trolley/counterweight assembly is not undue.

3.5 Preparation of test specimens

The test specimen shall be a whole product or a cut piece measuring at least (100 x 70) mm incorporating the upper face of the unit. At least six specimens shall selected from an homogenous batch. The sampling is not the responsibility of the test laboratory except where especially requested. The orientation of the test face with respect to anisotropy planes (e.g. bedding, foliation) shall be noted.

The test specimens shall be clean and dried at (70 ± 5) °C to a constant mass. Constant mass is reached when the difference between two successive weighings at an interval of (24 ± 2) h is not greater than 0,1 % of the mass of the specimen.

The upper face, which shall be tested, shall be flat within a tolerance of ± 1 mm measured in accordance with EN 13373 in two perpendicular directions, but over 100 mm.

If the upper face has a rough texture or is outside this tolerance it shall be lightly ground to produce a smooth flat surface within tolerance.

Immediately before testing, the surface to be tested shall be cleaned with a stiff brush and covered with a surface dye to facilitate measuring the groove (e.g. painting with a permanent marker pen).

3.6 Test procedure

3.6.1 Test Method

Fill the storage hopper with dry abrasive material, (maximum moisture content 1,0%). Move the clamping trolley away from the wide abrasion wheel. Position the specimen on it so that the groove produced shall be at least 15 mm from any edge of the specimen and fix the specimen on a wedge to let the abrasive flow pass under it. Place the abrasive collector beneath the abrasion wheel.

Bring the specimen into contact with the wide abrasion wheel. Open the control valve and simultaneously start the motor so that the wide abrasion wheel achieves 75 revolutions in (60 ± 3) s. Visually check the regularity of the flow of the abrasive material during the test. After 75 revolutions of the wheel, the abrasive flow and the wheel are stopped. Whenever possible, two tests shall be performed on each specimen. These shall be on adjacent faces if there is any doubt on the orientation of the stone in use.

3.6.2 Measuring the groove

Put the specimen under a magnifying glass to facilitate the measuring of the groove.

With a pencil with a lead diameter 0,5 mm and hardness 6H or 7H, draw the external longitudinal limits (l_1 and l_2) of the groove using a ruler (see Figure 4).

Then draw a line (A B) in the middle of the groove perpendicular to the centreline of the groove. Position a digital calliper square tips on the points A and B to the inside edge of the longitudinal limits (l_1 and l_2) of the groove and measure and record the dimension to the nearest ± 0,1 mm.

For calibration purposes, repeat the measurement (10 ± 1) mm from the ends of the groove (C D) to give 3 readings.