BRITISH STANDARD

BS EN ISO
10545-3:1997

Ceramic tiles —

Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density

The European Standard EN ISO 10545-3:1997 has the status of a British Standard

ICS 91.100.20

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee B/539, Ceramic tiles and other rigid tiling, upon which the following bodies were represented:

Association of Building Engineers
British Adhesives and Sealants Association
British Ceramic Research Ltd.
British Ceramic Tile Council
Building Research Establishment
Chartered Institute of Building
Concrete Society
Construction Confederation
Consumer Policy Committee of BSI
Contract Flooring Association
Federation of Master Builders
Federation of Resin Formulators and Applicators
Health and Safety Executive
Institute of Clerks of Works of Great Britain
London Underground Ltd.
Mortar Producers' Association
National Federation of Clay Industries
National Federation of Terrazzo, Marble and Mosaic Specialists
National Master Tile Fixers' Association
National Tile, Faience and Mosaic Fixers' Society
Natural Slate Quarries Association
Royal Institute of British Architects
Stone Federation

This British Standard, having been prepared under the direction of the Sector Board for Building and Civil Engineering, was published under the authority of the Standards Board and comes into effect on
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The following BSI references relate to the work on this standard:
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Amendments issued since publication

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Contents

National foreword

This British Standard has been prepared by Technical Committee B/539 and is the English language version of EN ISO 10545-3:1997 *Ceramic tiles — Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density,* published by the European Committee for Standardization (CEN). It is identical with ISO 10545-3:1995, including its Technical Corrigendum 1:1997, published by the International Organization for Standardization (ISO). It supersedes BS 6431-11:1983, which will be withdrawn when Parts 1 to 16 of BS EN ISO 10545 have all been published.

This Part of BS EN ISO 10545 was originally drafted by CEN/TC 67, Ceramic tiles, as EN 99, published in 1982, and confirmed in 1991. Subsequently the European Standard was revised by ISO as a Part of ISO 10545, which has now been approved by CEN as a Part of EN ISO 10545.

The technical changes from the method described in BS 6431-11 are as follows.

Additional methods are included for determination of the apparent porosity, apparent relative density and bulk density. Impregnation of the tiles with water may be achieved by boiling or under vacuum. Classification of tiles for specification purposes is to be made using the boiling method. After the vacuum impregnated tiles have been weighed in air, they are weighed again in water. This further step enables the additional properties to be calculated.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN ISO title page, pages 2 to 4 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 10545-3

July 1997

ICS 91.100.20

Supersedes EN 99:1991

Descriptors: Ceramics, tiles, tests, water absorption tests, determination, porosity, density (mass/volume), bulk density

English version

Ceramic tiles — Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density

(ISO 10545-3:1995, including Technical Corrigendum 1:1997)

Carreaux et dalles céramiques —
Partie 3: Détermination de l'absorption d'eau, de la porosité ouverte, de la densité relative apparente et de la masse volumique globale
(ISO 10545-3:1995, Rectificatif Technique 1:1997 inclus)

Keramische Fliesen und Platten —
Teil 3: Bestimmung von Wasseraufnahme, offener Porosität, scheinbarer relativer Dichte und Rohdichte
(ISO 10545-3:1995, einschließlich Technische Korrektur 1:1997)

This European Standard was approved by CEN on 1997-05-01. 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.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN ISO 10545-3:1997 E

Foreword

The text of the International Standard from Technical Committee ISO/TC 159, Ceramic tiles, of the International Organization for Standardization (ISO) has been taken over as a European Standard by Technical Committee CEN/TC 67, Ceramic tiles, the secretariat of which is held by UNI.

This European Standard supersedes EN 99:1991.
EN ISO 10545 consists of the following Parts, under the common title *Ceramic tiles*.

— *Part 1: Sampling and basis for acceptance;*

— *Part 2: Determination of dimensions and surface quality;*

— *Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density;*

— *Part 4: Determination of modulus of rupture and breaking strength;*

— *Part 5: Determination of impact resistance by measurement of coefficient of restitution;*

— *Part 6: Determination of resistance to deep abrasion for unglazed tiles;*

— *Part 7: Determination of resistance to surface abrasion for glazed tiles;*

— *Part 8: Determination of linear thermal expansion;*

— *Part 9: Determination of resistance to thermal shock;*

— *Part 10: Determination of moisture expansion;*

— *Part 11: Determination of crazing resistance for glazed tiles;*

— *Part 12: Determination of frost resistance;*

— *Part 13: Determination of chemical resistance;*

— *Part 14: Determination of resistance to stains;*

— *Part 15: Determination of lead and cadmium given off by glazed tiles*

— *Part 16: Determination of small colour differences;*

— *Part 17: Determination of coefficient of friction.*

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 1998, and conflicting national standards shall be withdrawn at the latest by January 1998.

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.

Endorsement notice

The text of the International Standard ISO 10545-3:1995, including Technical Corrigendum 1:1997, has been approved by CEN as a European Standard without technical modifications.

1 Scope

This part of ISO 10545 specifies methods for determining water absorption, apparent porosity, apparent relative density and bulk density of ceramic tiles.

There are two methods of obtaining impregnation with water of the samples' open pores: boiling and immersion under vacuum. Boiling will impregnate open pores that are easily fillable; the vacuum method fills almost all the open pores.

The boiling method shall be used for classification of tiles and product specifications. The vacuum method shall be used for apparent porosity, apparent relative density and water absorption for purposes other than classification.

2 Principle

Impregnation of dry tiles with water and then suspension in water. Calculation of the listed properties using the relationships between the dry, saturated and suspended masses.

3 Apparatus

3.1 *Drying oven,* capable of being operated at (110 ± 5) °C.

Microwave, infrared or other drying systems may be used provided that it has been determined that the same results are obtained.

3.2 *Heating apparatus,* constructed of suitable inert material, in which boiling takes place.

3.3 *Source of heat*

3.4 *Balance,* accurate to 0,01 % of the mass of a test specimen.

3.5 *Deionized* or *distilled water*

3.6 *Desiccator*

3.7 *Chamois leather*

3.8 *Wire loop, halter* or *basket,* capable of supporting specimens under water for making suspended mass measurements.

3.9 *Glass beaker,* or similar container of size and shape such that the sample, when suspended from the balance (**3.4**) by the wire loop (**3.8**), is completely immersed in water, with the test specimen and the wire loop being completely free of contact with any part of the container.

3.10 *Vacuum chamber* and *vacuum system,* of sufficient capacity to accommodate the required number of test specimens and achieve and hold a vacuum of (10 ± 1) kPa for 30 min.

4 Test specimens

4.1 A sample of each type of tile under test shall consist of 10 whole tiles.

4.2 If the proper surface area of each individual tile is greater than 0,04 m^2, only five whole tiles shall be used for the test.

4.3 When the mass of each individual tile is below 50 g, a sufficient number of tiles shall be taken so that each test specimen reaches a mass of 50 g to 100 g.

4.4 Tiles with sides longer than 200 mm may be cut into smaller pieces, but all such pieces shall be included in the measurement. With polygonal and other non-rectangular tiles, the lengths and widths shall be those of the enclosing rectangles.

5 Procedure

Dry the tiles in the oven (**3.1**) adjusted to (110 ± 5) °C, until constant mass is reached, i.e. until the difference between two successive weighings at intervals of 24 h is less than 0,1 %. Cool the tiles in the desiccator (**3.6**) over silica gel or another suitable desiccant, but not an acid.

Weigh each tile and record the results to the corresponding accuracy shown in Table 1.

Table 1 — Tile mass and accuracy of measurement

Values in grams

Mass of tile	Accuracy of measurement
50 to 100	0,02
> 100 to 500	0,05
> 500 to 1 000	0,25
> 1 000 to 3 000	0,50
> 3 000	1,00

5.1 Impregnation with water

5.1.1 *Boiling method*

Place the tiles vertically, with no contact between them, in the heating apparatus (**3.2**) so that there is a depth of 5 cm of water (**3.5**) above and below the tiles. Maintain the water level at 5 cm above the tiles throughout the test. Heat the water until it boils and continue to boil for 2 h. Then remove the source of heat (**3.3**) and allow the tiles to cool to room temperature, still completely immersed, in 4 h ± 15 min. Water at ambient temperature or refrigerating coils may be used to cool the test specimens to room temperature. Prepare the chamois leather (**3.7**) by wetting and wringing out by hand. Place it on a flat surface and lightly dry each side of each tile in turn. Dab any relief surfaces with the chamois leather.

Immediately after this procedure, weigh each tile and record the results to the same accuracy as for the dry state (see Table 1).

5.1.2 ***Vacuum method***

Place the tiles vertically, with no contact between them, in the vacuum chamber (**3.10**). Evacuate to a pressure of (10 ± 1) kPa and maintain it for 30 min. Then while maintaining the vacuum, slowly admit sufficient water to cover the tiles by 5 cm. Release the vacuum and allow the tiles to remain submerged for 15 min. Prepare the chamois leather (**3.7**) by wetting and wringing out by hand. Place it on a flat surface and lightly dry each side of each tile in turn. Dab any relief surfaces with the chamois leather.

Immediately after this procedure, weigh each tile and record the results to the same accuracy as for the dry state (see Table 1).

5.2 Suspended weight

After impregnation under vacuum of the test specimens, determine, to the nearest 0,01 g, the mass m_3 of each specimen while suspended in water. Carry out weighing by placing the specimen in a wire loop, halter, or basket (**3.8**) that is suspended from one arm of the balance (**3.4**). Before actually weighing, counterbalance the scale with the wire loop, halter, or basket in place and immerse in water to the same depth as is used when the specimens are in place.

6 Expression of results

m_1 is the mass of the dry tile;

m_{2b} is the mass of the tile impregnated with boiling water;

m_{2v} is the mass of the tile impregnated by immersion under vacuum;

m_3 is the mass of the suspended tile impregnated by immersion under vacuum.

In the following calculations, the assumption is made that 1 cm^3 of water weighs 1 g. This is true within about 3 ‰ for water at room temperature.

6.1 Water absorption

For each tile, the water absorption, $E_{(b,v)}$, expressed as a percentage of the dry mass, is calculated using the equation

$$E_{(b,v)} = \frac{m_{2(b,v)} - m_1}{m_1} \times 100$$

where

m_1 is the mass of the dry tile;

m_2 is the mass of the wet tile.

The designation E_b shall be used for the water absorption determined using m_{2b}, and E_v when using m_{2v}. E_b represents water penetration into the easily fillable pores, while E_v represents water penetration into almost all of the open pores.

6.2 Apparent porosity

6.2.1 The external volume, V, expressed in cubic centimetres is calculated using the equation

$$V = m_{2v} - m_3$$

6.2.2 The volume of open pores, V_o, and the volume of the impervious portion, V_i, expressed in cubic centimetres, are given by the equations

$$V_o = m_{2v} - m_1$$

$$V_i = m_1 - m_3$$

6.2.3 The apparent porosity, P, expressed as a percentage, is the relationship of the volume of the open pores of the test specimen to its exterior volume. The apparent porosity is calculated using the equation

$$p = \frac{m_{2v} - m_1}{V} \times 100$$

6.3 Apparent relative density

The apparent relative density, T, of the impervious portion of the test specimen, is calculated using the equation

$$T = \frac{m_1}{m_1 - m_3}$$

6.4 Bulk density

The bulk density, B, expressed in grams per cubic centimetre, of a specimen is the quotient of its dry mass divided by the exterior volume, including pores. The bulk density is calculated using the equation

$$B = \frac{m_1}{V}$$

7 Test report

The test report shall include the following information:

a) reference to this part of ISO 10545;

b) a description of the tiles;

c) for each property determined, report the results for each individual tile;

d) for each property determined, report the average value.

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BSI — British Standards Institution

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Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

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