



BSI Standards Publication

# Ceramic tiles - Definitions, classification, characteristics, evaluation of conformity and marking

**National foreword**

This British Standard is the UK implementation of EN 14411:2012. It supersedes BS EN 14411:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/539, Ceramic tiles and other rigid tiling.

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

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EUROPEAN STANDARD  
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EUROPÄISCHE NORM

**EN 14411**

October 2012

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English Version

**Ceramic tiles - Definitions, classification, characteristics,  
evaluation of conformity and marking**

Carreaux céramiques - Définitions, classification,  
caractéristiques, évaluation de la conformité et marquage

Keramische Fliesen und Platten - Definitionen,  
Klassifizierung, Eigenschaften, Konformitätsbewertung und  
Kennzeichnung

This European Standard was approved by CEN on 10 August 2012.

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## Foreword

This document (EN 14411:2012) has been prepared by Technical Committee CEN/TC 67 "Ceramic tiles", 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of an identical text or by endorsement, at the latest by April 2013, and conflicting national standards shall be withdrawn at the latest by July 2014.

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 document supersedes EN 14411:2006.

The main changes with respect to the previous edition are listed below:

- inclusion of decorative pieces, trims and mosaics;
- no application of ceramic tiles in ceilings;
- consideration of technical specification for slipperiness;
- inclusion of mandated characteristic on tactility, when required;
- rearrangement and readjustment of evaluation of conformity clause according to CEN template;
- modification of dimensional tolerances for group B tiles (Annexes G to L);
- elimination of previous Annex Q on "Additional European requirements on ceramic tiles" (this information is already clarified in the body of the standard);
- Annex ZA: simplification of tables and revised content of simplified marking.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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

## 1 Scope

This European Standard defines terms and specifies characteristics for ceramic tiles produced by extrusion and dry-pressing techniques, used for internal and/or external floorings (including stairs) and walls. Furthermore, it provides the level of requirements for these characteristics and references to the test methods applied (see Note) as well as provisions for evaluation of conformity and marking.

**NOTE** The series of standards EN ISO 10545 describe the test procedures required to determine most of the product characteristics listed in this European Standard. The series is divided into 16 parts, each describing a specific test procedure or related matter.

This European Standard does not cover:

- ceramic tiles made by processes other than extrusion or dry-pressing;
- dry-pressed unglazed ceramic tiles with water absorption greater than 10 %;
- ceramic tiles used for floorings on external road finishes;
- ceramic tiles used in ceiling finishes or suspended ceilings.

## 2 Normative references

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

EN 1015-12, *Methods of test of mortar for masonry — Part 12: Determination of adhesive strength of hardened rendering and plastering mortars on substrates*

EN 12004:2007+A1:2012, *Adhesives for tiles — Requirements, evaluation of conformity, classification and designation*

CEN/TS 15209, *Tactile paving surface indicators produced from concrete, clay and stone*

CEN/TS 16165, *Determination of slip resistance of pedestrian surfaces — Methods of evaluation*

EN ISO 10545-1, *Ceramic tiles — Part 1: Sampling and basis for acceptance (ISO 10545-1)*

EN ISO 10545-2, *Ceramic tiles — Part 2: Determination of dimensions and surface quality (ISO 10545-2)*

EN ISO 10545-3, *Ceramic tiles — Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density (ISO 10545-3)*

EN ISO 10545-4, *Ceramic tiles — Part 4: Determination of modulus of rupture and breaking strength (ISO 10545-4)*

EN ISO 10545-5, *Ceramic tiles — Part 5: Determination of impact resistance by measurement of coefficient of restitution (ISO 10545-5)*

EN ISO 10545-6, *Ceramic tiles — Part 6: Determination of resistance to deep abrasion for unglazed tiles (ISO 10545-6)*

EN ISO 10545-7, *Ceramic tiles — Part 7: Determination of resistance to surface abrasion for glazed tiles (ISO 10545-7)*

EN ISO 10545-8, *Ceramic tiles — Part 8: Determination of linear thermal expansion (ISO 10545-8)*

EN ISO 10545-9, *Ceramic tiles — Part 9: Determination of resistance to thermal shock (ISO 10545-9)*

EN ISO 10545-10, *Ceramic tiles — Part 10: Determination of moisture expansion (ISO 10545-10)*

EN ISO 10545-11, *Ceramic tiles — Part 11: Determination of crazing resistance for glazed tiles (ISO 10545-11)*

EN ISO 10545-12, *Ceramic tiles — Part 12: Determination of frost resistance (ISO 10545-12)*

EN ISO 10545-13, *Ceramic tiles — Part 13: Determination of chemical resistance (ISO 10545-13)*

EN ISO 10545-14, *Ceramic tiles — Part 14: Determination of resistance to stains (ISO 10545-14)*

EN ISO 10545-15, *Ceramic tiles — Part 15: Determination of lead and cadmium given off by glazed tiles (ISO 10545-15)*

EN ISO 10545-16, *Ceramic tiles — Part 16: Determination of small colour differences (ISO 10545-16)*

ISO 1006:1983, *Building construction — Modular coordination — Basic module*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1006:1983 and the following apply.

#### 3.1

##### **ceramic tile**

tile made from clays and/or other inorganic raw materials

Note 1 to entry: Tiles are usually shaped by extruding (Method A) or dry-pressing (Method B) at room temperature followed by drying and firing at temperatures sufficient to develop the required properties, but can be formed by other processes (these are not covered by this European Standard). Tiles can be glazed (GL) or unglazed (UGL).

#### 3.2

##### **porcelain ceramic tile**

fully vitrified ceramic tile with water absorption of 0,5 % or less

Note 1 to entry: See groups Ala and Bla, as given in Table 1.

#### 3.3

##### **glaze**

vitrified covering on ceramic tile

#### 3.4

##### **engobed surface**

clay-based covering with a matt finish which can be permeable or impermeable

Note 1 to entry: A tile with an engobed surface is regarded as an unglazed tile.

#### 3.5

##### **polished surface**

surface of a glazed or unglazed ceramic tile which has been given a glossy finish by mechanical polishing carried out after firing

### 3.6

#### **extruded ceramic tile**

ceramic tile whose body is shaped in the plastic state in an extruder, the column obtained being cut into tiles of pre-determined dimension

Note 1 to entry: 1 This European Standard classifies extruded tiles as “precision” or “natural”. Traditionally they were known as double extruded tiles or split tiles (precision) and single extruded tiles or quarry tiles (natural). Split tiles are produced as a double tile, which is split in two after firing. Split tiles are characterised by typical parallel ridges on their reverse. Quarry tiles are shaped by cutting a single column and are often subsequently dry pressed.

Note 2 to entry: This European Standard classifies extruded tiles upon the different technical characteristics as listed in Annexes A to F and L.

Note 3 to entry: Extruded ceramic tiles include the letter ‘A’ in their classification (see Table 1).

### 3.7

#### **dry-pressed tile**

tile formed from a finely milled body mixture and shaped by pressing

Note 1 to entry: This European Standard classifies dry-pressed tiles upon the different technical characteristics as listed in the Annexes G to K.

Note 2 to entry: Dry-pressed ceramic tiles include the letter ‘B’ in their classification (see Table 1).

### 3.8

#### **spacer lug**

projection which is located along certain edges of tiles so that when two tiles are placed together, in line, the lugs on adjacent edges separate the tiles by a distance not less than the specified width of the joint

Note 1 to entry: Lugs are positioned so that the joint between the tiles may be filled with grout without the lugs remaining exposed.

Note 2 to entry: Dry-pressed tiles may be made with other spacer lug systems and, in such cases, the manufacturer's work size applies.

Note 3 to entry: Figure 1 illustrates a ceramic tile without spacer lugs and Figure 2 ceramic tile with spacer lugs.

### 3.9

#### **water absorption ( $E_b$ )**

percentage (by mass) of water absorbed by the ceramic body

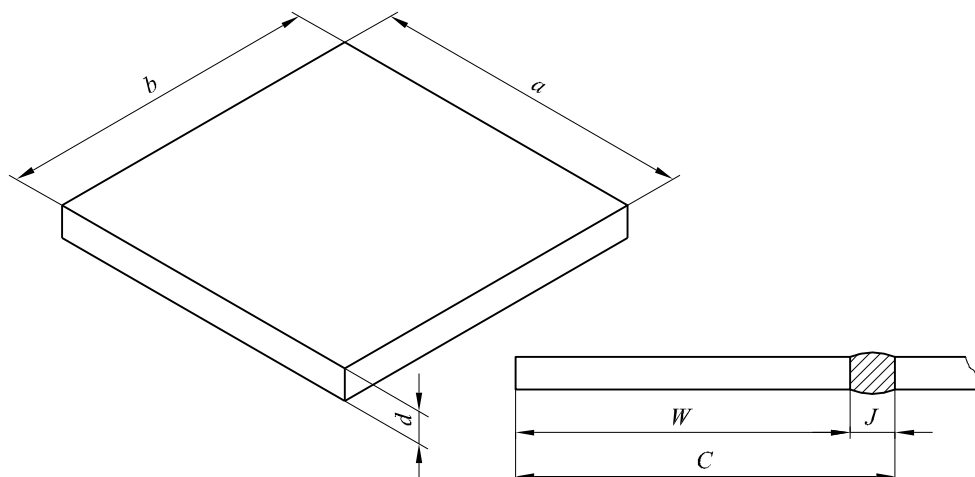
Note 1 to entry: For the purpose of classification (ITT), the test method for water absorption is the boiling method according to EN ISO 10545-3.

### 3.10

#### **nominal size ( $N$ )**

size used to describe the ceramic tile

Note 1 to entry: This and the following sizes are only defined for rectangular tiles. If the sizes of non-rectangular tiles are required, they are defined by the smallest rectangle into which they fit.

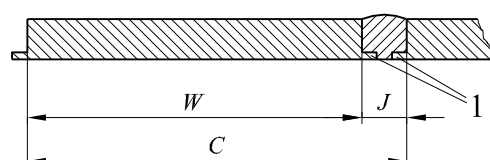


**Key**

coordinating size ( $C$ ) = work size ( $W$ ) + joint ( $J$ )

work size ( $W$ ) = dimension of the visible face ( $a$ ), ( $b$ ) and thickness ( $d$ )

**Figure 1 — Ceramic tile**



**Key**

1 spacer lugs

coordinating size ( $C$ ) = work size ( $W$ ) + joint ( $J$ )

work size ( $W$ ) = dimension of the visible face ( $a$ ), ( $b$ ) and thickness ( $d$ )

**Figure 2 — Ceramic tile with spacer lug**

**3.11**

**work size ( $W$ )**

size of a tile specified for manufacturing to which the actual size conforms within specified permissible deviations

**3.12**

**actual size**

size obtained by measuring the face of the tile

**3.13**

**coordinating size ( $C$ )**

work size plus the joint width

**3.14**

**modular size**

dimensions based on the modules  $M$ , and also their multiples or subdivisions, except for tiles with a surface area of less than 9 000 mm<sup>2</sup>

Note 1 to entry: See ISO 1006, where 1 M = 100 mm.

### 3.15

#### **non-modular size**

size not based on module M

Note 1 to entry: See ISO 1006, where 1 M = 100 mm.

### 3.16

#### **tolerance**

permissible deviation from work size

### 3.17

#### **product group**

ceramic tiles manufactured through a defined process (extrusion or dry pressing) and featuring a specific water absorption (see Table 1)

### 3.18

#### **family in a product group**

ceramic tiles manufactured for which the test results of any tile within the family are valid for all other tiles within the family

Note 1 to entry: Families can be defined in terms of body characteristics (same composition, size and thickness) or surface finish characteristics (same glaze and/or decoration composition and properties).

## 4 Classification of ceramic tiles

Ceramic tiles shall be classified into groups according to two parameters: by their method of manufacture (also referred to 'shaping') that is, extrusion (method A) or dry-pressing (method B), and by their water absorption level (see 3.9 and Table 1). The groups do not presuppose the usage of the products. The requirements for each product group shall be as given in Annexes A to L.

**Table 1 — Classification of ceramic tiles with respect to water absorption and shaping**

| Shaping                 | Water absorption ( $E_b$ )                                         |                                                         |                                                         |                                          |
|-------------------------|--------------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|------------------------------------------|
|                         | Group I<br>$E_b \leq 3 \%$                                         | Group II <sub>a</sub><br>$3 \% < E_b \leq 6 \%$         | Group II <sub>b</sub><br>$6 \% < E_b \leq 10 \%$        | Group III<br>$E_b > 10 \%$               |
| Method A<br>Extruded    | Group AI <sub>a</sub><br>$E_b \leq 0,5 \%$<br>(see Annex L)        | Group AII <sub>a-1</sub> <sup>a)</sup><br>(see Annex B) | Group AII <sub>b-1</sub> <sup>a)</sup><br>(see Annex D) | Group AIII<br>(see Annex F)              |
|                         | Group AI <sub>b</sub><br>$0,5 \% < E_b \leq 3 \%$<br>(see Annex A) | Group AII <sub>a-2</sub> <sup>a)</sup><br>(see Annex C) | Group AII <sub>b-2</sub> <sup>a)</sup><br>(see Annex E) |                                          |
| Method B<br>Dry-pressed | Group BI <sub>a</sub><br>$E_b \leq 0,5 \%$<br>(see Annex G)        | Group BII <sub>a</sub><br>(see Annex I)                 | Group BII <sub>b</sub><br>(see Annex J)                 | Group BIII <sub>b</sub><br>(see Annex K) |
|                         | Group BI <sub>b</sub><br>$0,5 \% < E_b \leq 3 \%$<br>(see Annex H) |                                                         |                                                         |                                          |

a) Groups AII<sub>a</sub> and AII<sub>b</sub> are divided into two parts (Parts 1 and 2) with different product specification. Part 1 covers most of the tiles in the group; Part 2 covers certain specific products, which are manufactured under different names (e.g. terre cuite in France and Belgium, cotto in Italy and baldosin catalán in Spain).

b) Group BIII covers glazed ceramic tiles only. There is a low quantity of dry-pressed unglazed tiles produced with water absorption greater than 10 % that is not covered by this product group.

## 5 Requirements

### 5.1 General

Ceramic tiles are generally classified according to the level of compliance with this European Standard.

Ceramic tiles complying with both the mandatory and voluntary requirements (see Table 2) of this European Standard can be designated as first quality.

### 5.2 Characteristics

The characteristics of ceramic tiles relevant for different applications shall be as given in Table 2.

Requirements for these characteristics, i.e. for dimensional and surface quality as well as those for physical and chemical properties shall be as given in the specific annex according to the product group (Annexes A to L).

Characteristics given in Table 2 in “plain” text are relevant to all intended uses, while those in “italics” are additionally relevant for specific intended use(s) only. Characteristics, given in “bold” text, are the mandated essential characteristics or the corresponding proxy characteristics (for CE marking, see Annex ZA) and those in “normal” text, the voluntary characteristics (not for CE marking).

Table 2 — Characteristics of ceramic tiles required for different applications

| Characteristics <sup>a)</sup> |                                                                                   | Floorings |          | Walls    |          | Test method                      |
|-------------------------------|-----------------------------------------------------------------------------------|-----------|----------|----------|----------|----------------------------------|
| A)                            | Dimensions and surface quality                                                    | Interior  | Exterior | Interior | Exterior | Reference                        |
| A.1                           | Length and width                                                                  | X         | X        | X        | X        | EN ISO 10545-2                   |
| A.2                           | Thickness                                                                         | X         | X        | X        | X        | EN ISO 10545-2                   |
| A.3                           | Straightness of sides (i.e. facial sides) <sup>b)</sup>                           | X         | X        | X        | X        | EN ISO 10545-2                   |
| A.4                           | Rectangularity <sup>b)</sup>                                                      | X         | X        | X        | X        | EN ISO 10545-2                   |
| A.5                           | Surface flatness (curvature and warpage)                                          | X         | X        | X        | X        | EN ISO 10545-2                   |
| A.6                           | Surface quality                                                                   | X         | X        | X        | X        | EN ISO 10545-2                   |
| B)                            | Physical properties                                                               | Interior  | Exterior | Interior | Exterior | Reference                        |
| B.1                           | Water absorption                                                                  | X         | X        | X        | X        | EN ISO 10545-3                   |
| <b>B.2</b>                    | <b>Breaking strength<sup>c)</sup></b>                                             | <b>X</b>  | <b>X</b> | <b>X</b> | <b>X</b> | <b>EN ISO 10545-4</b>            |
| B.3                           | Flexural tensile strength <sup>d)</sup> or Modulus of rupture <sup>d)</sup>       | X         | X        | X        | X        | EN ISO 10545-4                   |
| B.4 a)                        | Resistance to deep abrasion – unglazed tiles                                      | X         | X        |          |          | EN ISO 10545-6                   |
| B.4 b)                        | Resistance to surface abrasion – glazed tiles <sup>c)</sup>                       | X         | X        |          |          | EN ISO 10545-7                   |
| B.5                           | Linear thermal expansion <sup>e)</sup>                                            | X         | X        | X        | X        | EN ISO 10545-8                   |
| <b>B.6</b>                    | <b>Resistance to thermal shock<sup>f)</sup></b>                                   | X         | X        | X        | <b>X</b> | <b>EN ISO 10545-9</b>            |
| B.7                           | Resistance to crazing <sup>g)</sup>                                               | X         | X        | X        | X        | EN ISO 10545-11                  |
| <b>B.8</b>                    | <b>Freeze-thaw resistance<sup>h)</sup></b>                                        |           | <b>X</b> |          | <b>X</b> | <b>EN ISO 10545-12</b>           |
| <b>B.9</b>                    | <b>Slipperiness<sup>i)</sup></b>                                                  | <b>X</b>  | <b>X</b> |          |          | <b>CEN/TS 16165<sup>j)</sup></b> |
| <b>B.10 a)</b>                | <b>Bond strength/adhesion<sup>k)</sup> – cementitious adhesives</b>               |           |          | <b>X</b> | <b>X</b> | EN 12004:2007+A1:2012, 4.1       |
| <b>B.10 b)</b>                | <b>Bond strength/adhesion<sup>k)</sup> – dispersion adhesives</b>                 |           |          | <b>X</b> | <b>X</b> | EN 12004:2007+A1:2012, 4.2       |
| <b>B.10 c)</b>                | <b>Bond strength/adhesion<sup>k)</sup> – reaction resin adhesives</b>             |           |          | <b>X</b> | <b>X</b> | EN 12004:2007+A1:2012, 4.3       |
| <b>B.10 d)</b>                | <b>Bond strength/adhesion<sup>k)</sup> – mortar</b>                               |           |          | <b>X</b> | <b>X</b> | EN 1015-12                       |
| B.11                          | Moisture expansion <sup>l)</sup>                                                  | X         | X        | X        | X        | EN ISO 10545-10                  |
| B.12                          | Small colour differences <sup>m)</sup>                                            | X         | X        | X        | X        | EN ISO 10545-16                  |
| B.13                          | Impact resistance <sup>n)</sup>                                                   | X         | X        |          |          | EN ISO 10545-5                   |
| <b>B.14</b>                   | <b>Reaction to fire<sup>o)</sup></b>                                              | <b>X</b>  |          | <b>X</b> | <b>X</b> | WT                               |
| <b>B.15</b>                   | <b>Tactility<sup>p)</sup></b>                                                     | <b>X</b>  | <b>X</b> |          |          | <b>CEN TS 15209<sup>j)</sup></b> |
| C)                            | Chemical properties                                                               | Interior  | Exterior | Interior | Exterior | Reference                        |
| C.1 a)                        | Resistance to staining – glazed tiles <sup>q)</sup>                               | X         | X        | X        | X        | EN ISO 10545-14                  |
| C.1 b)                        | Resistance to staining – unglazed tiles <sup>q)</sup>                             | X         | X        | X        | X        | EN ISO 10545-14                  |
| C.2 a)                        | Resistance to acids and alkalis of low concentration <sup>r)</sup>                | X         | X        | X        | X        | EN ISO 10545-13                  |
| C.2 b)                        | Resistance to acids and alkalis of high concentration <sup>r)</sup>               | X         | X        | X        | X        | EN ISO 10545-13                  |
| C.2 c)                        | Resistance to household cleaning agents and swimming pool chemicals <sup>r)</sup> | X         | X        | X        | X        | EN ISO 10545-13                  |
| <b>C.3 a)</b>                 | <b>Release of cadmium – glazed tiles<sup>t)</sup></b>                             | <b>X</b>  | <b>X</b> | <b>X</b> | <b>X</b> | <b>EN ISO 10545-15</b>           |
| <b>C.3 b)</b>                 | <b>Release of lead – glazed tiles<sup>t)</sup></b>                                | <b>X</b>  | <b>X</b> | <b>X</b> | <b>X</b> | <b>EN ISO 10545-15</b>           |
| <b>C.3 c)</b>                 | <b>Release of other dangerous substances<sup>s)</sup></b>                         | <b>X</b>  | <b>X</b> | <b>X</b> | <b>X</b> | <b>As relevant</b>               |

**Table 2** (*continued*)

- a) Requirements for these characteristics are given in Annexes A to L.
- b) Not applicable for ceramic tiles having curved shapes.
- c) For floorings only.
- d) For walls only.
- e) See N.2.2.
- f) For ceramic tiles, which intended use is subject to localised thermal shock.
- g) For glazed ceramic tiles only.
- h) For ceramic tiles that are intended to be used where frost may apply.
- i) For floorings on pedestrian circulation areas (where required by regulations).
- j) Unless a different test method is required by national regulations in the market of the relevant Member State(s) for the intended use, in which case the test method and results shall be declared as given therein.
- k) For walls when performing the test with actual ceramic tiles and suitable adhesive(s) or mortar only.
- l) See N.2.3.
- m) See N.2.6.
- n) See N.2.1.
- o) For ceramic tiles intended to be used for internal floorings and for internal and external walls only.
- p) For tactile paving surfaces only i.e. when required for blind or vision impaired persons.
- q) See N.2.5.
- r) See N.2.4.
- s) When relevant, see Notes 1 and 2 in ZA.1 for release of other dangerous substances, if any.
- t) For glazed ceramic tiles only, when intended to be used on worktops and on wall surfaces where food preparation takes place and food may be in direct contact with the glazed tile surface. As indicative limits, reference could be made to Directive 2005/31/CE.

## 6 Evaluation of conformity

### 6.1 General

The conformity of ceramic tiles within a family in a product group with the requirements of this European Standard and with the declared performances (i.e. classes, values) of the characteristics of these tiles according to their intended use shall be demonstrated by:

- initial type testing;
- factory production control by the manufacturer, including product assessment.

For the purposes of initial type testing, ceramic tiles may be grouped into product families where it is considered that the results for one or more characteristics from any ceramic tile in the family are representative for all tiles within that family. However, a ceramic tile may be in different product families for different characteristics.

### 6.2 Initial type testing

#### 6.2.1 General

Initial type testing (ITT) shall be carried out to confirm that the characteristics of a family of ceramic tiles relevant to their intended use meet the requirements of this European Standard.

All those characteristics of ceramic tiles given in Table 3, the performances of which are to be declared for the relevant intended use, shall be subject to initial type testing.

NOTE 1 Initial Type Testing (ITT) in this standard is relevant for the characteristics specified in Tables ZA.1.1 and ZA.1.2, the performances of which are to be declared for the relevant intended uses of ceramic tiles as indicated in Table 2.

NOTE 2 Performances of most of these characteristics are to be obtained by testing. However, the performance of some of them may be obtained without need for testing.

In addition, ITT shall be performed for the declared characteristics in the case of significant modifications in the composition of the ceramic tiles (unless it concerns a member of the same family) or in their manufacturing process.

Tests previously performed in accordance with the provisions of this European Standard (i.e. same product, same characteristic(s), same or more rigorous test method, same sampling procedure, system of attestation of conformity etc. so that the results are applicable to the products in question) may be taken into account for the purposes of ITT.

Where a manufacturer produces the same product on more than one production line or unit, or in more than one factory, using the same raw materials and provided that the production equipment and/or production line or unit does not influence the declared performances, there is no need to repeat the ITT for these lines or various factories. It is the manufacturer's responsibility to ensure that the tiles are indeed the same.

The results of the ITT shall be recorded and be available for inspection for at least ten years after the date of last production of the family of ceramic tiles to which they relate.

## **6.2.2 Test samples, testing and compliance criteria**

The sampling and basis for acceptance shall be in accordance with EN ISO 10545-1. For the characteristics of bond strength and tactility, refer to the relevant standard, that is, EN 12004 and EN 1015-12 for bond strength and CEN/TS 15209 for tactility.

## **6.3 Factory production control (FPC)**

### **6.3.1 General requirements**

The manufacturer shall establish, document and maintain an FPC system to ensure that the ceramic tiles placed on the market comply with the declared performances of their characteristics, which were declared on a basis of ITT for the relevant intended use.

The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the ceramic tiles.

NOTE An FPC system conforming to the requirements of EN ISO 9001, and which addresses the requirements of this standard, is considered to satisfy the FPC requirements.

The FPC shall achieve an appropriate level of confidence in the conformity of the product. This involves:

- documented procedures and instructions relating to FPC operations;
- the effective implementation of these procedures and instruction;
- the recording of these operations (inspections, tests, assessments) and results;
- the use of these results to correct any deviations, repair the effects of such deviations, treat any resulting instances of non-conformity and, if necessary, revise the FPC to rectify the cause of non-conformity.

The results of inspections, tests or assessments requiring action shall be recorded, as shall any action taken. The action to be taken when control values or criteria are not met shall be recorded and retained for the period specified in the manufacturer's FPC procedures.

Where subcontracting takes place, the manufacturer shall retain the overall control of the product and ensure that he receives all the information that is necessary to fulfil his responsibilities according to this European Standard.

If the manufacturer has part of the product designed, manufactured, assembled, packed, processed and/or labelled by subcontracting, the FPC of the subcontractor may be taken into account, where appropriate for the product in question.

### **6.3.2 Equipment**

The manufacturer shall maintain and apply documented procedures to control, calibrate and maintain inspection, measuring and test equipment, used to demonstrate the compliance of the ceramic tiles to the specified requirements. Equipment shall be used in a manner, which ensures that measurement uncertainty is known and is consistent with the required measurement capability.

Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

### **6.3.3 Product testing and evaluation**

The manufacturer shall carry out all final inspection and testing in accordance with the quality control plan or documented procedures to complete the evidence of compliance of the ceramic tiles to the specified requirements.

The tests shall be carried out for each characteristic, which performance has been established under ITT and declared within a family of ceramic tiles according to the relevant test methods.

For the characteristics listed in Tables ZA.1.1 and/or ZA.1.2, the tests shall be carried out with the minimum frequency as given in Table 3 (see Note 1). For all remaining characteristics listed in Table 2, the minimum frequencies of testing shall be defined in the manufacturer's quality control plan taking into account the production organisation (see Note 1).

Nevertheless, each of these characteristics should be controlled more often, if possible, and with the appropriate parameter(s) related to such characteristics (e.g. composition), according to relevant direct or indirect test or assessment method(s). All these should be specified in the manufacturer's quality control plan.

Indirect testing or the use of test methods different from those used for ITT is allowed, if a relationship correlation between the result of the FPC test method and that of the ITT method (e.g. controls carried out on the production line) is established, which ensures the compliance of the ceramic tiles to the specified requirements.

Whenever practicable, the repetition of tests on the same ceramic tiles within one family shall be avoided, in order to check as many different tiles as possible among the ones manufactured during the control period.

Non-complying products shall be treated according to written procedures, including the relevant responsibilities. The corrective actions to be taken shall be recorded.

### **6.3.4 Inspection and test records**

The manufacturer shall maintain records in order to be able to prove that a ceramic tile or a family of ceramic tiles in a group of products has been inspected and/or tested. The records shall contain, as a minimum, a product's description, including description of the relevant family in a group of products, date of manufacture, test method, test results, date of test and compliance criteria.

These records shall show clearly whether the ceramic tiles have passed or failed the inspections and/or tests according to defined acceptance criteria.

Records of tests on ceramic tiles (according to Table 3) shall be maintained for ten years. Records on the remaining tests shall be maintained according to what specified in the manufacturer's quality control plan.

**Table 3 — Test methods and minimum frequency of FPC testing for ceramic tiles**

| Characteristic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Test method               | Requirements <sup>a</sup>     | Minimum frequency        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------|--------------------------|
| Breaking strength <sup>c</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | EN ISO 10545-4            | B.2                           | Once a month             |
| Resistance to thermal shock <sup>b</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EN ISO 10545-9            | B.6                           | Once a year              |
| Freeze-thaw resistance <sup>b</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EN ISO 10545-12           | B.8                           | Once a year              |
| Slipperiness <sup>d</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CEN/TS 16165 <sup>e</sup> | B.9                           | Once a year <sup>f</sup> |
| Tactility <sup>d</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CEN/TS 15209 <sup>e</sup> | B.15                          | Once a year <sup>g</sup> |
| Bond strength/adhesion <sup>b</sup> , for:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                           |                               |                          |
| a) cementitious adhesives<br>b) dispersion adhesives<br>c) reaction resin adhesives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EN 12004                  | B.10 a)<br>B.10 b)<br>B.10 c) | Once per product group   |
| d) mortar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | EN 1015-12                | B.10 d)                       |                          |
| Reaction to fire                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | —                         | B.14                          | —                        |
| Release of other dangerous substances <sup>d</sup> (see Notes 1 & 2 in ZA.1) of:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                           |                               |                          |
| - Lead and Cadmium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EN 10545-15               | C.3 a), b)                    | Once a year              |
| <p>a For reference to the requirement see relevant Tables A.1 to L.1.</p> <p>b Testing for a product group.</p> <p>c Testing for a family in a group of products (group of absorption, dimensions and thickness).</p> <p>d Testing for a family in a group of products (finish surface characteristics, same composition and properties).</p> <p>e Unless a different test method is required by national regulations in the market of the relevant Member State(s) for the intended use, in which case the test method and results shall be declared as given therein (as long as a consolidated European test method is not available).</p> <p>f For floorings on pedestrian circulation areas (where required by regulation).</p> <p>g For tactile paving surfaces only i.e. when required for blind or vision impaired persons.</p> |                           |                               |                          |

## 7 Designation

Where required, the symbols, specified in Annex O, may be used for indication of the intended use of ceramic tiles as well as for the expressions of the names and/or performances of some of their characteristics.

## 8 Marking

Each ceramic tile covered by this European Standard shall bear on its reverse side or edge, the indication of the country where the tile was manufactured.

Furthermore, each packaging of ceramic tiles shall bear the following marking information:

- manufacturer's mark and/or trademark and indication of the country where the tile was manufactured, that is, the country where the tile was first fired;
- indication of quality designation, when relevant (see 5.1);
- reference to the appropriate annex of this European Standard, i.e. EN 14411:2012, and classification ("Precision" or "Natural"), where applicable;

- d) nominal and work sizes;
- e) nature of the surface, i.e. glazed (GL) or unglazed (UGL);
- f) surface treatment applied after firing, if any;
- g) maximum total dry weight of a packaging of ceramic tiles.

EXAMPLE 1 Ceramic tile of 1<sup>st</sup> quality EN 14411, Annex A, Precision  
25 cm × 12,5 cm (W 240 mm × 115 mm × 10 mm) GL  
Polished, Max. dry weight: ... kg

EXAMPLE 2 Ceramic tile of the 1<sup>st</sup> quality EN 14411, Annex A, Natural  
15 cm × 15 cm (W 150 mm × 150 mm × 12 mm) UGL  
Max. dry weight: ... kg

## Annex A (normative)

### Requirements for extruded ceramic tiles of Group A<sub>b</sub> (0,5 % < $E_b$ ≤ 3 %)

Requirements for dimensions and surface quality and for physical and chemical properties of this group of ceramic tiles shall be in accordance with Table A.1.

**Table A.1 — Requirements for extruded ceramic tiles, Group A<sub>b</sub>, (0,5 % <  $E_b$  ≤ 3 %)**

| Characteristics                                                                                                                        | Requirements for                                                                        |                                | Test method    |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------|----------------|
|                                                                                                                                        | Precision                                                                               | Natural                        |                |
| A) DIMENSIONS AND SURFACE QUALITY                                                                                                      |                                                                                         |                                |                |
| A.1 Length and width                                                                                                                   |                                                                                         |                                |                |
| The work size shall be chosen as follows for:                                                                                          |                                                                                         |                                |                |
| a) modular tiles:                                                                                                                      | in order to allow a nominal joint width of between 3 and 11 mm <sup>a</sup>             |                                | –              |
| b) non-modular tiles:                                                                                                                  | so that the difference between the work size and the nominal size is not more than 3 mm |                                | –              |
| The permissible deviation, of the average size for each tile (2 or 4 sides) from the work size ( <i>W</i> )                            | ± 1,0 % to a maximum of ± 2 mm                                                          | ± 2,0 % to a maximum of ± 4 mm | EN ISO 10545-2 |
| The permissible deviation of the average size for each tile (2 or 4 sides) from the average size of 10 test specimens (20 or 40 sides) | ± 1,0 %                                                                                 | ± 1,5 %                        | EN ISO 10545-2 |
| A.2 Thickness                                                                                                                          |                                                                                         |                                |                |
| a) The thickness shall be specified                                                                                                    | Declared thickness                                                                      |                                | –              |
| b) The permissible deviation, of the average thickness of each tile from the work size thickness                                       | ± 10 %                                                                                  | ± 10 %                         | EN ISO 10545-2 |
| A.3 Straightness of sides <sup>b</sup><br>(facial sides)                                                                               |                                                                                         |                                |                |
| The maximum permissible deviation from straightness, related to the corresponding work sizes.                                          | ± 0,5 %                                                                                 | ± 0,6 %                        | EN ISO 10545-2 |
| A.4 Rectangularity <sup>b</sup>                                                                                                        |                                                                                         |                                |                |
| The maximum permissible deviation from rectangularity, related to the corresponding work sizes                                         | ± 1,0 %                                                                                 | ± 1,0 %                        | EN ISO 10545-2 |

Table A.1 (continued)

| Characteristics                                                                           | Requirements for                                                                                                            |                                                                                       | Test method                  |
|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------|
|                                                                                           | Precision                                                                                                                   | Natural                                                                               |                              |
| A) DIMENSIONS AND SURFACE QUALITY                                                         |                                                                                                                             |                                                                                       |                              |
| A.5 Surface flatness                                                                      |                                                                                                                             |                                                                                       |                              |
| The maximum permissible deviation from flatness:                                          |                                                                                                                             |                                                                                       |                              |
| a) centre curvature, related to diagonal calculated from the work sizes                   | ± 0,5 %                                                                                                                     | ± 1,5 %                                                                               | EN ISO 10545-2               |
| b) edge curvature, related to the corresponding work sizes                                | ± 0,5 %                                                                                                                     | ± 1,5 %                                                                               | EN ISO 10545-2               |
| c) warpage related to diagonal calculated from the work sizes                             | ± 0,8 %                                                                                                                     | ± 1,5 %                                                                               | EN ISO 10545-2               |
| A.6 Surface quality <sup>c</sup>                                                          | A minimum of 95 % of the tiles shall be free from visible defects that would impair the appearance of a major area of tiles |                                                                                       | EN ISO 10545-2               |
| B) PHYSICAL PROPERTIES                                                                    |                                                                                                                             |                                                                                       |                              |
| B.1 Water absorption<br>(% by mass)                                                       | 0,5 % < E <sub>b</sub> ≤ 3,0 %<br>Individual max. 3,3 %                                                                     | 0,5 % < E <sub>b</sub> ≤ 3,0 %<br>Individual max. 3,3 %                               | EN ISO 10545-3               |
| B.2 Breaking strength, for:                                                               |                                                                                                                             |                                                                                       |                              |
| a) Thickness ≥ 7,5 mm                                                                     | Not less than 1 100 N                                                                                                       | Not less than 1 100 N                                                                 | EN ISO 10545-4               |
| b) Thickness < 7,5 mm                                                                     | Not less than 600 N                                                                                                         | Not less than 600 N                                                                   | EN ISO 10545-4               |
| B.3 Flexural tensile strength or modulus of rupture <sup>d</sup>                          | Average minimum<br>23 N/mm <sup>2</sup><br>Individual minimum<br>18 N/mm <sup>2</sup>                                       | Average minimum<br>23 N/mm <sup>2</sup><br>Individual minimum<br>18 N/mm <sup>2</sup> | EN ISO 10545-4               |
| B.4 Abrasion resistance, as:                                                              |                                                                                                                             |                                                                                       |                              |
| a) Resistance to deep abrasion of unglazed tiles: removed volume                          | Maximum 275 mm <sup>3</sup>                                                                                                 | Maximum 275 mm <sup>3</sup>                                                           | EN ISO 10545-6               |
| b) Resistance to surface abrasion of glazed tiles intended for use on floors <sup>e</sup> | Abrasion class and cycles passed                                                                                            | Abrasion class and cycles passed                                                      | EN ISO 10545-7               |
| B.5 Coefficient of linear thermal expansion:                                              |                                                                                                                             |                                                                                       |                              |
| – from ambient temperature to 100 °C                                                      | Declared value <sup>f</sup>                                                                                                 | Declared value <sup>f</sup>                                                           | EN ISO 10545-8               |
| B.6 Thermal shock resistance                                                              | Pass according to EN ISO 10545-1 <sup>g</sup>                                                                               |                                                                                       | EN ISO 10545-9               |
| B.7 Crazing resistance:<br>glazed tiles <sup>h</sup>                                      | Pass according to EN ISO 10545-1 <sup>g</sup>                                                                               |                                                                                       | EN ISO 10545-11 <sup>h</sup> |
| B.8 Frost resistance                                                                      | Pass according to EN ISO 10545-1 <sup>g</sup>                                                                               |                                                                                       | EN ISO 10545-12              |
| B.9 Slipperiness                                                                          | Declared value(s) g                                                                                                         |                                                                                       | CEN/TS 16165 i               |

Table A.1 (continued)

| Characteristics                                                                                                                                                                                                                                                                                                                                                                                                                    | Requirements for                             |                 | Test method                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------|-----------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                    | Precision                                    | Natural         |                                         |
| B) PHYSICAL PROPERTIES                                                                                                                                                                                                                                                                                                                                                                                                             |                                              |                 |                                         |
| B.10 Bond strength/adhesion <sup>j</sup> , for:                                                                                                                                                                                                                                                                                                                                                                                    |                                              |                 |                                         |
| a) cementitious adhesives <sup>k</sup>                                                                                                                                                                                                                                                                                                                                                                                             | Declared value(s)                            |                 | EN 12004:2007+A1:2012, 4.1 <sup>l</sup> |
| b) dispersion adhesives <sup>k</sup>                                                                                                                                                                                                                                                                                                                                                                                               | Declared value(s)                            |                 | EN 12004:2007+A1:2012, 4.2 <sup>l</sup> |
| c) reaction resin adhesives <sup>k</sup>                                                                                                                                                                                                                                                                                                                                                                                           | Declared value(s)                            |                 | EN 12004:2007+A1:2012, 4.3 <sup>l</sup> |
| d) mortar                                                                                                                                                                                                                                                                                                                                                                                                                          | Declared value(s)                            |                 | EN 1015-12 <sup>l</sup>                 |
| B.11 Moisture expansion (in mm/m)                                                                                                                                                                                                                                                                                                                                                                                                  | Declared value <sup>f</sup>                  |                 | EN ISO 10545-10                         |
| B.12 Small colour differences <sup>f</sup> for:                                                                                                                                                                                                                                                                                                                                                                                    |                                              |                 |                                         |
| a) Glazed tiles                                                                                                                                                                                                                                                                                                                                                                                                                    | $\Delta E_{\text{cmc}} < 0,75$               |                 | EN ISO 10545-16                         |
| b) Unglazed tiles                                                                                                                                                                                                                                                                                                                                                                                                                  | $\Delta E_{\text{cmc}} < 1,0$                |                 | EN ISO 10545-16                         |
| B.13 Impact resistance, as:                                                                                                                                                                                                                                                                                                                                                                                                        |                                              |                 |                                         |
| – Coefficient of restitution (COR)                                                                                                                                                                                                                                                                                                                                                                                                 | Declared value <sup>f</sup>                  |                 | EN ISO 10545-5                          |
| B.14 Reaction to fire                                                                                                                                                                                                                                                                                                                                                                                                              | (Class A1 or A1 <sub>FL</sub> ) <sup>m</sup> |                 | –                                       |
| B.15 Tactility <sup>n</sup>                                                                                                                                                                                                                                                                                                                                                                                                        | Declare surface description <sup>g</sup>     |                 | CEN/TS 15209 <sup>i</sup>               |
| C) CHEMICAL PROPERTIES                                                                                                                                                                                                                                                                                                                                                                                                             |                                              |                 |                                         |
| C.1 Resistance to staining, for:                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |                 |                                         |
| a) Glazed tiles                                                                                                                                                                                                                                                                                                                                                                                                                    | Minimum Class 3                              | Minimum Class 3 | EN ISO 10545-14                         |
| b) Unglazed tiles                                                                                                                                                                                                                                                                                                                                                                                                                  | Declared value <sup>f</sup>                  |                 | EN ISO 10545-14                         |
| C.2 Resistance to chemicals:                                                                                                                                                                                                                                                                                                                                                                                                       |                                              |                 |                                         |
| a) Resistance to low concentrations of acids and alkalis                                                                                                                                                                                                                                                                                                                                                                           | Declared value <sup>f</sup>                  |                 | EN ISO 10545-13                         |
| b) Resistance to high concentrations of acids and alkalis                                                                                                                                                                                                                                                                                                                                                                          | Declared value <sup>f</sup>                  |                 | EN ISO 10545-13                         |
| c) Resistance to household chemicals and swimming pool salts                                                                                                                                                                                                                                                                                                                                                                       | Minimum class B                              | Minimum class B | EN ISO 10545-13                         |
| C.3 Release of dangerous substances                                                                                                                                                                                                                                                                                                                                                                                                |                                              |                 |                                         |
| a) Cadmium (in mg/dm <sup>2</sup> )                                                                                                                                                                                                                                                                                                                                                                                                | Declared value <sup>g</sup>                  |                 | EN ISO 10545-15                         |
| b) Lead (in mg/dm <sup>2</sup> )                                                                                                                                                                                                                                                                                                                                                                                                   | Declared value <sup>g</sup>                  |                 | EN ISO 10545-15                         |
| c) other dangerous substances <sup>o</sup>                                                                                                                                                                                                                                                                                                                                                                                         | Declared value                               |                 | As relevant                             |
| a Similar joint widths may be used to apply to traditional systems based on non-metric sizes.                                                                                                                                                                                                                                                                                                                                      |                                              |                 |                                         |
| b Not applicable for tiles having curved shapes.                                                                                                                                                                                                                                                                                                                                                                                   |                                              |                 |                                         |
| c Because of firing, slight variations from the standard colour are unavoidable. This does not apply to intentional irregularities of colour variation of the face of tiles (which can be unglazed, glazed or partly glazed) or to the colour variation over a tile area which is characteristic of the given tile and desirable. Spots or coloured dots which are introduced for decorative purposes are not considered a defect. |                                              |                 |                                         |

**Table A.1** (*concluded*)

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| d | Not applicable to ceramic tiles with breaking strength > 3 000 N.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| e | Where required, the abrasion class resistance according to Annex M may be declared.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| f | See Annex N Additional information on applicability.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| g | See Table 2 for uses where it is applicable.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| h | Certain decorative effects may have a tendency to craze. They are to be identified by the manufacturer, in which case the crazing test given in EN ISO 10545-11 is not applicable.                                                                                                                                                                                                                                                                                                                    |
| i | Unless a different test method is required by national regulations in the market of the relevant Member State(s) for the intended use, in which case the test method and results shall be declared as given therein (as long as a consolidated European test method is not available).                                                                                                                                                                                                                |
| j | For intended uses subject to requirements against accidental fall of objects on to transit areas only. Tests are to be performed using the actual tiles and suitable adhesive and/or mortar.                                                                                                                                                                                                                                                                                                          |
| k | For the types of adhesives, defined in EN 12004:2007+A1:2012 only.                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| l | The proposed test methods are intended to determine the adhesion strength of adhesive and have not been developed to determine ceramic tile characteristics. Thus, there might be no correlation between the declared bond strength and the performance of the tile in use (other factors like proper installation techniques and type of background support will influence the final performance).                                                                                                   |
| m | Ceramic, as a homogeneously distributed material used for ceramic tiles, is considered a material of known and stable performance with respect to the reaction to fire performance as it does not consist of any organic material. As such, it does not contribute to the fire and it may be considered without the need for testing (CWT) as the Class A1 material <sup>1</sup> . The reaction to fire performance of ceramic tiles may also be classified also as Class A1 according to EN 13501-1. |
| n | For tactile paving surfaces only i.e. when required for blind or vision impaired persons.                                                                                                                                                                                                                                                                                                                                                                                                             |
| o | When relevant, see Notes 1 and 2 in ZA.1 for the performance of the product concerning this characteristic, if any to be declared.                                                                                                                                                                                                                                                                                                                                                                    |

<sup>1</sup>) Commission Decision 96/603/EC, as amended (see Bibliography, [1]).

## Annex B (normative)

### Requirements for extruded ceramic tiles of Group All<sub>a-1</sub> (3 % < $E_b$ ≤ 6 %)

Requirements for dimensions and surface quality and for physical and chemical properties of this group of ceramic tiles shall be in accordance with Table B.1.

**Table B.1 — Requirements for extruded ceramic tiles, Group All<sub>a-1</sub>, (3 % <  $E_b$  ≤ 6 %)**

| Characteristics                                                                                                                        | Requirements for                                                                        |                                | Test method    |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------|----------------|
|                                                                                                                                        | Precision                                                                               | Natural                        |                |
| A) DIMENSIONS AND SURFACE QUALITY                                                                                                      |                                                                                         |                                |                |
| A.1 Length and width                                                                                                                   |                                                                                         |                                |                |
| The work size shall be chosen as follows for:                                                                                          |                                                                                         |                                |                |
| a) modular tiles:                                                                                                                      | in order to allow a nominal joint width of between 3 and 11 mm <sup>a</sup>             |                                | —              |
| b) non-modular tiles:                                                                                                                  | so that the difference between the work size and the nominal size is not more than 3 mm |                                | —              |
| The permissible deviation, of the average size for each tile (2 or 4 sides) from the work size ( <i>W</i> )                            | ± 1,25 % to a maximum of ± 2 mm                                                         | ± 2,0 % to a maximum of ± 4 mm | EN ISO 10545-2 |
| The permissible deviation of the average size for each tile (2 or 4 sides) from the average size of 10 test specimens (20 or 40 sides) | ± 1,0 %                                                                                 | ± 1,5 %                        | EN ISO 10545-2 |
| A.2 Thickness                                                                                                                          |                                                                                         |                                |                |
| a) The thickness shall be specified                                                                                                    | Declared thickness                                                                      |                                | —              |
| b) The permissible deviation, of the average thickness of each tile from the work size thickness                                       | ± 10 %                                                                                  | ± 10 %                         | EN ISO 10545-2 |
| A.3 Straightness of sides <sup>b</sup><br>(facial sides)                                                                               |                                                                                         |                                |                |
| The permissible maximum deviation from straightness, related to the corresponding work sizes                                           | ± 0,5 %                                                                                 | ± 0,6 %                        | EN ISO 10545-2 |

Table B.1 (continued)

| Characteristics                                                                                | Requirements for                                                                                                            |                                                                                       | Test method                  |
|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------|
|                                                                                                | Precision                                                                                                                   | Natural                                                                               |                              |
| A) DIMENSIONS AND SURFACE QUALITY                                                              |                                                                                                                             |                                                                                       |                              |
| A.4 Rectangularity <sup>b</sup>                                                                |                                                                                                                             |                                                                                       |                              |
| The maximum permissible deviation from rectangularity, related to the corresponding work sizes | ± 1,0 %                                                                                                                     | ± 1,0 %                                                                               | EN ISO 10545-2               |
| A.5 Surface flatness                                                                           |                                                                                                                             |                                                                                       |                              |
| The maximum permissible deviation from flatness:                                               |                                                                                                                             |                                                                                       |                              |
| a) centre curvature, related to diagonal calculated from the work sizes                        | ± 0,5 %                                                                                                                     | ± 1,5 %                                                                               | EN ISO 10545-2               |
| b) edge curvature, related to the corresponding work sizes                                     | ± 0,5 %                                                                                                                     | ± 1,5 %                                                                               | EN ISO 10545-2               |
| c) warpage related to diagonal calculated from the work sizes                                  | ± 0,8 %                                                                                                                     | ± 1,5 %                                                                               | EN ISO 10545-2               |
| A.6 Surface quality <sup>c</sup>                                                               | A minimum of 95 % of the tiles shall be free from visible defects that would impair the appearance of a major area of tiles |                                                                                       | EN ISO 10545-2               |
| B) PHYSICAL PROPERTIES                                                                         |                                                                                                                             |                                                                                       |                              |
| B.1 Water absorption<br>(% by mass)                                                            | 3 % < E <sub>b</sub> ≤ 6 %<br>Individual max 6,5 %                                                                          | 3 % < E <sub>b</sub> ≤ 6 %<br>Individual max 6,5 %                                    | EN ISO 10545-3               |
| B.2 Breaking strength, for:                                                                    |                                                                                                                             |                                                                                       |                              |
| a) Thickness ≥ 7,5 mm                                                                          | Not less than 950 N                                                                                                         | Not less than 950 N                                                                   | EN ISO 10545-4               |
| b) Thickness < 7,5 mm                                                                          | Not less than 600 N                                                                                                         | Not less than 600 N                                                                   | EN ISO 10545-4               |
| B.3 Flexural tensile strength or modulus of rupture <sup>d</sup>                               | Average minimum<br>20 N/mm <sup>2</sup><br>Individual minimum<br>18 N/mm <sup>2</sup>                                       | Average minimum<br>20 N/mm <sup>2</sup><br>Individual minimum<br>18 N/mm <sup>2</sup> | EN ISO 10545-4               |
| B.4 Abrasion resistance, as:                                                                   |                                                                                                                             |                                                                                       |                              |
| a) Resistance to deep abrasion of unglazed tiles: removed volume                               | Maximum 393 mm <sup>3</sup>                                                                                                 | Maximum 393 mm <sup>3</sup>                                                           | EN ISO 10545-6               |
| b) Resistance to surface abrasion of glazed tiles intended for use on floors <sup>e</sup>      | Abrasion class and cycles passed                                                                                            | Abrasion class and cycles passed                                                      | EN ISO 10545-7               |
| B.5 Coefficient of linear thermal expansion:                                                   |                                                                                                                             |                                                                                       |                              |
| – from ambient temperature to 100 °C                                                           | Declared value <sup>f</sup>                                                                                                 | Declared value <sup>f</sup>                                                           | EN ISO 10545-8               |
| B.6 Thermal shock resistance                                                                   | Pass according to EN ISO 10545-1 <sup>g</sup>                                                                               |                                                                                       | EN ISO 10545-9               |
| B.7 Crazing resistance:<br>glazed tiles <sup>h</sup>                                           | Pass according to EN ISO 10545-1 <sup>g</sup>                                                                               |                                                                                       | EN ISO 10545-11 <sup>h</sup> |
| B.8 Frost resistance                                                                           | Declared value <sup>g</sup>                                                                                                 |                                                                                       | EN ISO 10545-12              |

Table B.1 (continued)

| Characteristics                                              | Requirements for                             |                 | Test method                             |
|--------------------------------------------------------------|----------------------------------------------|-----------------|-----------------------------------------|
|                                                              | Precision                                    | Natural         |                                         |
| B) PHYSICAL PROPERTIES                                       |                                              |                 |                                         |
| B.9 Slipperiness                                             | Declared value(s) <sup>g</sup>               |                 | CEN/TS 16165 <sup>i</sup>               |
| B.10 Bond strength/adhesion <sup>j</sup> , for:              |                                              |                 |                                         |
| a) cementitious adhesives <sup>k</sup>                       | Declared value(s)                            |                 | EN 12004:2007+A1:2012, 4.1 <sup>i</sup> |
| b) dispersion adhesives <sup>k</sup>                         | Declared value(s)                            |                 | EN 12004:2007+A1:2012, 4.2 <sup>i</sup> |
| c) reaction resin adhesives <sup>k</sup>                     | Declared value(s)                            |                 | EN 12004:2007+A1:2012, 4.3 <sup>i</sup> |
| d) mortar                                                    | Declared value(s)                            |                 | EN 1015-12 <sup>l</sup>                 |
| B.11 Moisture expansion (in mm/m)                            | Declared value <sup>f</sup>                  |                 | EN ISO 10545-10                         |
| B.12 Small colour differences <sup>f</sup> for:              |                                              |                 |                                         |
| a) Glazed tiles                                              | $\Delta E_{cmc} < 0,75$                      |                 | EN ISO 10545-16                         |
| b) Unglazed tiles                                            | $\Delta E_{cmc} < 1,0$                       |                 | EN ISO 10545-16                         |
| B.13 Impact resistance, as:                                  |                                              |                 |                                         |
| – Coefficient of restitution (COR)                           | Declared value <sup>f</sup>                  |                 | EN ISO 10545-5                          |
| B.14 Reaction to fire                                        | (Class A1 or A1 <sub>FL</sub> ) <sup>m</sup> |                 | –                                       |
| B.15 Tactility <sup>n</sup>                                  | Declare surface description <sup>g</sup>     |                 | CEN/TS 15209 <sup>i</sup>               |
| C) CHEMICAL PROPERTIES                                       |                                              |                 |                                         |
| C.1 Resistance to staining, for:                             |                                              |                 |                                         |
| a) Glazed tiles                                              | Minimum Class 3                              | Minimum Class 3 | EN ISO 10545-14                         |
| b) Unglazed tiles                                            | Declared value <sup>f</sup>                  |                 | EN ISO 10545-14                         |
| C.2 Resistance to chemicals:                                 |                                              |                 |                                         |
| a) Resistance to low concentrations of acids and alkalis     | Declared value <sup>f</sup>                  |                 | EN ISO 10545-13                         |
| b) Resistance to high concentrations of acids and alkalis    | Declared value <sup>f</sup>                  |                 | EN ISO 10545-13                         |
| c) Resistance to household chemicals and swimming pool salts | Minimum class B                              | Minimum class B | EN ISO 10545-13                         |
| C.3 Release of dangerous substances                          |                                              |                 |                                         |
| a) Cadmium (in mg/dm <sup>2</sup> )                          | Declared value <sup>g</sup>                  |                 | EN ISO 10545-15                         |
| b) Lead (in mg/dm2)                                          | Declared value <sup>g</sup>                  |                 | EN ISO 10545-15                         |
| c) other dangerous substances <sup>o</sup>                   | Declared value                               |                 | As relevant                             |

<sup>a</sup> Similar joint widths may be used to apply to traditional systems based on non-metric sizes.

<sup>b</sup> Not applicable for tiles having curved shapes.

<sup>c</sup> Because of firing, slight variations from the standard colour are unavoidable. This does not apply to intentional irregularities of colour variation of the face of tiles (which can be unglazed, glazed or partly glazed) or to the colour variation over a tile area which is characteristic of the given tile and desirable. Spots or coloured dots which are introduced for decorative purposes are not considered a defect.