

Ceramic tiles — Definitions, classification, characteristics and marking

The European Standard EN 14411:2003 has the status of a
British Standard

ICS 91.100.25

National foreword

This British Standard is the official English language version of EN 14411:2003.

EN 14411:2003 is a candidate “harmonized” European Standard and fully takes into account the requirements of the European Commission mandate M/119, *Floorings*, and M/121, *Internal and external wall and ceiling finishes*, given under the EU Construction Products Directive (89/106/EEC), and intended to lead to CE marking. The date of applicability of EN 14411:2003 as a “harmonized” European Standard, i.e. the date after which this standard may be used for CE marking purposes, is subject to an announcement in the *Official Journal of the European Communities*.

The Commission in consultation with Member States have agreed a transition period for the co-existence of “harmonized” European Standards and their corresponding national standard(s). It is intended that this period will comprise a period, usually nine months, after the date of availability of the European Standard, during which any required changes to national regulations are to be made, followed by a further period, usually twelve months, for the implementation of CE marking. At the end of this co-existence period, the national standard(s) will be withdrawn.

EN 14411:2003 is the subject of transitional arrangements agreed under the Commission mandate. In the UK, the corresponding national standards are:

- BS 6431-1:1983, *Ceramic floor and wall tiles — Part 1: Specification for classification and marking, including definitions and characteristics*;
- BS 6431-2:1984, *Ceramic floor and wall tiles — Part 2: Specification for extruded ceramic tiles with a low water absorption ($E \leq 3\%$) — Group A1*;
- BS 6431-3.1:1986, *Ceramic floor and wall tiles — Part 3: Extruded ceramic tiles with a water absorption of $3\% < E \leq 6\%$ — Group A11a: Section 3.1 Specification for general products*;
- BS 6431-3.2:1986, *Ceramic floor and wall tiles — Part 3: Extruded ceramic tiles with a water absorption of $3\% < E \leq 6\%$ — Group A11a: Section 3.2 Specification for specific products (terre cuite, cotto, baldosin catalan)*;
- BS 6431-4.1:1986, *Ceramic floor and wall tiles — Part 4: Extruded ceramic tiles with a water absorption of $6\% < E \leq 10\%$ — Group A11b: Section 4.1 Specification for general products*;
- BS 6431-4.2:1986, *Ceramic floor and wall tiles — Part 4: Extruded ceramic tiles with a water absorption of $6\% < E \leq 10\%$ — Group A11b: Section 4.2 Specification for specific products (terre cuite, cotto, baldosin catalan)*;
- BS 6431-5:1986, *Ceramic floor and wall tiles — Part 5: Specification for extruded ceramic tiles with a water absorption of $E > 10\%$ — Group A111*;
- BS 6431-6:1984, *Ceramic floor and wall tiles — Part 6: Specification for dust-pressed ceramic tiles with a low water absorption ($E \leq 3\%$) — Group B1*;
- BS 6431-7:1986, *Ceramic floor and wall tiles — Part 7: Specification for dust-pressed ceramic tiles with a water absorption of $3\% < E \leq 6\%$ — Group B11a*;
- BS 6431-8:1986, *Ceramic floor and wall tiles — Part 8: Specification for dust-pressed ceramic tiles with a water absorption of $6\% < E \leq 10\%$ — Group B11b*;
- BS 6431-9:1984, *Ceramic floor and wall tiles — Part 9: Specification for dust-pressed ceramic tiles with a water absorption of $E > 10\%$ — Group B111*;

and based on this transition period of twenty-one months, these parts to BS 6431 would be withdrawn in April 2005.

NOTE This date is approximate. Users of this standard should contact BSI Customer Services for confirmation of withdrawal.

Further, EN 14411:2003 makes normative reference to the test methods contained in BS EN ISO 10545 (Parts 1 to 16). Thus, upon withdrawal of the above listed product specification parts to BS 6431, the remaining product test method parts to BS 6431, listed below, will be redundant and therefore also withdrawn:

BS 6431-10:1984, *Ceramic floor and wall tiles — Part 10: Method for determination of dimensions and surface quality*;

BS 6431-11:1983, *Ceramic floor and wall tiles — Part 11: Method for determination of water absorption*;

BS 6431-12:1983, *Ceramic floor and wall tiles — Part 12: Method for determination of modulus of rupture*;

BS 6431-13:1986, *Ceramic floor and wall tiles — Part 13: Method for determination of scratch hardness of surface according to Mohs*;

BS 6431-14:1983, *Ceramic floor and wall tiles — Part 14: Method for determination of resistance to deep abrasion — Unglazed tiles*;

BS 6431-15:1983, *Ceramic floor and wall tiles — Part 15: Method for determination of linear thermal expansion*;

BS 6431-16:1983, *Ceramic floor and wall tiles — Part 16: Method for determination of resistance to thermal shock*;

This British Standard, was published under the authority of the Standards Policy and Strategy Committee on 12 May 2004

© BSI 12 May 2004

ISBN 0 580 42901 6

BS 6431-17:1983, *Ceramic floor and wall tiles — Part 17: Method for determination of crazing resistance — Glazed tiles*;

BS 6431-18:1983, *Ceramic floor and wall tiles — Part 18: Method for determination of chemical resistance — Unglazed tiles*;

BS 6431-19:1984, *Ceramic floor and wall tiles — Part 19: Method for determination of chemical resistance — Glazed tiles*;

BS 6431-20:1984, *Ceramic floor and wall tiles — Part 20: Method for determination of resistance to surface abrasion — Glazed tiles*;

BS 6431-21:1984, *Ceramic floor and wall tiles — Part 21: Method for determination of moisture expansion using boiling water — Unglazed tiles*;

BS 6431-22:1986, *Ceramic floor and wall tiles — Part 22: Method for determination of frost resistance*;

BS 6431-23:1986, *Ceramic floor and wall tiles — Part 23: Specification for sampling and basis for acceptance*.

The UK participation in its preparation was entrusted to Technical Committee B/539, Ceramic tiles and other rigid tiling, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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Summary of pages

This document comprises a front cover, an inside front cover, page ii, a blank page, the EN title page, pages 2 to 73 and a back cover.

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Amendments issued since publication

Amd. No.	Date	Comments

English version

Ceramic tiles - Definitions, classification, characteristics and marking (ISO 13006:1998, modified)

Carreaux et dalles céramiques - Définitions, classification, caractéristiques et marquage (ISO 13006:1998, modifiée)

Keramische Fliesen und Platten - Begriffe, Klassifizierung, Güteermkmale und Kennzeichnung (ISO 13006:1998, modifiziert)

This European Standard was approved by CEN on 9 April 2003.

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Contents

Foreword.....	3
1 Scope	5
2 Normative references	5
3 Terms and definitions	6
4 Classification.....	8
4.1 Basis of classification	8
4.2 Methods of manufacture	8
4.3 Water absorption (<i>E</i>) groups	8
5 Characteristics	8
6 Sampling and basis for acceptance.....	9
7 Requirements	9
8 Marking and specifications.....	9
8.1 Marking	9
8.2 Product literature	9
8.3 Specifications.....	9
9 Ordering.....	10
Annex A (normative) Extruded ceramic tiles $E \leq 3\%$ Group AI	14
Annex B (normative) Extruded ceramic tiles $3\% < E \leq 6\%$ Group AII _a — Part 1	18
Annex C (normative) Extruded ceramic tiles $3\% < E \leq 6\%$ Group AII _a — Part 2	22
Annex D (normative) Extruded ceramic tiles $6\% < E \leq 10\%$ Group AII _b — Part 1	26
Annex E (normative) Extruded ceramic tiles $6\% < E \leq 10\%$ Group AII _b — Part 2	30
Annex F (normative) Extruded ceramic tiles $E > 10\%$ Group AIII	34
Annex G (normative) Dry-pressed ceramic tiles with low water absorption $E \leq 0,5\%$ Group BI _a	38
Annex H (normative) Dry-pressed ceramic tiles with low water absorption $0,5\% < E \leq 3\%$ Group BI _b	42
Annex J (normative) Dry-pressed ceramic tiles $3\% < E \leq 6\%$ Group BII _a	46
Annex K (normative) Dry-pressed ceramic tiles $6\% < E \leq 10\%$ Group BII _b	50
Annex L (normative) Dry-pressed ceramic tiles $E > 10\%$ Group BIII.....	54
Annex M (informative) Symbols for intended use.....	58
Annex N (informative) Classification of glazed tiles for floors according to their abrasion resistance	59
Annex P (informative) Test methods.....	60
Annex Q (normative) Additional European requirements on tiles	61
Annex ZA (informative) Ceramic tiles for flooring Clauses of this European Standard addressing the provisions of the EU Construction Products Directive	62
Annex ZB (informative) Ceramic tiles for wall and ceiling finishes Clauses of this European Standard addressing the provisions of the EU Construction Products Directive.....	67
Bibliography	73

Foreword

The text of ISO 13006:1998 has been prepared by Technical Committee ISO/TC 189 "Ceramic tile" of the International Organization for Standardization (ISO) and has been taken over as EN 14411:2003 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 2004, and conflicting national standards shall be withdrawn at the latest by July 2005.

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 89/106/EEC.

For relationship with EU Directives, see informative Annexes ZA and ZB which are an integral part of this standard.

The ISO Standards listed in clause 2 "Normative references" correspond to the following European Standards:

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

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

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

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

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

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

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

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

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

ISO 10545-10 = EN ISO 10545-10, *Ceramic tiles - Part 10: Determination of moisture expansion*

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

ISO 10545-12 = EN ISO 10545-12, *Ceramic tiles - Part 12: Determination of frost resistance*

ISO 10545-13 = EN ISO 10545-13, *Ceramic tiles - Part 13: Determination of chemical resistance*

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

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

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

Some characteristics not considered in the previous standards have been added (see superseded standards).

The annexes A, B, C, D, E, F, G, H, J, K, L, Q are normative, while annexes M, N, P, ZA and ZB are informative.

This document will supersede EN 87:1991, EN 121:1991, EN 159:1991, EN 176:1991, EN 177:1991, EN 178:1991, EN 186-1:1991, EN 186-2:1991, EN 187-1:1991, EN 187-2:1991 and EN 188:1991.

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

Endorsement notice

The text of the International Standard ISO 13006:1998 has been approved by CEN as a draft European Standard with the following agreed common modifications and indicated in the text by strike-out and underlining:

- modification of the Scope (inclusion of products not of first quality and other clarifications);
- deletion of the reference to ISO/DIS 10545-17 and modification of the text in 8.2 as well as in A.3.2, B.3.2, etc. and annex P;
- addition of annex Q (normative) criteria for tiles not of first quality and for release of cadmium and lead;
- note 1 to Table 2;
- Table A.1 characteristic "Frost resistance";
- addition of annexes ZA and ZB, harmonised part of the standard.
- Other modifications in 3 Terms and definitions

1 Scope

This European Standard defines and gives terms, requirements and marking criteria for ceramic tiles (produced by extrusion and dust pressing techniques) of the first commercial quality.

Tiles not of first commercial quality are also covered following the provisions of annex Q.

This European Standard does not cover tiles made by other than the normal commercial processes of extrusion or dry pressing (see 3.7).

NOTE ISO 10545 describes the test procedures required to determine the product characteristics listed in ISO 13006. ISO 10545 is divided into parts each describing a specific test procedure or related matter.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

ISO 1006, *Building construction — Modular coordination — Basic module*.

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

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

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

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

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

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

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

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

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

ISO 10545-10, *Ceramic tiles — Part 10: Determination of moisture expansion*.

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

ISO 10545-12, *Ceramic tiles — Part 12: Determination of frost resistance*.

ISO 10545-13, *Ceramic tiles — Part 13: Determination of chemical resistance*.

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

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

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

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in ISO 1006 and the following apply.

3.1

ceramic tiles

thin slabs made from clays and/or other inorganic raw materials, generally used as coverings for floors and walls, usually shaped by extruding (A) or pressing (B) at room temperature but may be formed by other processes (C), then dried and subsequently fired at temperatures sufficient to develop the required properties; tiles can be glazed (GL) or unglazed (UGL) and are incombustible and unaffected by light

NOTE A fully vitrified tile is a tile with water absorption lower than 0,5%.

3.2

glaze

vitrified covering which is impermeable

3.3

engobed surface

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

NOTE A tile with an engobed surface is regarded as an unglazed tile.

3.4

polished surface

surface of an unglazed tile which has been given a glossy finish by mechanical polishing as the last stage of manufacture

3.5

extruded tiles

[designated as A]

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

NOTE 1 This European Standard classifies extruded tiles as “precision” or “natural”. The classification is dependent upon the different technical characteristics as listed in the normative annexes A to F.

NOTE 2 Traditional terms used for extruded products are “split tiles” and “quarry tiles”. They commonly indicate double-extruded and single-extruded tiles respectively. The term “quarry tiles” only refers to extruded tiles with a water absorption not exceeding 6 %.

3.6

dry-pressed tiles

[designated as B]

tiles formed from a finely milled body mixture and shaped in moulds at high pressure

3.7

tiles made by other processes

[designated as C]

tiles made by other than the normal commercial processes, i.e. extruded or dry-pressed

NOTE These tiles are not covered in this European Standard.

3.8

spacer lugs

projections which are 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

See Figure 2.

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

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

3.9

water absorption

[symbol E]

percentage of water by mass, measured in accordance with ISO 10545-3

3.10 description of sizes

See Figures 1 and 2.

NOTE These 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 will fit.

3.10.1

nominal size

size used to describe the product

3.10.2

work size

[symbol W]

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

NOTE This is specified by the dimensions length, width and thickness.

3.10.3

actual size

size obtained by measuring the face of the tile in accordance with ISO 10545-2

3.10.4

coordinating size

[symbol C]

work size plus the joint width

3.10.5

modular size

tiles and sizes based on module M, 2 M, 3 M and 5 M and also their multiples or subdivisions, except for tiles with a surface area of less than 9 000 mm²

NOTE See ISO 1006 where 1 M = 100 mm.

3.10.6

non-modular sizes

sizes not based on module M

NOTE 1 See ISO 1006 where 1 M = 100 mm.

NOTE 2 Tiles of these sizes are those commonly used in most countries.

3.10.7

tolerance

difference between the permissible limits of size

4 Classification

4.1 Basis of classification

Ceramic tiles are divided into groups according to their method of manufacture and their water absorption (see 3.9 and Table 1). The groups do not presuppose the usage of the products.

4.2 Methods of manufacture

There are three methods of manufacture as follows:

- method A, extruded tiles (see 3.5);
- method B, dry-pressed tiles (see 3.6);
- method C, tiles made by other processes (see 3.7).

4.3 Water absorption (E) groups

There are three water absorption groups as follows.

a) Tiles of low water absorption (Group I), $E \leq 3 \%$

Group I is further divided as follows for dry-pressed tiles:

- 1) $E \leq 0,5 \%$ (Group BI_a);
- 2) $0,5 \% < E \leq 3 \%$ (Group BI_b).

b) Tiles of medium water absorption (Group II), $3 \% < E \leq 10 \%$

Group II is further divided as follows for extruded tiles:

b1) for extruded tiles:

- 1) $3 \% < E \leq 6 \%$ (Group AII_a, Parts 1 and 2);
- 2) $6 \% < E \leq 10 \%$ (Group AII_b, Parts 1 and 2).

b2) for dry-pressed tiles:

- 3) $3 \% < E \leq 6 \%$ Group BII_a
- 4) $6 \% < E \leq 10 \%$ Group BII_b

c) Tiles of high water absorption (Group III), $E > 10 \%$

5 Characteristics

Characteristics for different applications of ceramic tiles are given in Table 2.

6 Sampling and basis for acceptance

The sampling and basis for acceptance shall be in accordance with that presented in ISO 10545-1. The control frequencies for the evaluation of conformity as regard the characteristics shall be stated and declared by the manufacturer, taking into account the production organisation. The frequency shall be at least once every two years.

7 Requirements

Dimensional and surface quality requirements and physical and chemical properties shall be as given in the specific annex (annexes A through L) for each tile group (see contents).

8 Marking and specifications

8.1 Marking

Tiles and/or their packaging shall bear the following marking:

- a) manufacturer's mark and/or trademark and the country of origin;
- b) mark to indicate first quality;
- c) type of tile and reference to the appropriate annex in this European Standard;
- d) nominal and work sizes, modular (M) or non-modular;
- e) nature of the surface, i.e. glazed (GL) or unglazed (UGL).

8.2 Product literature

Product literature for tiles intended for use on floors shall state:

- a) For slipperiness, where required by regulation and considering the test method(s) applicable within the member state of destination, and/or where requested by the customer, the results obtained;
- b) the abrasion class for glazed tiles.

NOTE See also annex M for informative symbols.

8.3 Specifications

Tiles shall be specified by designating the following:

- a) the method of shaping;
- b) the annex in this European Standard covering the specific class of tile;
- c) nominal and work sizes, modular (M) and non-modular;
- d) the nature of the surface, i.e. glazed (GL) or unglazed (UGL).

EXAMPLES

Precision extruded tile, EN 14411, annex A

AI M25 cm × 12,5 cm (*W* 240 mm × 115 mm × 10 mm) GL

Natural extruded tile, EN 14411, annex A

AI 15 cm × 15 cm (*W* 150 mm × 150 mm × 12,5 mm) UGL

9 Ordering

When an order is placed, items such as size, thickness, type of surface, colour, profile, abrasion class for glazed tiles and other properties shall be agreed by the parties concerned.

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

Shaping	Group I $E \leq 3 \%$	Group II _a $3 \% < E \leq 6 \%$	Group II _b $6 \% < E \leq 10 \%$	Group III $E > 10 \%$
A Extruded	Group AI (see annex A)	Group AII _{a-1} ^a (see annex B)	Group AII _{b-1} ^a (see annex D)	Group AIII (see annex F)
		Group AII _{a-2} ^a (see annex C)	Group AII _{b-2} ^a (see annex E)	
B Dry pressed	Group BI _a $E \leq 0,5 \%$ (see annex G)	Group BII _a (see annex J)	Group BII _b (see annex K)	Group BIII ^b (see annex L)
	Group BI _b $0,5 \% < E \leq 3 \%$ (see annex H)			
C Tiles made by other processes	Group CI ^c	Group CII _a ^c	Group CII _b ^c	Group CIII ^c

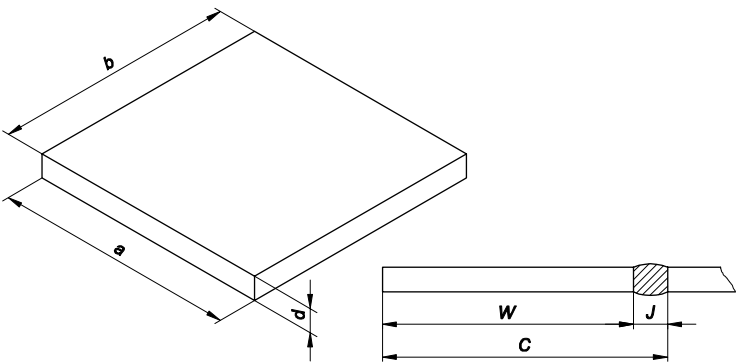
a Groups AII_a and AII_b are divided into two parts (Parts 1 and 2) with different product specifications.

b Group BIII covers glazed 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.

c These tiles are not covered in this European Standard.

Table 2 — Characteristics required for different applications

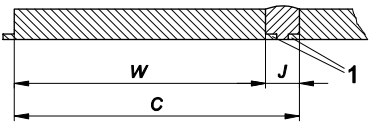
Characteristics	Floors		Walls		Test
Dimensions and surface quality	Interior	Exterior	Interior	Exterior	Reference
Length and width	X	X	X	X	ISO 10545-2
Thickness	X	X	X	X	ISO 10545-2
Straightness of sides	X	X	X	X	ISO 10545-2
Rectangularity	X	X	X	X	ISO 10545-2
Surface flatness (curvature and warpage)	X	X	X	X	ISO 10545-2
Surface quality	X	X	X	X	ISO 10545-2
Physical properties	Interior	Exterior	Interior	Exterior	Reference
Water absorption	X	X	X	X	ISO 10545-3
Breaking strength	X	X	X	X	ISO 10545-4
Modulus of rupture	X	X	X	X	ISO 10545-4
Resistance to deep abrasion – unglazed tiles	X	X			ISO 10545-6
Resistance to surface abrasion – glazed tiles	X	X			ISO 10545-7
Linear thermal expansion ^a	X	X	X	X	ISO 10545-8
Resistance to thermal shock ^a	X	X	X	X	ISO 10545-9
Resistance to crazing – glazed tiles	X	X	X	X	ISO 10545-11
Frost resistance ^b		X		X	ISO 10545-12
Coefficient of friction	X	X			Declare test method used
Moisture expansion ^a	X	X	X	X	ISO 10545-10
Small colour differences ^a	X	X	X	X	ISO 10545-16
Impact resistance ^a	X	X			ISO 10545-5
Chemical properties	Interior	Exterior	Interior	Exterior	Reference
Resistance to staining					ISO 10545-14
— glazed tiles	X	X	X	X	ISO 10545-14
— unglazed tiles ^a	X	X	X	X	ISO 10545-14
Resistance to low concentrations of acids and alkalis.	X	X	X	X	ISO 10545-13
Resistance to high concentrations of acids and alkalis ^a	X	X	X	X	ISO 10545-13
Resistance to household cleaners and swimming pool salts.	X	X	X	X	ISO 10545-13
Lead and cadmium release – glazed tiles ^a	X	X	X	X	ISO 10545-15
a Test method available, but this standard does not fix requirement values.					
b For tiles intended to be used in situations where frost conditions apply.					



Coordinating size (C) Work size (W) + Joint (J)

Work size (W) Dimension of the visible face (a), (b) and thickness (d)

Figure 1 — 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 — Tile with spacer lug

Annex A (normative)

Extruded ceramic tiles $E \leq 3 \%$ Group AI

A.1 Requirements

Dimensional and surface quality requirements and physical and chemical properties shall be in accordance with Table A.1.

Table A.1 — Requirements for extruded ceramic tiles, Group AI, $E \leq 3 \%$

Dimensions and surface quality	Precision	Natural	Test
Length and width			
The manufacturer shall choose the work size as follows: a) for modular tiles in order to allow a nominal joint width of between 3 mm and 11 mm^a; b) for non-modular tiles so that the difference between the work size and the nominal size is not more than ± 3 mm. The deviation, in percent, of the average size for each tile (2 or 4 sides) from the work size (W).	$\pm 1,0 \%$ to a maximum of ± 2 mm	$\pm 2,0 \%$ to a maximum of ± 4 mm	ISO 10545-2
The deviation, in percent, of the average size for each tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides).	$\pm 1,0 \%$	$\pm 1,5 \%$	ISO 10545-2
Thickness			
a) The thickness shall be specified by the manufacturer.			
b) The deviation, in percent, of the average thickness of each tile from the work size thickness.	$\pm 10 \%$	$\pm 10 \%$	ISO 10545-2
Straightness of sides ^b (facial sides)			
The maximum deviation from straightness, in percent, related to the corresponding work sizes.	$\pm 0,5 \%$	$\pm 0,6 \%$	ISO 10545-2

Table A.1 (continued)

Dimensions and surface quality	Precision	Natural	Test
Rectangularity ^b			
The maximum deviation from rectangularity, in percent, related to the corresponding work sizes.	$\pm 1,0 \%$	$\pm 1,0 \%$	ISO 10545-2
Surface flatness			
The maximum deviation from flatness, in percent:			
a) centre curvature, related to diagonal calculated from the work sizes;	$\pm 0,5 \%$	$\pm 1,5 \%$	ISO 10545-2
b) edge curvature, related to the corresponding work sizes;	$\pm 0,5 \%$	$\pm 1,5 \%$	ISO 10545-2
c) warpage, related to diagonal calculated from the work sizes.	$\pm 0,8 \%$	$\pm 1,5 \%$	ISO 10545-2
Surface quality ^c	A minimum of 95 % of the tiles shall be free from visible defects that would impair the appearance of a major area of tiles		ISO 10545-2
Physical properties	Precision	Natural	Test
Water absorption Percent by mass ^h	$\leq 3,0 \%$ Individual maximum 3,3 %	$\leq 3,0 \%$ Individual maximum 3,3 %	ISO 10545-3
Breaking strength, in N			
a) Thickness $\geq 7,5$ mm	Not less than 1 100	Not less than 1 100	ISO 10545-4
b) Thickness $< 7,5$ mm	Not less than 600	Not less than 600	ISO 10545-4
Modulus of rupture, in N/mm² Not applicable to tiles with breaking strength $\geq 3\,000$ N.	Minimum 23 Individual minimum 18	Minimum 23 Individual minimum 18	ISO 10545-4
Abrasion resistance			
a) Resistance to deep abrasion of unglazed tiles: removed volume, in cubic millimetres.	Maximum 275	Maximum 275	ISO 10545-6
b) Resistance to surface abrasion of glazed tiles intended for use on floors ^g .	Report abrasion class and cycles passed	Report abrasion class and cycles passed	ISO 10545-7
Coefficient of linear thermal expansion			
From ambient temperature to 100 °C.	Test method available	Test method available	ISO 10545-8
Thermal shock resistance	Test method available	Test method available	ISO 10545-9
Crazing resistance: glazed tiles ^f	Required	Required	ISO 10545-11
Frost resistance	Required	Required	ISO 10545-12
Coefficient of friction			
Tiles intended for use on floors.	where required	where required	Declare test method(s)

Table A.1 (concluded)

Physical properties	Precision	Natural	Test
Moisture expansion, in mm/m ^e	Test method available	Test method available	ISO 10545-10
Small colour differences ^e	Test method available	Test method available	ISO 10545-16
Impact resistance ^e	Test method available	Test method available	ISO 10545-5
Chemical properties	Precision	Natural	Test
Resistance to staining			
a) Glazed tiles	Minimum Class 3	Minimum Class 3	ISO 10545-14
b) Unglazed tiles	Test method available	Test method available	ISO 10545-14
Resistance to chemicals			
Resistance to low concentrations of acids and alkalis a) glazed tiles; b) unglazed tiles ^g .	Manufacturer to state classification	Manufacturer to state classification	ISO 10545-13
Resistance to high concentrations of acids and alkalis ^e	Test method available	Test method available	ISO 10545-13
Resistance to household chemicals and swimming pool salts a) glazed tiles; b) unglazed tiles ^g .	Minimum GB Minimum UB	Minimum GB Minimum UB	ISO 10545-13
Lead and cadmium release	Test method available	Test method available	ISO 10545-15
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 for this type of tile and desirable. Spots or coloured dots which are introduced for decorative purposes are not considered a defect. d Reference may be made to annex N of this European Standard for the abrasion resistance classification for all glazed tiles intended for use on floors. e Reference may be made to annex P of this European Standard for information regarding requirements which are non-compulsory but which are listed "test method available". f Certain decorative effects may have a tendency to craze. They shall be identified by the manufacturer, in which case the crazing test given in ISO 10545-11 is not applicable. g If the hue becomes slightly different, this is not considered to be chemical attack. h A fully vitrified tile is a tile with water absorption of a maximum individual value of 0,5 % (sometimes described as impervious).			

A.2 Sampling and basis for acceptance

The sampling and basis for acceptance shall be in accordance with that presented in ISO 10545-1.

A.3 Marking and specifications

A.3.1 Marking

Tiles and/or their packaging shall bear the following marking:

- a) manufacturer's mark and/or trademark and the country of origin;
- b) mark to indicate first quality;
- c) type of tile and reference to the appropriate annex in this European Standard (see contents);
- d) nominal and work sizes, modular (M) or non-modular;
- e) nature of the surface, i.e. glazed (GL) or unglazed (UGL).

A.3.2 Product literature

Product literature for tiles intended for use on floors shall state:

- a) For slipperiness, where required by regulation and considering the test method(s) applicable within the member state of destination, and/or where requested by the customer, the results obtained;
- b) the abrasion class for glazed tiles.

NOTE See also annex M for informative symbols.

A.3.3 Specifications

Tiles shall be specified by designating the following:

- a) the method of shaping;
- b) the annex in this European Standard covering the specific class of tile;
- c) nominal and work sizes, modular (M) and non-modular;
- d) the nature of the surface, i.e. glazed (GL) or unglazed (UGL).

EXAMPLES

Precision extruded tile, EN 14411, annex A

AI M25 cm × 12,5 cm (*W* 240 mm × 115 mm × 10 mm) GL

Natural extruded tile, EN 14411, annex A

AI 15 cm × 15 cm (*W* 150 mm × 150 mm × 12,5 mm) UGL

A.4 Ordering

When an order is placed, items such as size, thickness, type of surface, colour, profile, abrasion class for glazed tiles and other properties shall be agreed by the parties concerned.

Annex B (normative)

Extruded ceramic tiles $3 \% < E \leq 6 \%$ Group AII_a — Part 1

B.1 Requirements

Dimensional and surface quality requirements and physical and chemical properties shall be in accordance with table B.1.

Table B.1 — Requirements for extruded ceramic tiles, Group AII_{a-1}, $3 \% < E \leq 6 \%$

Dimensions and surface quality	Precision	Natural	Test
Length and width			
The manufacturer shall choose the work size as follows: a) for modular tiles in order to allow a nominal joint width of between 3 mm and 11 mm^a; b) for non-modular tiles so that the difference between the work size and the nominal size is not more than ± 3 mm. The deviation, in percent, of the average size for each tile (2 or 4 sides) from the work size (<i>W</i>).	$\pm 1,25 \%$ to a maximum of ± 2 mm	$\pm 2,0 \%$ to a maximum of ± 4 mm	ISO 10545-2
The deviation, in percent, of the average size for each tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides).	$\pm 1,0 \%$	$\pm 1,5 \%$	ISO 10545-2
Thickness			
a) The thickness shall be specified by the manufacturer.			
b) The deviation, in percent, of the average thickness of each tile from the work size thickness.	$\pm 10 \%$	$\pm 10 \%$	ISO 10545-2
Straightness of sides ^b (facial sides)			
The maximum deviation from straightness, in percent, related to the corresponding work sizes.	$\pm 0,5 \%$	$\pm 0,6 \%$	ISO 10545-2

Table B.1 (continued)

Dimensions and surface quality	Precision	Natural	Test
Rectangularity^b			
The maximum deviation from rectangularity, in percent, related to the corresponding work sizes.	$\pm 1,0 \%$	$\pm 1,0 \%$	ISO 10545-2
Surface flatness			
The maximum deviation from flatness, in percent:			
a) centre curvature, related to diagonal calculated from the work sizes;	$\pm 0,5 \%$	$\pm 1,5 \%$	ISO 10545-2
b) edge curvature, related to the corresponding work sizes;	$\pm 0,5 \%$	$\pm 1,5 \%$	ISO 10545-2
c) warpage, related to diagonal calculated from the work sizes.	$\pm 0,8 \%$	$\pm 1,5 \%$	ISO 10545-2
Surface quality^c	A minimum of 95 % of the tiles shall be free from visible defects that would impair the appearance of a major area of tiles		ISO 10545-2
Physical properties	Precision	Natural	Test
Water absorption Percent by mass	$3,0 \% < E \leq 6,0 \%$ Individual maximum 6,5 %	$3,0 \% < E \leq 6,0 \%$ Individual maximum 6,5 %	ISO 10545-3
Breaking strength, in N			
a) Thickness $\geq 7,5$ mm	Not less than 950	Not less than 950	ISO 10545-4
b) Thickness $< 7,5$ mm	Not less than 600	Not less than 600	ISO 10545-4
Modulus of rupture, in N/mm² Not applicable to tiles with breaking strength $\geq 3\,000$ N.	Minimum 20 Individual minimum 18	Minimum 20 Individual minimum 18	ISO 10545-4
Abrasion resistance			
a) Resistance to deep abrasion of unglazed tiles: removed volume, in cubic millimetres.	Maximum 393	Maximum 393	ISO 10545-6
b) Resistance to surface abrasion of glazed tiles intended for use on floors ^d .	Report abrasion class and cycles passed	Report abrasion class and cycles passed	ISO 10545-7
Coefficient of linear thermal expansion^e			
From ambient temperature to 100 °C.	Test method available	Test method available	ISO 10545-8
Thermal shock resistance^e	Test method available	Test method available	ISO 10545-9
Crazing resistance: glazed tiles ^f	Required	Required	ISO 10545-11
Frost resistance^e	Test method available	Test method available	ISO 10545-12
Coefficient of friction			
Tiles intended for use on floors.	where required	where required	Declare test method(s)

Table B.1 (concluded)

Physical properties	Precision	Natural	Test
Moisture expansion, in mm/m ^e	Test method available	Test method available	ISO 10545-10
Small colour differences ^e	Test method available	Test method available	ISO 10545-16
Impact resistance ^e	Test method available	Test method available	ISO 10545-5
Chemical properties	Precision	Natural	Test
Resistance to staining			
a) Glazed tiles	Minimum Class 3	Minimum Class 3	ISO 10545-14
b) Unglazed tiles ^e	Test method available	Test method available	ISO 10545-14
Resistance to chemicals			
Resistance to low concentrations of acids and alkalis			
a) glazed tiles; b) unglazed tiles ^g	Manufacturer to state classification	Manufacturer to state classification	ISO 10545-13
Resistance to high concentrations of acids and alkalis ^e .	Test method available	Test method available	ISO 10545-13
Resistance to household chemicals and swimming pool salts			
a) glazed tiles; b) unglazed tiles ^g .	Minimum GB Minimum UB	Minimum GB Minimum UB	ISO 10545-13
Lead and cadmium release ^e	Test method available	Test method available	ISO 10545-15
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 for this type of tile and desirable. Spots or coloured dots which are introduced for decorative purposes are not considered a defect. d Reference may be made to annex N of this European Standard for the abrasion resistance classification for all glazed tiles intended for use on floors. e Reference may be made to annex P of this I European Standard for information regarding requirements which are non-compulsory but which are listed "test method available". f Certain decorative effects may have a tendency to craze. They shall be identified by the manufacturer, in which case the crazing test given in ISO 10545-11 is not applicable. g If the hue becomes slightly different, this is not considered to be chemical attack.			

B.2 Sampling and basis for acceptance

The sampling and basis for acceptance shall be in accordance with that presented in ISO 10545-1.

B.3 Marking and specifications

B.3.1 Marking

Tiles and/or their packaging shall bear the following marking:

- a) manufacturer's mark and/or trademark and the country of origin;
- b) mark to indicate first quality;
- c) type of tile and reference to the appropriate annex in this European Standard (see contents);