

BS EN ISO 10545-16:2012



BSI Standards Publication

## Ceramic tiles

Part 16: Determination of small colour differences (ISO 10545-16:2010)

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**National foreword**

This British Standard is the UK implementation of EN ISO 10545-16:2012. It is identical to ISO 10545-16:2010. It supersedes BS EN ISO 10545-16:2000, which is withdrawn.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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Date	Text affected
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English Version

**Ceramic tiles - Part 16: Determination of small colour differences  
(ISO 10545-16:2010)**

Carreaux et dalles céramiques - Partie 16: Détermination  
de faibles différences de couleur (ISO 10545-16:2010)

Keramische Fliesen und Platten - Teil 16: Bestimmung  
kleiner Farbabweichungen (ISO 10545-16:2010)

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## Foreword

The text of ISO 10545-16:2010 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 ISO 10545-16:2012 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of an identical text or by endorsement, at the latest by August 2012, and conflicting national standards shall be withdrawn at the latest by August 2012.

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The text of ISO 10545-16:2010 has been approved by CEN as a EN ISO 10545-16:2012 without any modification.

## Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 10545-16 was prepared by Technical Committee ISO/TC 189, *Ceramic tile*.

This second edition cancels and replaces the first edition (ISO 10545-16:1999), 3.5 and 7.2 of which have been technically revised.

ISO 10545 consists of the following parts, under the general title *Ceramic tiles*:

- *Part 1: Sampling and basis for acceptance*
- *Part 2: Determination of dimensions and surface quality*
- *Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density*
- *Part 4: Determination of modulus of rupture and breaking strength*
- *Part 5: Determination of impact resistance by measurement of coefficient of restitution*
- *Part 6: Determination of resistance to deep abrasion for unglazed tiles*
- *Part 7: Determination of resistance to surface abrasion for glazed tiles*
- *Part 8: Determination of linear thermal expansion*
- *Part 9: Determination of resistance to thermal shock*
- *Part 10: Determination of moisture expansion*
- *Part 11: Determination of crazing resistance for glazed tiles*
- *Part 12: Determination of frost resistance*
- *Part 13: Determination of chemical resistance*
- *Part 14: Determination of resistance to stains*
- *Part 15: Determination of lead and cadmium given off by glazed tiles*
- *Part 16: Determination of small colour differences*



# Ceramic tiles —

## Part 16:

# Determination of small colour differences

## 1 Scope

This part of ISO 10545 describes a method for utilizing colour measuring instruments for quantifying the small colour differences between plain coloured ceramic tiles, which are designed to be of uniform and consistent colour. It permits the specification of a maximum acceptable value, which depends only on the closeness of match and not on the nature of the colour difference.

This part of ISO 10545 is not applicable to colour variations produced for artistic purposes.

NOTE This test is applicable only when small colour differences between plain coloured tiles are important in a specification or by agreement.

## 2 Normative references

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

ISO 105-J03:2009, *Textiles — Tests for colour fastness — Part J03: Calculation of colour differences*

CIE 015:2004, *Colorimetry*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 3.1

#### **chroma**

attribute of colour that is defined as deviation from grey of the same lightness

NOTE The more a colour deviates from grey, the higher the chroma.

### 3.2

#### **lightness**

parameter that relates the colour to a continuous grey scale between white and black

### 3.3

#### CIE 1976 L\*a\*b\* value

#### CIELAB value

value calculated from the measured spectral reflectance curves given in CIE 015:2004

NOTE 1 CIE stands for "Commission internationale de l'éclairage"<sup>1)</sup>.

NOTE 2 For more information about spectral reflectance curves, see ISO 23603/CIE S 012. More details on the CIE 1976 L\*a\*b\* colour space can be found in ISO 11664-4/CIE S 014.

### 3.4

#### CMC colour difference

$\Delta E_{\text{cmc}}$

set of colour difference equations utilizing CIELAB ( $\Delta L^*$ ,  $\Delta C^*_{\text{ab}}$ ,  $\Delta H^*_{\text{ab}}$ ) values, calculated between a test specimen and a reference standard, to determine the ellipsoidal boundary containing all colours which would be visually acceptable when compared to the reference standard

NOTE CMC stands for the Colour Measurement Committee<sup>2)</sup>.

### 3.5

#### commercial factor

cf

measurement of the tolerance agreed on by all parties or those commonly utilized in the tile industry for determining the acceptability of the colour difference,  $\Delta E_{\text{cmc}}$

## 4 Principle

Colorimetric measurements are made on reference standard tiles and a test specimen of tiles of the same colour and the differences are calculated. The calculated CMC colour difference,  $\Delta E_{\text{cmc}}$ , of a test specimen is compared to a reference value, using a previously agreed-on commercial factor (cf) or the cf commonly used in the tile industry, to determine the acceptability of the colour match.

NOTE 1 Colorimetry describes a measure of colour difference, not appearance difference. Calculations are only valid when the reference and test specimens have essentially the same gloss and texture.

NOTE 2 It is intended that, on revision, ISO 13006 will include commercial factors of 0,75 for glazed tiles and 1,0 for unglazed tiles.

## 5 Test equipment

The instrument used for colour measurement shall be either a reflectance spectrophotometer or a tristimulus colorimeter. The instrument geometry shall conform to one of the four sets of illuminating and viewing conditions specified by the CIE. The instrument geometries are identified by the convention: illuminating geometry/viewing geometry. The four accepted instrument geometries with their abbreviations are 45/normal (45/0), normal/45 (0/45), diffuse/normal (d/0) and normal/diffuse (0/d). If a diffuse geometry (d/0 or 0/d) instrument is used, the specular component of reflectance shall be included in the measurement. The angle between the sample normal and the illuminating beam in 0/d geometry and the angle between the sample normal and the viewing beam in d/0 geometry shall not exceed 10°.

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1) Commission internationale de l'éclairage (International Commission on Illumination), Central Bureau, Kegelgasse 27, 1030 Vienna, Austria.

2) Colour Measurement Committee, The Society of Dyers and Colourists, Perkin House, 82 Grattan Road, Bradford BD1 2LU, United Kingdom.



## 6 Procedure

### 6.1 Test specimens

#### 6.1.1 Reference specimen

To avoid the phenomenon of metamerism, select a batch of tiles containing the same pigments, or combination of pigments as samples submitted for testing. The reference sampling shall comprise at least five tiles. However, a smaller number of reference tiles may be used, but they shall represent a homogeneous batch.

#### 6.1.2 Test specimen

Statistical methods shall be used to determine the number of randomly selected tiles which are representative, but the number shall never be less than five.

#### 6.1.3 Preparation

Clean the surface to be measured for colour with a cloth dipped in laboratory-grade isopropanol, followed by drying with a lint-free, dry cloth or paper tissue which does not contain fluorescent whitening agents (FWAs).

### 6.2 Test procedure

Operate the instrument in accordance with the instructions supplied by the manufacturer, allowing specified warm-up time. Prepare the test and reference standard tiles as outlined in 6.1.3. Take alternate readings of the reference specimen and the test specimen in quick succession, until a total of three readings has been made on each tile. Record them and use the average of the three measurements for each tile as the values for use in calculating the colour difference.

## 7 Calculations and interpretation of results

### 7.1 Calculations

#### 7.1.1 CIELAB values

##### 7.1.1.1 Calculation of CIELAB values

Calculate the CIELAB values  $L^*$ ,  $a^*$ ,  $b^*$ ,  $C_{ab}^*$  and  $H_{ab}^*$  from the  $X$ ,  $Y$  and  $Z$  values for each specimen, using the equations given in ISO 105-J03. Daylight illuminant (D65) and 10° observer shall be used.

##### 7.1.1.2 Calculation of CIELAB colour difference values

Calculate the CIELAB colour difference values  $\Delta L^*$ ,  $\Delta a^*$ ,  $\Delta b^*$ ,  $\Delta C_{ab}^*$ , and  $\Delta H_{ab}^*$  using the equations given in ISO 105-J03.

##### 7.1.2 Calculation of component CMC colour differences

Calculate the component CMC colour differences,  $\Delta L_{CMC}$ ,  $\Delta C_{CMC}$  and  $\Delta H_{CMC}$ , of the reference specimens and test specimens, following the procedure given in ISO 105-J03.

##### 7.1.3 Calculation of the CMC colour difference, $\Delta E_{CMC}$

Calculate the CMC colour difference in CMC ( $l:c$ ) units using the equations given in ISO 105-J03:2009, 3.3. When CMC colour difference is used, a decision shall be taken on whether the ratio of lightness to chroma

[CMC ( $l:c$ )], as determined by the CMC equations, is acceptable. CMC allows the user to change the ratio of lightness to chroma ( $l:c$ ). An  $l:c$  ratio of 1,5:1 is typically used for smooth surface, high-gloss glazed tiles.

## 7.2 Interpretation of results

For the purposes of determining acceptability, a “tolerance” (cf) which is agreeable to all parties involved shall be selected. The  $\Delta E_{\text{cmc}}$  value calculated between a test sample and the reference standard, when compared to this agreed-on tolerance, provides a means of determining if a test sample is an acceptable match to the reference standard. Specimens which are compared to a reference standard fall into two categories: those for which the  $\Delta E_{\text{cmc}}$  values are less than or equal to the agreed-on tolerance are acceptable (pass), while those for which the  $\Delta E_{\text{cmc}}$  values are greater than the agreed-on tolerance are unacceptable (fail).

## 8 Test report

The test report shall include the following information:

- a) a reference to this part of ISO 10545, i.e. ISO 10545-16;
- b) a description of the tiles;
- c) details of the instrument and specific measurement conditions;
- d) the  $\Delta L^*$ ,  $\Delta C^*_{\text{ab}}$ , and  $\Delta H^*_{\text{ab}}$  components;
- e) the agreed-on (cf) tolerance;
- f) the average CMC colour difference calculated between the test and the reference tiles;
- g) the ratio of lightness to chroma.

## Bibliography

- [1] ISO 11664-4/CIE S 014, *Colorimetry — Part 4: CIE 1976 L\*a\*b\* Colour space*
- [2] ISO 13006, *Ceramic tiles — Definitions, classification, characteristics and marking*
- [3] ISO 23603/CIE S 012, *Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour*





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