INTERNATIONAL STANDARD

ISO 10545-16

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Ceramic tiles —

Part 16: Determination of small colour differences

Carreaux et dalles céramiques —

Partie 16: Détermination de faibles différences de couleur

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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"[1)].

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
ΔE_{cmc}
set of colour difference equations utilizing CIELAB (ΔL^*, ΔC^*_{ab}, ΔH^*_{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[2)].

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, ΔE_{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, ΔE_{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°.

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 ΔL^*, Δa^*, Δb^*, ΔC^*_{ab}, and ΔH^*_{ab} using the equations given in ISO 105-J03.

7.1.2 Calculation of component CMC colour differences

Calculate the component CMC colour differences, ΔL_{cmc}, ΔC_{cmc} and ΔH_{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, ΔE_{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 ΔE_{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 ΔE_{cmc} values are less than or equal to the agreed-on tolerance are acceptable (pass), while those for which the ΔE_{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 ΔL^*, ΔC^*_{ab}, and ΔH^*_{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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