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

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.

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.

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

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*

— *Part 17: Determination of coefficient of friction*

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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 glazed 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.

Colour variations produced for artistic purposes are not covered in this part of ISO 10545.

NOTE This test should only be used when small colour differences between plain coloured glazed tiles are important in a specification.

2 Normative references

The following documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10545. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10545 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

CIE Publication No. 15.2:1986, *Colorimetry.*

ISO 105-J03:1995, *Textiles — Tests for colour fastness — Part J03: Calculation of colour differences*.

3 Definitions

For the purposes of this part of ISO 10545, the following definitions apply.

3.1
chroma
attribute of colour which 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 which relates the colour to a continuous grey scale between white and black

3.3
CIE[1] 1976 L^* a^* b^* (CIELAB) values
values calculated from measured spectral reflectance curves given in CIE Publication No. 15.2

3.4
CMC[2] colour difference
ΔE_{cmc}
set of colour difference equations which utilizes 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

3.5
commercial factor
cf
tolerance agreed upon by all parties or those commonly utilized in the tile industry for determining the acceptability of the colour difference, ΔE_{cmc}

NOTE A cf value of 0,75 for glazed tiles is commonly used.

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 upon commercial factor (cf) or the cf commonly used in the tile industry, to determine the acceptability of the colour match.

NOTE 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.

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 allowed 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°.

6 Procedure

6.1 Test specimens

6.1.1 Reference specimen

Take one or more tiles containing the same pigments or combination of pigments as the test specimen to avoid the complications of metamerism. A minimum of five representative tiles is normally considered suitable. However, if only a limited number of tiles is available, the most representative tile(s) shall be used.

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1) Commission Internationale de l'Eclairage (International Commission on Illumination), Central Bureau, Kegelgasse 27, A-1030 Vienna, Austria.

2) Colour Measurement Committee, Society of Dyers and Colourists, P.O. Box 244, Perkin House, 82 Grattan Road, GB-Bradford BD1 2JB, United Kingdom.

6.1.2 Test specimen

Statistical methods shall be used to determine the number of randomly selected tiles that will be 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 lintless dry cloth or paper tissue that 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 under 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 to be used in calculating the colour difference.

7 Calculations and interpretation of results

7.1 Calculations

7.1.1 CIELAB values

7.1.1.1 Calculate the CIELAB L^* a^* b^*, C^*_{ab} and h_{ab} values from the X, Y, 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 Calculate the CIELAB colour differences ΔL^*, Δa^*, Δb^*, ΔC^*_{ab}, and ΔH^*_{ab} using the equations given in ISO 105-J03.

7.1.2 CMC colour differences

Calculate the CMC component 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 ΔE_{cmc} values

Calculate the CMC colour difference in CMC (l:c) units using the equation given in ISO 105-J03:1995, 3.3. When CMC colour difference is used, it is necessary to decide if 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. If a tolerance has not been agreed on in advance, the normal industry tolerance of 0,75 for glazed tiles shall be used. The ΔE_{cmc} value calculated between a test sample and the reference standard, when compared to this agreed upon 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 will fall into two categories: those for which the ΔE_{cmc} values are less than or equal to the agreed upon tolerance are acceptable (pass), while those for which the ΔE_{cmc} values are greater than the agreed upon tolerance are unacceptable (fail).

8 Test report

The test report shall include the following information:

a) reference to this part of ISO 10545;

b) description of tiles;

c) details of the instrument and specific measurement conditions;

d) the ΔL^*, ΔC^*_{ab}, and ΔH^*_{ab} components;

e) the agreed upon (cf) tolerance;

f) average CMC colour difference calculated between the test and reference tiles.

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