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Ceramic tiles —

Part 20:
Determination of deflection of ceramic tiles for calculating their radius of curvature

Carreaux et dalles céramiques —

Partie 20: Détermination de la flèche des carreaux et dalles céramiques pour calculer leur rayon de courbure

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Foreword

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This document was prepared by Technical Committee ISO/TC 189, *Ceramic tile,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 67, *Ceramic tiles,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 10545 series can be found on the ISO website.

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Ceramic tiles —

Part 20:
Determination of deflection of ceramic tiles for calculating their radius of curvature

1 Scope

This document specifies a method for measuring the deflection of ceramic tiles for calculating their radius of curvature.

NOTE   ISO 13006 provides property requirements for tiles and other useful information on these products.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 10545-4:2019, *Ceramic tiles — Part 4: Determination of modulus of rupture and breaking strength*

ISO 48-2, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
breaking load
F
force necessary to cause the test specimen to break, as read from the pressure gauge

Note 1 to entry: See Figure 1.

3.2
deflection at breaking
Z
deflection of tile at the breaking point under load

Note 1 to entry: See Figure 1.

3.3
curvature radius
r
radius of the circumference that approximates the curve that is determined when the tile is deflected at breaking

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4   Principle

Measure of deflection of ceramic tiles, subjected to a load applied in the middle of the surface during a three-point test. The measure is performed by using dial gauges or other suitable apparatus for linear measurements.

5   Apparatus

The usual laboratory apparatus and, in particular, the following shall be used:

5.1   Drying oven, capable of being operated at (105 ± 5) °C. Microwave, infrared or other drying systems can be used provided that it has been determined that equal results are obtained.

5.2   Recording pressure gauge, with an accuracy to 2,0 %.

5.3   Cylindrical support rods, made of metal, the parts in contact with the test specimens being covered with rubber having a hardness of (50 ± 5) IRHD, measured in accordance with ISO 48-2. One rod shall be slightly pivotable ([Figure 2](#)) and the other shall be slightly rotatable about its own axis. See [Table 1](#) for relevant dimensions.

5.4   Central cylindrical rod, made of same metal and with same diameter as support rods. The parts in contact with the test specimens shall be covered with rubber having a hardness of (50 ± 5) IRHD, measured in accordance with ISO 48-2, for transmission of the load. This rod shall be slightly pivotable ([Figure 2](#)). See [Table 1](#) for relevant dimensions.

Table 1 — Diameter of rods, d, thickness of rubber, t, and overlap of tile beyond the edge supports, l_1

Diameter of rod [mm]	Thickness of rubber [mm]	Overlap of tile beyond the edge supports [mm]
d	t	l_1
20 ± 1	5 ± 1	10 ± 1

5.5   Deflection measurement device, able to measure the deflection in the central point due to the contact between the central cylindrical rod and the surface of the specimen under load, without being affected by the thickness of the specimen, by the deformations of the framework of the equipment and by the deformations generated by the compression of the rubber layers covering the support rods. The centre of the specimen is identified by the crossing point of the two diagonals. The gauge shall be able to measure the deflection with a precision of at least 0,03 mm, in correspondence to the centre of the specimen with a span of + 1 mm. When the test specimen is positioned on the two support rods, the device shall register the deflection in the centre of the specimen with an accuracy of at least 0,1 mm, also including the deformation generated by the test specimen under its own weight. If the deflection measured by the testing equipment includes deviation (e.g. generated by the rubber of the rod or frame), the deflection value, Z, shall be corrected to remove such variables.

5.6   Stiff brush, with coarse bristles, for removing loose particles.

6   Test specimens

Select the tiles at random from the lot to be tested.

[Table 2](#) reports recommended specimen dimensions with relevant thickness. In the case of special requests, it is possible to agree on different dimensions of the specimens being sure that the equipment

is suitable for test and tile deflection under its own weight is considered. Any condition on tile surface which can influence the measurement shall be registered before testing (e.g. relief surfaces).

If test specimens are obtained by cut, it is allowed to obtain more than one specimen from the same tile. The long side of the specimen shall be cut parallel to the long side of the tile and, for extruded tiles, parallel to the direction of extrusion.

Table 2 — Recommended specimen nominal dimensions with relevant thickness

Thickness (T) [mm]	Length [mm]	Width [mm]
$3 \leq T < 4$	400	250
$4 \leq T < 5$	500	200
$5 \leq T < 7$	600	200
$7 \leq T < 9$	700	100
$9 \leq T < 11$	800	100
$11 \leq T < 13$	900	100
$13 \leq T \leq 15$	1 000	100

Tiles and specimens shall not contain any visible damage or cracks prior to testing and shall not have been tested previously. Test a minimum of seven specimens keeping the front surface always up, unless the test has been expressly requested on the back surface.

7 Procedure

Remove any loosely adhering particles from the back of all test specimens with a stiff brush, without altering the specimens. Dry each test specimen in the drying oven (5.1) maintained over (105 ± 5) °C during at least 24 h and let them cool until they reach room temperature. Test specimens shall be tested not later than 3 h after they have reached room temperature.

Place the test specimen on the support rods (5.3) so that the test specimen projects by a length, l_1, (see Table 1 and Figure 1) beyond each support rod. Place the test specimens with the long side at right angles to the support rods. Proceed to apply the load as reported in ISO 10545-4:2019, 7.5, and record the deflection at breaking, Z, for each test specimen.

8 Calculation

For each specimen, calculate the curvature radius using the following formula based on the approximation of a circumference.

$$r = \frac{Z}{2} + \frac{l_2^2}{8Z}$$

where

    r is the curvature radius on deflection at breaking (Z);

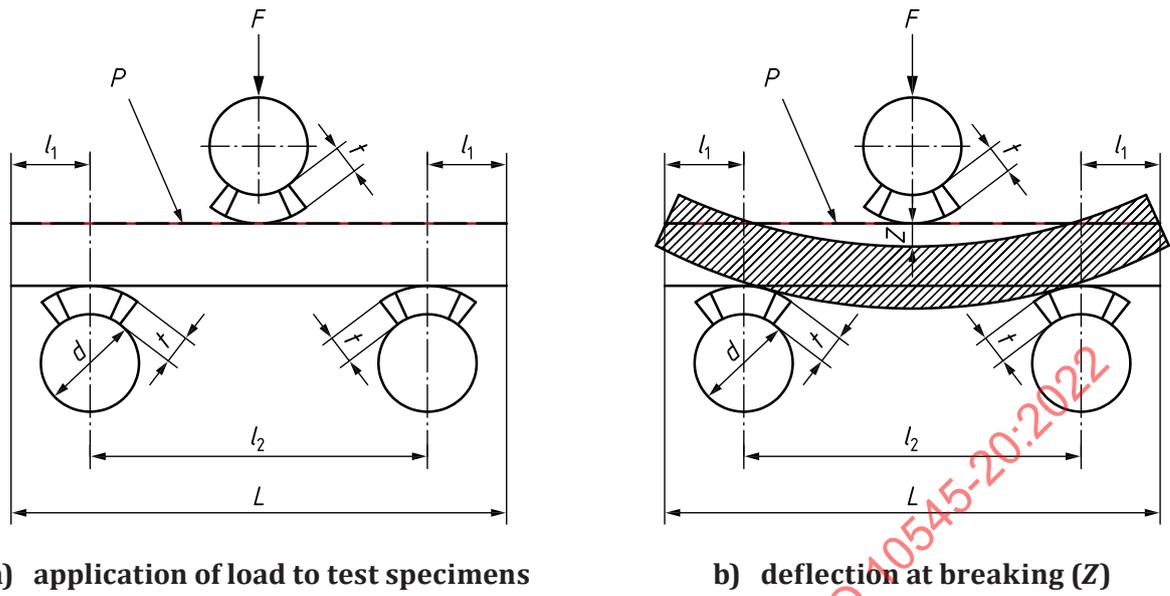 Z is the deflection at breaking;

    l_2 is the span between the support rods.

NOTE   It is possible that test specimens have a deflection at breaking higher or equal to 5 mm.

9 Test report

The test report shall include the following information:

a) a reference to this document, including the year of publication;

b) a description of the tiles, including relief surface, if any;

c) the original dimension of the tiles;

d) the number of test specimens, specifying if cut from the same tile;

e) the dimensions of the test specimens;

f) the test conditions if different from the one prescribed by this document;

g) the values of d, t, l_1, and l_2 (in mm, rounded to the unit) (see Figure 1);

h) the deflection at breaking, Z, (in mm, rounded to the tenth) of each test specimen, specifying if the test was carried out on the front or on the back of the test specimen;

i) the mean deflection at breaking (in mm, rounded to the tenth), specifying if the test was carried out on the front or on the back of the test specimen;

j) the breaking load, F, (in N, rounded to the unit) of each test specimen;

k) the mean breaking load (in N, rounded to the unit);

l) the curvature radius, r, (in meters, rounded to the tenth) of each test specimen, specifying if the test was carried out on the front or on the back of the test specimen;

m) the mean curvature radius (in meters, rounded to the tenth), specifying if the test was carried out on the front or on the back of the test specimen.

a) application of load to test specimens   b) deflection at breaking (Z)

Key

F breaking load

P surface of the specimen

Z deflection at breaking

t thickness of rubber

d diameter of rod

L long side of tile

l_1 overlap of tile beyond the edge supports

l_2 span between the support rods

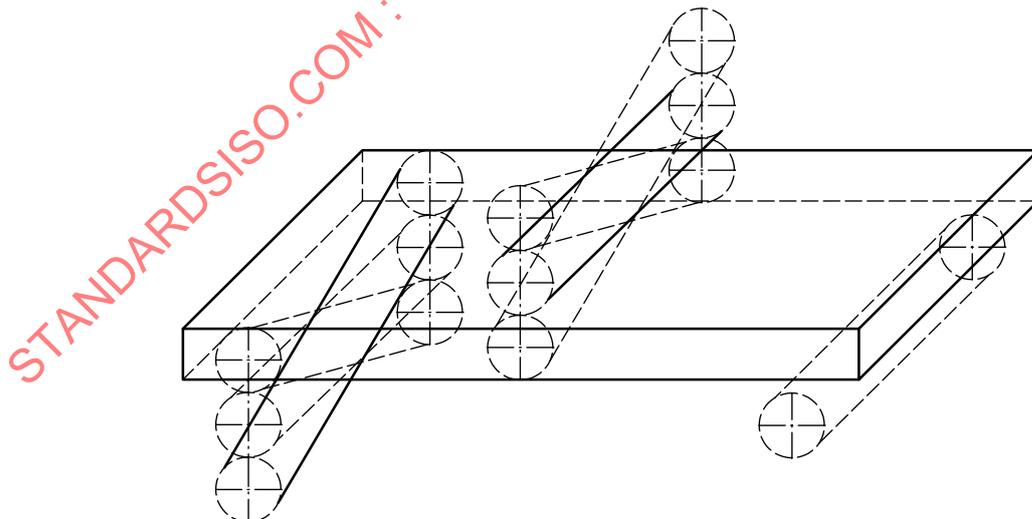**Figure 1 — Scheme of breaking load (F) and deflection at breaking (Z)**

Figure 2 — Allowable movement of rods

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