INTERNATIONAL STANDARD

ISO 10545-7

First edition
1996-12-15

Ceramic tiles —

Part 7:
Determination of resistance to surface abrasion for glazed tiles

Carreaux et dalles céramiques —

Partie 7: Détermination de la résistance à l'abrasion de surface pour les carreaux et dalles émaillés

Reference number
ISO 10545-7:1996(E)

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 10545-7 was prepared by Technical Committee ISO/TC 189, *Ceramic tile*.

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*

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

— *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*

Annex A of this part of ISO 10545 is for information only.

Ceramic tiles —

Part 7:
Determination of resistance to surface abrasion for glazed tiles

1 Scope

This part of ISO 10545 specifies a method for determining the resistance to surface abrasion of all glazed ceramic tiles used for floor covering.

2 Normative reference

The following standards 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.

ISO 8486-1:— [1], *Bonded abrasives — Grain size analysis — Designation and determination of grain size distribution — Part 1: Macrogrits F 4 to F 220.*

ISO 10545-14:1995, *Ceramic tiles — Part 14: Determination of resistance to stains.*

3 Principle

Determination of the abrasion resistance of the glaze of tiles by rotation of an abrasive load on the surface and assessment of the wear by means of visual comparison of abraded test specimens and non-abraded tiles.

4 Abrasive load

The total load on each test specimen shall consist of

70,0 g of steel balls of diameter 5 mm;
52,5 g of steel balls of diameter 3 mm;
43,75 g of stell balls of diameter 2 mm;
8,75 g of steel balls of diameter 1 mm;
3,0 g of white fused aluminium oxide of grain size F 80 according to ISO 8486;
20 ml of deionized or distilled water.

1) To be published. (Revision of ISO 8486:1986)

5 Apparatus

5.1 Abrasion apparatus (see figure 1), consisting of a steel case with an inbuilt electrical drive connected to a horizontal supporting plate with positions for test specimens of dimensions at least 100 mm × 100 mm. The distance between the centre of the supporting plate and the centre of each position shall be 195 mm. There shall be equal distances between each adjacent position. The supporting plate shall rotate at 300 r/min with an eccentricity, *e*, of 22,5 mm so that every part of each test specimen describes a circular motion of diameter 45 mm. The test specimens are held down with the aid of metal holders which are provided with rubber seals (see figure 2). The internal diameter of the holders is 83 mm, thus providing a test area of about 54 cm^2. The thickness of the rubber is 9 mm and the height of the space under the holder is 22,5 mm.

The apparatus switches off automatically after completion of a present number of revolutions.

The supporting plate with holders and test specimens shall be covered during operation.

A suitable apparatus of another description may be used, provided it gives the same results as those obtained with the apparatus described below.

5.2 Apparatus for visual assessment (see figure 3), consisting of a viewing box equipped with fluorescent lighting of colour temperature 6 000 K to 6 500 K placed vertically above the surface to be observed providing 300 lx illuminance. The dimensions of the box shall be 61 cm × 61 cm × 61 cm and the inner faces shall be painted a neutral gray. The light source is screened to avoid direct viewing.

5.3 Drying oven, capable of being operated at (110 + 5) °C.

5.4 Balance (if mass loss is required).

6 Test specimens

6.1 Types of test specimens

Test specimens shall be representative of the sample. Where tiles have different colours or decorative effects in parts of the surface, care should be taken to include all the distinctive parts.

The usual facial dimensions of test specimens are 100 mm × 100 mm. Test specimens with smaller facial dimensions shall be fastened close together on a suitable supporting material. Edge effects at the narrow joints shall be ignored.

6.2 Number of test specimens

Eleven test specimens are required. In addition, eight test specimens are required for the visual assessment.

The procedure requires one test specimen for each state of abrasion, and subsequently an additional three test specimens to ckeck the result at the visual-failure point.

6.3 Preparation

The glazed surfaces of the test specimens shall be clean and dry.

Dimensions in millimetres

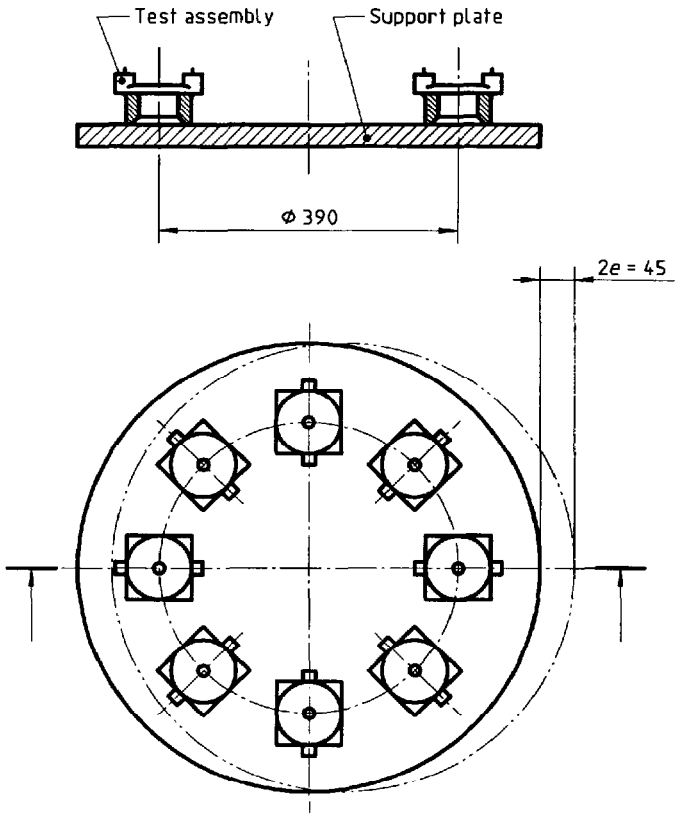

Figure 1 — Abrasion apparatus

Dimensions in millimetres

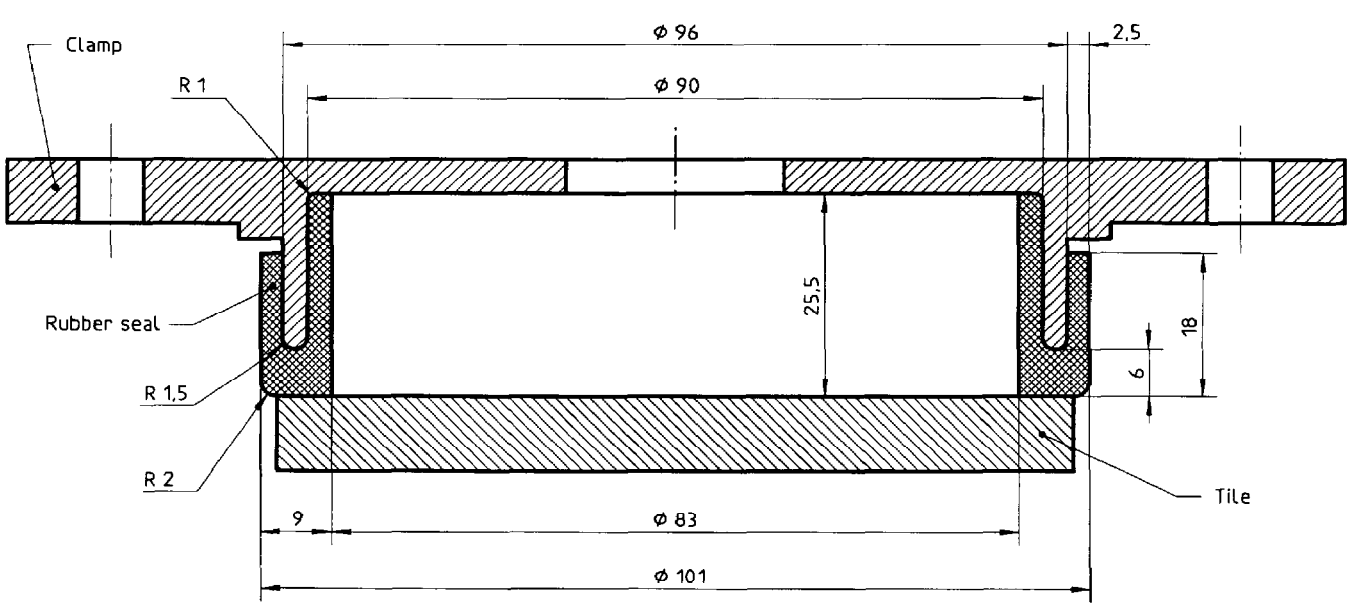

Figure 2 — Specimen holder

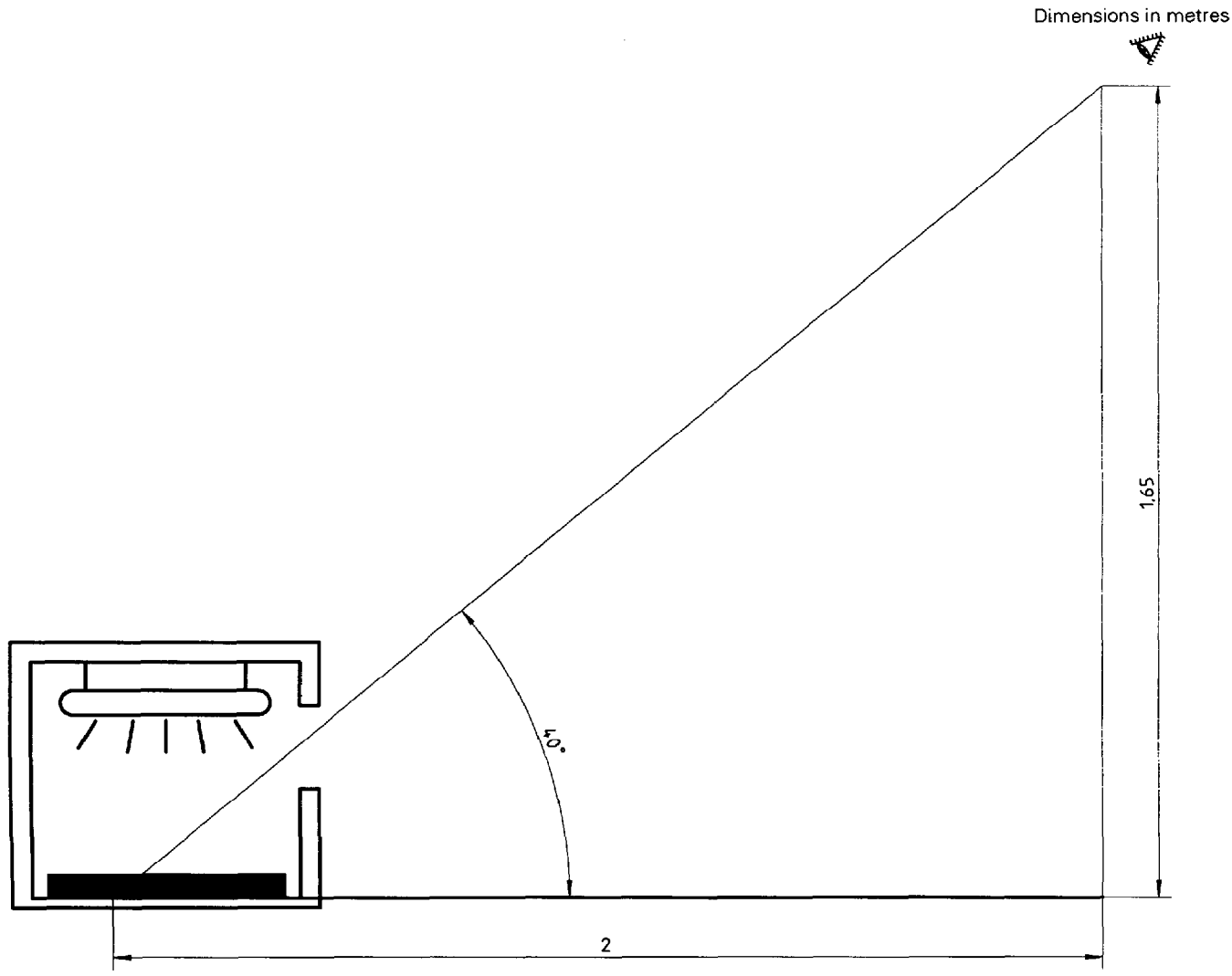

Figure 3 — Arrangement for visual assessment

7 Procedure

Calibration of the abrasion apparatus is only occasionally necessary or when there is a doubt regarding the validity of the results. One possible calibration method is described in Annex A.

Clamp a metal holder onto the glazed surface of each test specimen on the abrasion apparatus (5.1). Introduce the abrasive load (clause 4) into the holder through a hole in its upper surface. Then seal the hole to prevent loss from the abrasive load. The number of revolutions of the preset counter required for each abrasion stage of the test is 100, 150, 600, 750, 1 500, 2 100, 6 000, and 12 000. Remove one test specimen after each abrasion stage and continue the test until failure is observed.

After abrasion, rinse the test specimens under running water and dry in the oven (5.3) at (110 ± 5) °C. If the test specimens are stained with iron oxide, completely remove the stain with 10 % (*V/V*) hydrochloric acid. Immediately rinse under running water and dry.

For the visual comparison, surround an abraded test specimen with unabraded tiles of exactly the same type in an apparatus for visual assessment under an illuminance of 300 lx. View with the naked eye (or with spectacles if usually worn) from a distance of 2 m and a height of 1,65 m in a darkened room. Note the number of revolutions at which any change in the area that has been sujected to abrasion can readily be distinguished. The consensus of at least three observers is required.

Check the result by retesting at the abrasion stage when failure is observed and at the next higher *and lower* abrasion stages. If the restult is not the same, use the lower of the two abrasion stages to decide upon the classification.

Then test the abraded area of the tile which has passed the 12 000 revolutions stage for stain resistance in accordance with ISO 10545-14.

After use, clean the steel balls with water followed by methylated spirits and then thoroughly dry to prevent rusting. Before each test, screen the steel balls in the abrasive load into specified size categories (see clause 4) and replace any mass in each size category.

If there is an agreement to determine the mass lost from a surface during abrasion testing, obtain this by measuring the dry mass of three test specimens before the test and after 6 000 revolutions. Upon agreement, subsequently test abraded tiles which have passed the 1 500, 2 100 and 6 000 revolutions stages for stain resistance in accordance with ISO 10545-14 at the abrasion stage at which visual failure occurred. Other relevant properties may be determined by agreement during the execution of the test procedure, for instance change of colour or gloss. The additional information which is obtained by agreement shall not be used to classify tiles.

8 Classification of results

The test specimens shall be classified according to table 1. In order to be classified as Class 5, the tile shall also pass the test specified in ISO 10545-14 for resistance to stains on the abraded area. However, the following modifications to ISO 10545-14 will apply:

1) only one abraded tile (> 12 000 revolutions) may be used, provided care is taken to ensure separation of the stains (for example cutting the abraded tile prior to testing the resistance to stains);
2) cleaning procedure D specified in ISO 10545-14 shall be used without first employing procedures A, B and C.

If there is no visual failure after 12 000 revolutions but if stains cannot be removed by any of the procedures (A, B, C or D) specified in ISO 10545-14, the tile shall be of Class 4.

Table 1 — Classification of glazed ceramic tiles

Abrasion stage; Failure visible at revolutions	Class
100	0
150	1
600	2
750, 1 500	3
2 100, 6 000, 12 000	4
>12 000[1)]	5

1) Must pass the test specified in ISO 10545-14 for resistance to stains.

9 Test report

The test report shall include the following information:

a) reference to this part of ISO 10545;
b) a description of the tiles, including means of preparing the test specimens;
c) the classification according to clause 8;
d) the abrasion stage at which visual failure occurred;
e) by agreement, class of stain resistance for tiles of abrasion Class 4;
f) mass loss, colour change, gloss change or other properties measured by agreement.

Annex A
(informative)

Calibration of the abrasion apparatus using float glass

A.1 Reference material

The reference material shall be float glass with a minimum thickness of 6 mm.

Information about suitable reference materials may be obtained from national standards institutions.

A.2 General

As the calibration test is carried out on the float-bath side, this has first to be identified.

One of the following methods can be used.

A.2.1 Chemical method

A.2.1.1 Reagents

A.2.1.1.1 Etching solution

Thoroughly mix 10 volumes of concentrated hydrochloric acid, 8 volumes of concentrated hydrofluoric acid [40 %(*V*/*V*)] and 10 volumes of distilled water.

A.2.1.1.2 Cacotheline solution, 0,1 % (*V*/*V*) cacotheline in distilled water.

A.2.1.2 Procedure

Place 2 or 3 drops of the etching solution on the glass surface followed by 1 or 2 drops of the cacotheline solution.

In 5 s to 10 s, a purple colour will be seen on the float-bath side; otherwise, the solution will remain yellow.

A.2.2 Ultraviolet (UV) method

View the glass surface in a dark room when illuminated by ultraviolet light as shown in figure A.1. The float-bath side exhibits a slight fluorescence.

CAUTION — Ultraviolet light in the region 254 nm to 365 nm will damage the eyes and suitable protective UV-filter goggles must be worn.

A.2.3 Energy dispersive analysis (EDA) method

Examine the glass surfaces by energy dispersive analysis. The float-bath side is identified by its tin content.

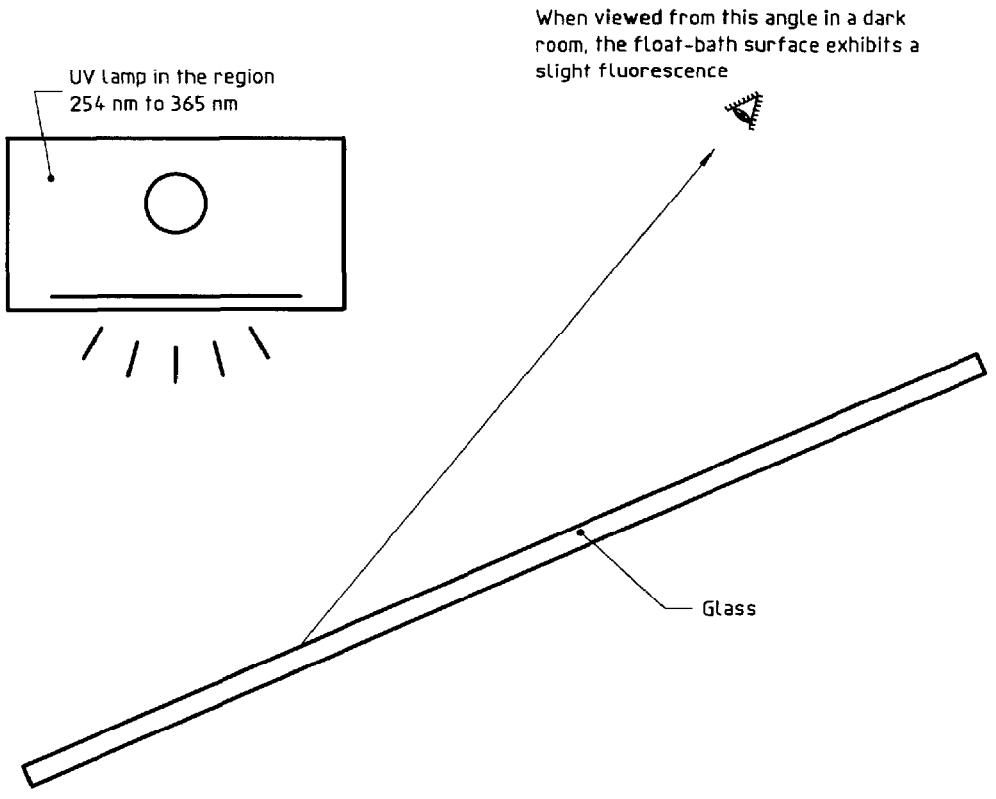

Figure A.1 — Arrangement for the UV method

A.3 Procedure for calibration

A.3.1 General

The abrasion apparatus is calibrated by measuring either the loss in mass (see A.3.2), or the change in gloss (see A.3.3). Eight float glass specimens of size 100 mm × 100 mm are abraded on the float-bath side using the abrasive load (clause 4).

A.3.2 Mass loss

Dry the test specimens in the drying oven (5.3) maintained at (110 ± 5) °C and measure the mass of each. Abrade the specimens for 6 000 revolutions. Rinse and then dry the specimens again at (110 ± 5) °C. Determine the loss in mass of each specimen and calculate the mean loss. Measure the abraded area of each specimen.

The abrasion apparatus is satisfactory if the mean loss in mass is (0,032 ± 0,002) mg per square millimetre of the abraded area.

A.3.3 Gloss change

Measure the 60° specular gloss on the float-bath side at the centre of each test specimen backed by a matt black surface, for example black velvet. Abrade the specimens for 1 000 revolutions. Rinse and then dry the specimens and remeasure the 60° specular gloss. Calculate the percentage loss in gloss for each specimen and the mean loss in gloss.

The abrasion apparatus is satisfactory if the mean loss in gloss at the centre of the abraded area is (50 ± 5) %.

NOTE — If any difficulty is experienced in obtaining stable initial gloss values, the specimens may first be cleaned by immersion in water containing a trace of detergent for at least 1 h at (75 ± 5) °C followed by rinsing with warm water.

ICS 91.100.20

Descriptors: ceramics, floor coverings, tiles, tests, abrasion tests, determination, abrasion resistance.

Price based on 7 pages