IS 4457 (2007): Ceramic unglazed vitreous acid resisting tile - [CED 5: Flooring, Wall Finishing and Roofing]

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भारतीय मानक

सिरैमिक की रलेज रहित काँचाभ अम्ल प्रतिरोधक टाइलें — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

CERAMIC UNGLAZED VITREOUS ACID RESISTING TILES — SPECIFICATION

(Second Revision)

ICS 91.100.23

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 8

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Flooring, Wall Finishing and Roofing Sectional Committee had been approved by the Civil Engineering Division Council.

Ceramic unglazed vitreous acid resisting tiles are suitable for protecting surfaces against corrosive action of acids and chemicals as well as to resist abrasion. These tiles are intensively used as floor covering for chemical and allied industries, lining of tanks, etc, where the necessity of resistance to acid and resistance to wear becomes essential. These tiles are normally used with chemical resistant mortars.

This standard was first published in 1967. As a result of the increased use of the standard, considerable amount of suggestions had been received from various bodies implementing it. This standard was first revised in 1982.

In order to accommodate changes in technology and higher demands on product performance this standard is being revised with a view to modify some of the provisions already laid down and adding some new provisions.

Experience shows that the modular dimensions of tiles specified in the earlier version of the standard are not being manufactured at present. The Committee responsible for the formulation of this standard feels that the difficulties experienced by the manufacturers to produce tiles to modular size could be overcome gradually by adjusting the manufacturing practice, and with this aspect in view, the dimensionally coordinated size has been retained. Also, it was felt that the revised version should be compatible with international market requirements and should be similar to ISO specification. However, tiles restricted up to a thickness of 20 mm have only been covered in this revision and units having thickness greater than 20 mm and termed as acid resisting bricks are intended to be covered in IS 4860 : 1968 'Specification for acid-resistant bricks'. The test for ascertaining the loss in abrasion, which was otherwise left to the agreement between the purchaser and the supplier in the earlier version, has been made compulsory and a specific value for abrasion loss has been recommended. Additional tests on flexural strength that are considered to be important in controlling the quality of such tiles have been introduced.

With improvements in manufacturing processes and the ever increasing demand of the consumer to have as little variation as possible, tolerances on length and width have been revised to better levels. This section has been included as a part of the 'Requirements' section, along with the other physical properties. Also, the tolerance values have been made more stringent when compared to the earlier standard. Since consumer demand for larger sized tiles is increasing (primarily because of the significant reduction in joints), it was felt that the tolerance limits need to be tighter. Larger sized tiles are prone to variations in size and thickness, if proper controls are not exercised. This can lead to creation of wide and uneven joints, defeating the very purpose of using the larger sized tiles.

Current ISO Standards have been adopted for the testing method of dimensions, warpage, straightness of sides and rectangularity and these results as prescribed by the ISO Standards shall be reported as a percentage in the current revision. Warpage has been expanded to include surface flatness, centre curvature and edge curvature.

The water absorption of the tile has been revised and requirements changed to less than 0.5 percent, instead of the current 2 percent. Over the years, customers have been demanding lower water absorption for improved acid and stain resistance performance. Also, the demand for higher strength from industrial consumers requires the product to have higher vitrification levels. Thanks to the use of better raw materials and newer technologies manufacturers are now able to satisfy this requirement. The product is expected to perform satisfactorily under current conditions provided the water absorption is less than 0.5 percent.

(Continued on third cover)

Indian Standard

CERAMIC UNGLAZED VITREOUS ACID RESISTING TILES — SPECIFICATION

(Second Revision)

1 SCOPE

This standard lays down the requirements for ceramic unglazed vitreous acid resisting tiles.

2 REFERENCES

The standards given in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards given at Annex A.

3 MANUFACTURE

The tiles shall be of vitreous ware and shall be free from deleterious substances. The finished tile, when fractured, shall appear fine grained in texture, dense and homogeneous. The tiles shall be sound, true to shape, flat, free from flaws and other manufacturing defects affecting their utility.

4 DIMENSIONS AND TOLERANCES

4.1 Sizes

a) 100 mm × 100 mm or 98.5 mm × 98.5 mm,
b) 150 mm × 150 mm or 148.5 mm × 148.5 mm,
c) 200 mm × 200 mm or 198.5 mm × 198.5 mm,
d) 304 mm × 304 or 300 mm × 300 mm,
e) 290 mm × 290 mm,
f) 304 mm × 151 mm or 300 mm × 150 mm,
g) 204 mm × 204 mm or 200 mm × 200 mm,
h) 200 mm × 100 mm or 198.5 mm × 98.5 mm, and
j) Or any other size as agreed between the manufacturer and the purchaser provided it is less than 375 mm × 375 mm.

The manufacturer shall choose the work size as follows:

a) For modular tiles in order to allow a nominal joint width of between 2 to 5 mm.
b) For non-modular tile so that the difference between the work size and the nominal size is not more than ± 2 percent (± 5 mm maximum).

NOTE — Similar joint widens may be used to apply to traditional system based on non-metric size.

4.2 Thickness

20, 15, 12, 10, 8 mm or any other thickness as reported by the manufacturer, provided it is less than 20 mm.

4.3 Half tiles for use as full tiles, if manufactured, shall have dimensions that shall be such as to make the half tiles, when joint together, match with the dimension of a full tile.

5 REQUIREMENTS

The tiles shall conform to the requirements given in col 2 of Table 1 when tested as per the method indicated in col 4 (*see* Annexes B to G).

6 MARKING

6.1 Each tile shall be legibly marked on the back with the following:

a) Name and address of the manufacturer and/ or trade-mark and the country of origin, and
b) Batch number/date of manufacture.

6.2 BIS Certification Marking

The tiles may also be marked with the Standard Mark.

6.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7 PACKING

The tiles shall be packed according to the usual trade practice and adequately protected.

8 SAMPLING AND CRITERIA FOR CONFORMITY

8.1 Lot

In a single consignment, all the tiles of the same shape, size and thickness produced under similar conditions of manufacture, shall constitute a lot.

Table 1 Unglazed Ceramic Vitreous Acid Resisting Tiles

(*Clause* 5)

Sl No.	Requirement	Surface Area (S) of the Product cm^2				Method of Test, Ref to Annex
(1)	(2)	(3)				(4)
		$S \leq 90$ Percent	$90 < S \leq 190$ Percent	$190 < S \leq 410$ Percent	$S > 410$ Percent	
i)	**Dimensions and Surface Quality**					
	a) *Length and width*					B
	1) The deviation in percent of the average size for each tile (2 or 4 sides) from the work size (w)	1.2	±1.0	±0.75	±0.6	
	2) The deviation in percent of the average size for each tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides)	± 0.75	±0.5	±0.5	±0.5	
	b) *Thickness*					
	The deviation in percent of the average thickness of each tile from the work size thickness. (The thickness shall be declared by the manufacture)	±10.0	±10.0	±5.0	± 5	
	c) *Straightness of sides*[1] *(facial sides)*					
	The maximum deviation from straightness in percent related to the corresponding size	± 0.75	±0.5	±0.5	± 0.2	
	d) *Rectangularity*					
	The maximum deviation from rectangularity in percent related to the corresponding work sizes	± 1.0	±0.6	±0.6	0.2	
	e) *Surface flatness*					
	1) Centre curvature, related to diagonal calculated from the work sizes	±1.0	±0.5	±0.5	±0.3	
	2) Edge curvature, related to the corresponding work size	±1.0	±0.5	±0.5	±0.3	
	3) Warpage, related to diagonal calculated from the work sizes	±1.0	±0.5	±0.5	±0.3	
ii)	**Surface Quality**[2]	Minimum 95 percent of the tiles shall be free from visible defects that would impair the appearance of a major area of tiles				B
iii)	**Physical Properties**					
	a) Water absorption by weight [3]	Average < 0.5 percent, individual 0.6, *Max*				C
	b) *Breaking strength*, in N					D
	1) Thickness ≥ 7.5 mm	1 300, *Min*				
	2) Thickness < 7.5 mm	700, *Min*				
	c) Modulus of rupture, in N/mm^2 Not applicable to tiles with breaking strength ≥ 3 000 N	Average 35, individual 32, *Min*				
	d) *Abrasion resistance*[4]					
	Resistance to deep abrasion of unglazed tiles: removed volume in mm^3	175, *Max*				E
iv)	**Chemical Properties**					
	a) Resistance to chemicals[5]					
	1) Resistance to low concentrations of acids and alkalies[6]	The level of resistance (Class) may be as agreed to between the manufacturer and the purchaser of the product				F
	2) Resistance to high concentrations of acids and alkalies[5]					
	3) Resistance to household chemicals and swimming pool salts[6]					
	b) Resistance to concentrated HNO_3 and H_2SO_4	Loss in mass not to exceed 1.5 percent				G

[1] Not applicable for tiles having curved shapes.

[2] Because of firing slight variation from the standard colour are unavoidable. This does not apply to intentional irregularities of colour variation of the face of tiles (which can be unglazed) or the colour variation over a tile area that is characteristic for this type of tile and desirable. Spots or coloured dots which are introduced for decorative purposes are not considered a defect.

[3] A vitrified tile is a tile with water absorption of a maximum individual value of 0.5 percent (some times described as impervious).

[4] Reference may be made to Annex D for the abrasion resistance classification for all unglazed tiles intended for use of floors.

[5] Reference may be made to Annex E for information regarding requirements which are non-compulsory but that are listed as 'test method available'.

[6] If the hue becomes slightly different, this is not considered to be chemical attack.

8.2 Sample Size and Criteria for Conformity

In respect of characteristics covered under (*see* **6**) dimensions and tolerances (*see* **4**) marking along with the requirements for straightness of sides and surface flatness (*see* **5**) the number of tiles to be selected from lot shall be in accordance with Table 2. The tiles shall be selected at random from the lot; for the actual method of random selection IS 4905 may be referred. Each tile in the sample shall be examined for each of the above requirements. A tile failing in one or more of these requirements shall be termed as a defective.

8.2.1 The lot shall be considered as conforming to these requirements, if the number of defectives in the sample does not exceed the corresponding acceptance number in Table 2.

8.2.2 In respect of all the other requirements the following procedure shall be adopted.

8.2.2.1 For lots containing up to 100 tiles the number of tests and criteria for conformity in respect of the requirements not covered in **8.2.1** shall be agreed.

Table 2 Scale of Sampling and Acceptance Number

(*Clauses* 8.2 *and* 8.2.1)

Sl No.	No. of Tiles in the Lot	Sample Size	Acceptance No.
(1)	(2)	(3)	(4)
i)	Up to 8	5	0
ii)	9-25	8	0
iii)	26-50	13	0
iv)	51-100	20	1
v)	101-500	32	2
vi)	501 and above	50	3

8.2.2.2 For lots containing 101 to 300 tiles one test and for lots containing more than 300 tiles two tests, for each of the requirements not covered under **8.2.1** shall be conducted on samples taken at random from those already inspected and found satisfactory in **8.2.1**. The lot shall be considered as conforming, if in respect of each of these requirements each sample tested is found satisfactory.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
264 : 2005	Nitric acid — Specification (*third revision*)
266 : 1993	Sulphuric acid (*third revision*)
460 (Part 1) : 1985	Specification for test sieves: Part 1 Wire cloth test sieves (*third revision*)
2062 : 1999	Steel for general purposes (*fifth revision*)
2303 : 1994	Method of grading glass for alkalinity (*first revision*)
3400 (Part 2) : 1995	Methods of test for vulcanized rubbers: Part 2 Hardness (*second revision*)
4860 : 1968	Specification for acid-resistant bricks
4905 : 1968	Methods for random sampling
11643 : 1985	Specification for silicon carbide for bonded abrasive products

ANNEX B

(*Table* 1)

DETERMINATION OF DIMENSIONS AND SURFACE QUALITY

B-1 GENERAL

B-1.1 This Annex covers methods for determining the dimensional characteristics (length, width, thickness, straightness of sides, rectangularity, surface flatness) and the surface quality of all ceramic tiles.

B-1.2 Tiles with area less than 400 mm^2 are excluded from measurements of length, width, thickness, straightness of sides, rectangularity, and surface flatness.

B-1.3 Spacer lugs, glaze bobs and other irregularities of the sides shall be ignored when measuring length, width, and straightness of sides, rectangularity, if these are subsequently hidden in the joints after fixing.

B-2 MEASUREMENTS OF LENGTH AND WIDTH

B-2.1 Apparatus

Vernier calipers or other suitable apparatus for linear measurement.

B-2.2 Test Specimens

Ten whole tiles in each type shall be tested.

B-2.3 Procedure

Measure each side of the tile under test at positions 5 mm from the corners. Measurements shall be made to the nearest 0.1 mm.

B-2.4 Expression of Results

The average dimension of square tiles is the average of four measurements. The average dimension of the sample is the average of 40 measurements. For oblong tiles, each similar pair of sides of a tile provides the appropriate average dimension of the tile, an average of two measurements. The average dimensions for length and width are the average of 20 measurements each.

B-2.5 Test Report

The test report shall contain the following:

a) Description of the tiles;
b) All measurements of length and width;
c) Average size of each test specimen for square tiles, and the average length and width for each oblong tile;
d) Average size of 10 test specimens for square tiles and the average length and width of oblong tiles;
e) Deviation in percent of the average size of each tile (2 or 4 sides) from the work size; and
f) Deviation in percent of the average size of each tile (2 or 4 sides) from the average size of the 10 test specimens (20 or 40 sides).

B-3 MEASUREMENTS OF THICKNESS

B-3.1 Apparatus

Micrometer screw gauge with anvils of 5 to 10 mm diameter, or other suitable apparatus.

B-3.2 Test Specimens

Ten whole tiles in each type shall be tested.

B-3.3 Procedure

B-3.3.1 For all tiles except split tiles, draw diagonals between the corners and measure the thickness at the thickest point within each of the four segments. Measure the thickness of each tile under test in four positions to an accuracy of 0.1 mm.

B-3.3.2 For split tiles, draw four lines at right angles across the extruded projections of 1/8, 3/8, 5/8, 7/8 of the length measured from the end. Measure the thickness at the thickest point on each line.

B-3.4 Expression of Results

For all tiles the average thickness of each individual tile is the average of four measurements. The average thickness of the sample is the average of 40 measurements.

B-3.5 Test Report

The test report shall contain the following:

a) A description of the tiles;
b) All measurements of thickness;
c) Average thickness of each test specimen; and
d) Deviation in percent of the average thickness of each tile (2 or 4 sides) from the work size thickness.

B-4 MEASUREMENTS OF STRAIGHTNESS OF SIDES

B-4.1 Terminology

For the purpose of measurement of straightness of

ceramic tiles according to this standard, the following definition shall apply.

B-4.1.1 *Straightness of Sides* — Defined as the deviation from straightness of the centre of the side in the plane of the tile. The measurement is only relevant to the straight sides of tiles (*see* Fig. 1).

B-4.2 Apparatus

B-4.2.1 An apparatus as shown in Fig. 2, or other suitable apparatus such as steel square. The dial gauge (*A*) is used for measuring the straightness of sides.

B-4.2.2 A calibrating plate made of steel of accurate dimensions and with straight flat sides.

B-4.3 Test Specimens

Ten whole tiles in each type shall be tested.

B-4.4 Procedure

B-4.4.1 Select an apparatus of the appropriate dimensions so that, when a tile is placed in the apparatus, the locating studs are 5 mm from the each corner of the side being measured.

B-4.4.2 Fit the appropriate calibrating plate exactly into position in the instrument and adjust the dial gauge reading to a suitable known value.

B-4.4.3 Remove the calibrating plate, place the proper surface of the tile on the locating studs in the apparatus and record the dial gauge reading in the centre of the side. Rotate the tile, if square, to obtain four measurements. Repeat this procedure for each tile. In the case of oblong tiles, use separate instruments of the appropriate dimensions to measure lengths and width. Measure to an accuracy of 0.1 mm.

B-4.5 Test Report

The test report contains the following:

a) A description of the tiles;
b) All measurements of straightness of sides; and
c) Maximum deviation from straightness in percent, related to the corresponding work sizes.

B-5 MEASUREMENT OF RECTANGULARITY

B-5.1 Terminology

For the purpose of measurement of rectangularity of ceramic tiles according to this standard, the following definition shall apply.

B-5.1.1 *Deviation from Rectangularity* — If a corner of the tile is placed against the angle of an accurate calibrating plate (*see* Fig. 3), deviation in percent from rectangularity is defined as:

$$= \frac{\delta}{L} \times 100$$

where

δ = deviation of the outer corner of the side of the tile (measured 5 mm from the corner) from the inner side of the calibrating plate, and

L = length of the adjacent sides of the tile.

B-5.2 Apparatus

B-5.2.1 An apparatus as shown in Fig. 2, or other suitable apparatus such as steel square. The dial gauge (*B*) is used for measuring the rectangularity of sides.

B-5.2.2 A calibrating plate, made of steel of accurate dimensions and with straight flat sides.

B-5.3 Test Specimens

Ten whole tiles in each type shall be tested.

B-5.4 Procedure

B-5.4.1 Select an apparatus of the appropriate dimensions so that, when a tile is placed in the apparatus, the locating studs are 5 mm from the each corner of the side being measured. The plunger of the dial gauge (*B*) shall also be 5 mm from the corner of the tile on the side being measured.

B-5.4.2 Fit the appropriate calibrating plate exactly into position in the instrument and adjust the dial gauge reading to a suitable known value.

B-5.4.3 Remove the calibrating plate, place the proper surface of the tile on the locating studs in the apparatus and record the dial gauge reading 5 mm from the corner. Rotate the tile, if square, to obtain four measurements. Repeat this procedure for each tile. In the case of oblong tiles, use separate instruments of the appropriate dimensions to measure lengths and width. Measure to an accuracy of 0.1 mm.

B-5.5 Expression of Results

Rectangularity shall be expressed as a percentage of the length and width for oblong tiles; and the size for square tiles.

B-5.6 Test Report

The test report contains the following:

a) A description of the tiles;
b) All measurements of rectangularity; and
c) Maximum deviation from rectangularity in percent, related to the corresponding work sizes.

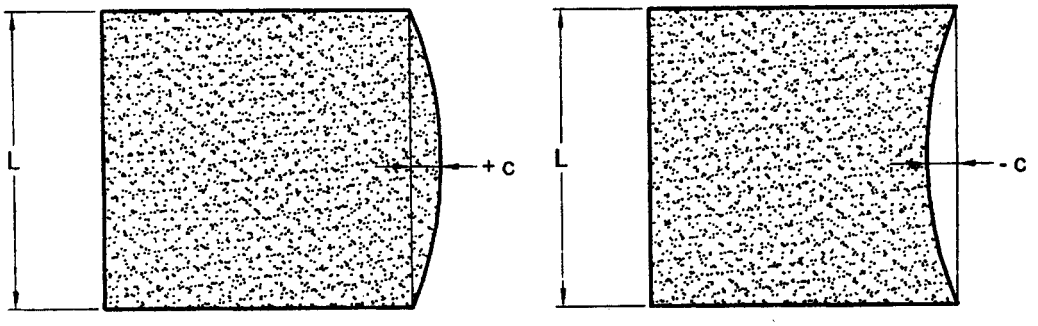


FIG. 1 STRAIGHTNESS OF SIDES, DEVIATION FROM STRAIGHTNESS: *c/L*

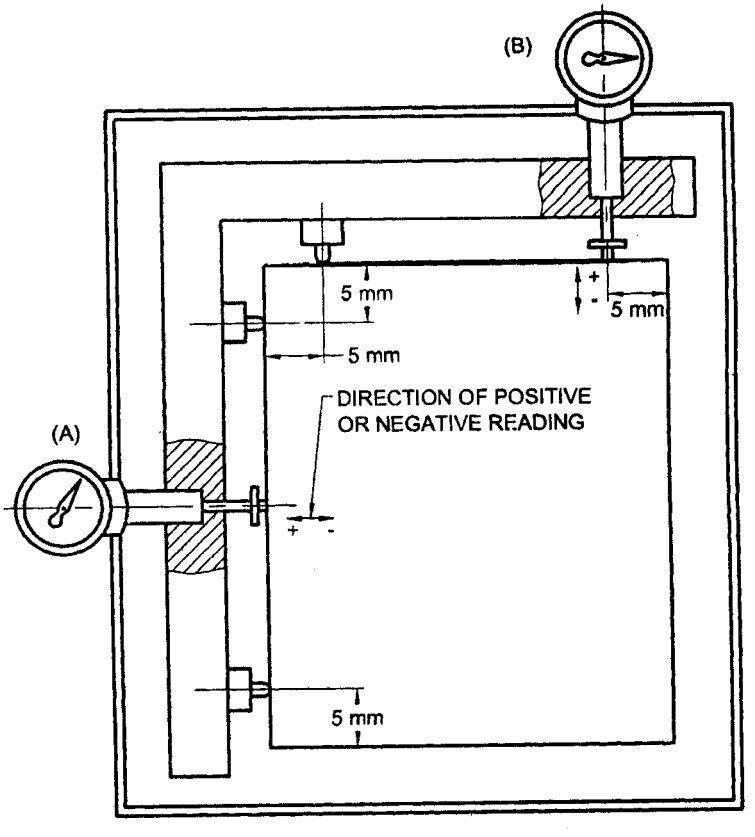


FIG. 2 APPARATUS FOR MEASUREMENT OF STRAIGHTNESS OF SIDES AND RECTANGULARITY

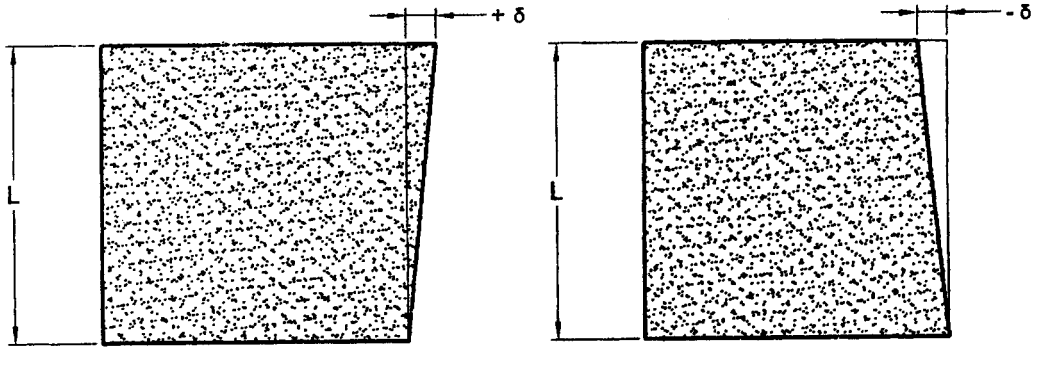


FIG. 3 RECTANGULARITY, DEVIATION FROM RECTANGULARITY δ/*L*

B-6 MEASUREMENTS OF SURFACE FLATNESS (CURVATURE AND WARPAGE)

B-6.1 Terminology

For the purpose of measurement of surface flatness (curvature and warpage) of ceramic tiles according to this standard, the following definitions shall apply.

B-6.1.1 *Surface Flatness* — Defined by measurements in three positions on the surface of tiles. Tiles that have relief on the proper surface preventing measurements on that surface shall, where possible, be measured on the back.

B-6.1.2 *Centre Curvature* — The departure of the centre of a tile from the plane in which three of the four corners lie (*see* Fig. 4).

B-6.1.3 *Edge Curvature* — The departure of the centre of one edge of a tile from the plane in which three of the four corners lie (*see* Fig. 5).

B-6.1.4 *Warpage* — The departure of the fourth corner of a tile from the plane in which three of the four corners lie (*see* Fig. 6).

B-6.2 Apparatus

B-6.2.1 For tiles larger than 40 mm × 40 mm the apparatus given in **6.2.1.1** and **6.2.2.2** shall be used.

B-6.2.1.1 An apparatus as shown in Fig. 7, or any other suitable instrument. Although only one dial gauge is shown in the figure, there are three on the instrument, located at the centre of one side, at the centre of the tile and at one corner. To measure smooth-surfaced tiles the support studs are 5 mm in diameter. In order to obtain meaningful results for other tile surfaces, suitable support studs shall be used.

B-6.2.1.2 True flat calibrating plate of metal or glass and at least 10 mm thick for the apparatus described in **6.2.1.1**.

B-6.2.2 For tiles of dimensions 40 mm × 40 mm or less the apparatus given in **6.2.2.1** and **6.2.2.2** shall be used.

B-6.2.2.1 *Metal straight edge*

B-6.2.2.2 *Thickness feeler gauges*

B-6.3 Test Specimens

Ten whole tiles in each type shall be tested.

B-6.4 Procedure

B-6.4.1 *For Tiles Larger Than* 40 *mm* × 40 *mm*

B-6.4.1.1 Select an apparatus of the appropriate size and place the corresponding calibrating plate exactly into positions on top of the three accurately positioned studs.

B-6.4.1.2 The centre of each stud is 10 mm from the side of the tile, and the two outer dial gauges are 10 mm from the sides of the tile.

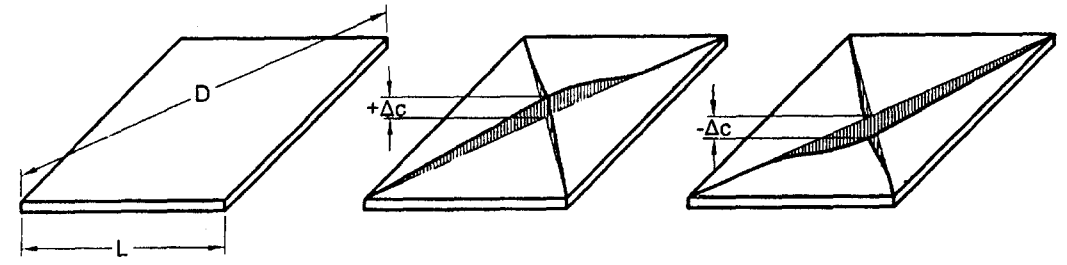


FIG. 4 CENTRE CURVATURE ($\Delta c/D$)

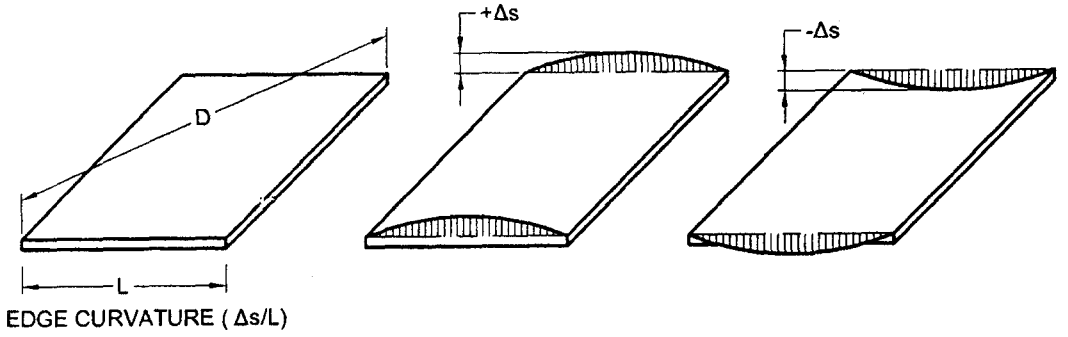


FIG. 5 EDGE CURVATURE ($\Delta s/L$)

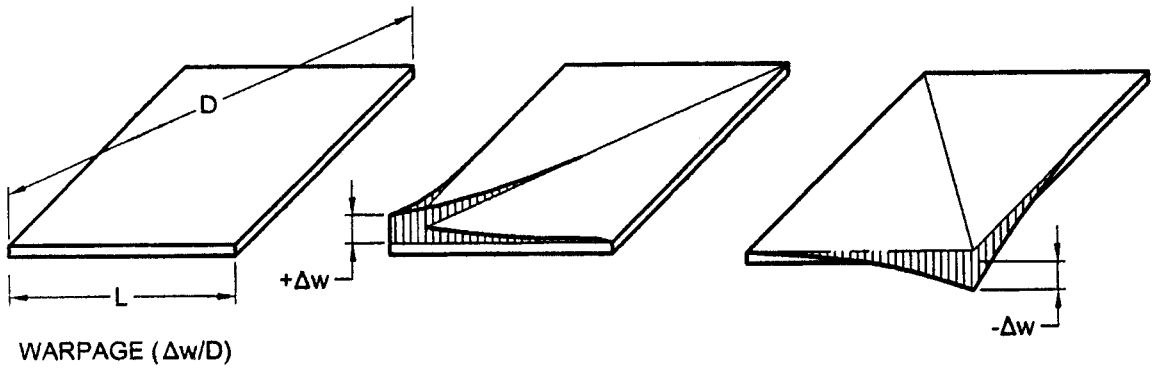


FIG. 6 WARPAGE ($\Delta w/D$)

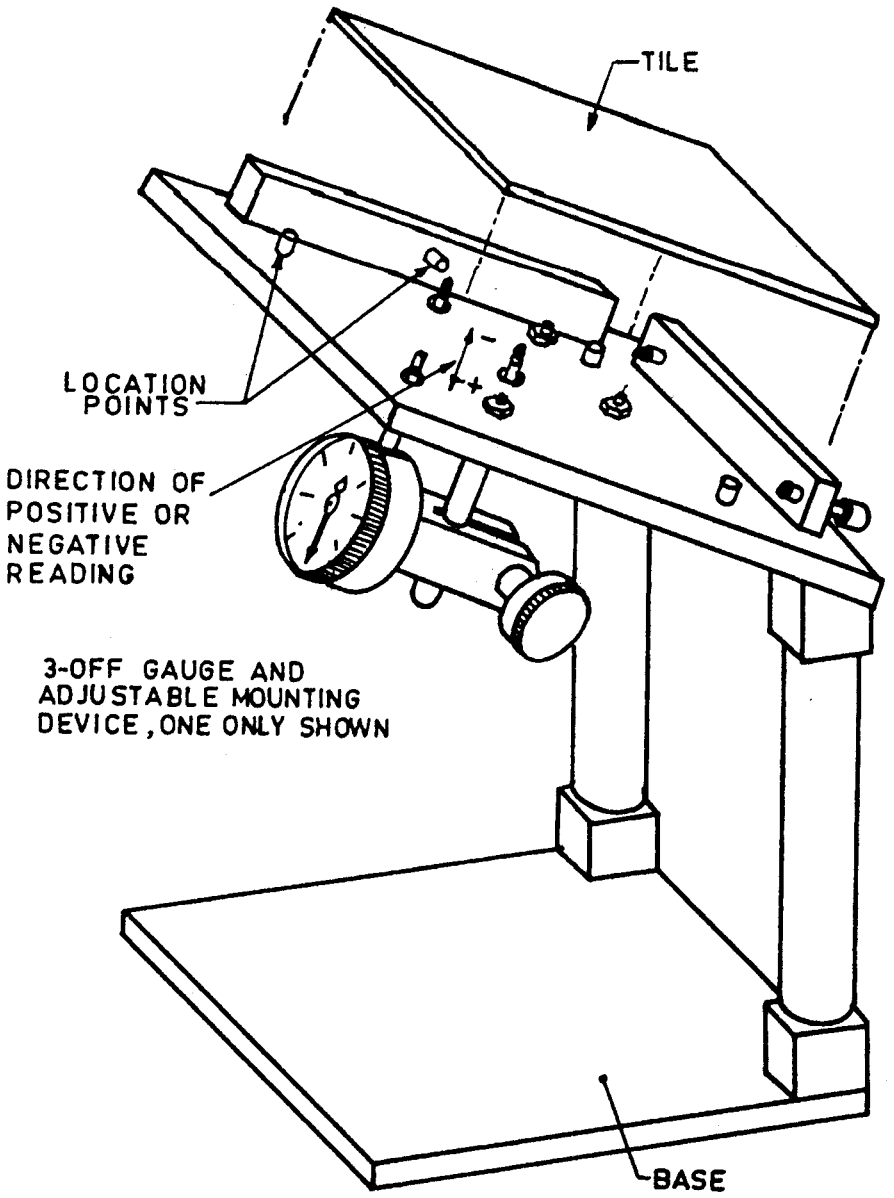


FIG. 7 APPARATUS FOR MEASUREMENT OF SURFACE FLATNESS

B-6.4.1.3 Adjust the three dial gauges to a suitable known value.

B-6.4.1.4 Remove the calibrating plate, place a tile on the apparatus with proper surface of the tile downwards and record the three dial gauge reading in the centre of the side. Rotate the tile, if square, to obtain four measurements of each properties. Repeat this procedure for each tile. In the case of oblong tiles, use separate instruments of the appropriate dimensions. Record the maximum centre curvature, edge curvature and warpage for each tile. Measure to an accuracy of 0.1 mm.

B-6.4.2 *For Tile Dimension of* 40 *mm* × 40 *mm or Less*

B-6.4.2.1 In order to measure edge curvature, place a straightedge across the edges and measure the gap under the straightedge by means of the feeler gauges. Determine centre curvature in the same manner but along diagonals.

B-6.4.2.2 There shall be no warpage measurements.

B-6.5 Expression of Results

B-6.5.1 Centre curvature is expressed as a percentage of the length of the diagonal.

B-6.5.2 Edge curvature is expressed as percentage of the length and width, for oblong tiles and percentage of the size for square tiles. Warpage is expressed as a percentage of the length of the diagonal.

B-6.5.3 Measurements for tiles with spacer lugs shall be expressed, in mm.

B-6.6 Test Report

The test report contains the following:

a) A description of the tiles;
b) All measurements of centre curvature;
c) All measurements of edge curvature;
d) All measurements of warpage;
e) Maximum centre curvature, in percentage, related to the diagonal calculated from work size;
f) Maximum edge curvature, in percentage, related to the corresponding work size; and
g) Maximum warpage, in percentage related to the diagonal calculated from work size.

B-7 SURFACE QUALITY

B-7.1 Surface Defects and Intentional Effects

B-7.1.1 Criteria for assessing the surface quality of glazed, engobed and unglazed tiles are as follows:

a) Cracks,
b) Crazing,
c) Short glazing,
d) Unevenness,
e) Depressions,
f) Holes,
g) Glaze devitrification,
h) Specks and spots,
j) Under glaze faults,
k) Decorating faults,
m) Shading,
n) Nipped edges, and
p) Nipped corners.

B-7.1.2 In order to judge whether an intentional decorative effect is acceptable or is a defect; see the relevant clause of the product standard. Cracks, nipped edges and nipped corners cannot be intentional effects.

B-7.2 Apparatus

B-7.2.1 *Fluorescent Lighting of Colour Temperature* 6 000 *K to* 6 500 *K*

B-7.2.2 *Meter Rule or Other Suitable Means of Measuring Distance*

B-7.2.3 *Light Meter*

B-7.3 Test Specimens

At least 1 m^2 with a minimum of 30 tiles shall be tested.

B-7.4 Procedure

B-7.4.1 Place the tiles with the proper surface under observation so that they can be viewed normally at a distance of 1 m. Illuminate them with an even light intensity of 300 lux at the surface of the tiles and check the light intensity at the centre and each corner of the area of tiles under test.

B-7.4.2 View the tiles with naked eye (with the aid of a spectacle, if usually worn).

B-7.4.3 Preparation of the test area and the viewing of the test shall not be performed by the same person.

B-7.4.4 Intentional effects in the surface shall not be regarded as defects.

B-7.5 Expression of Results

Surface quality is expressed as the percentage of tiles without defects.

B-7.5.1 *Test Report*

The test report shall contain the following:

a) A description of the tiles;
b) Number of tiles tested including the area of tiles tested;
c) Assessment criteria used; and
d) Percentage of tiles without defects.

ANNEX C

(*Table* 1)

DETERMINATION OF WATER ABSORPTION AND BULK DENSITY

C-1 GENERAL

This Annex covers methods of test for determining the water absorption of all ceramic tiles.

C-2 TERMINOLOGY

For the purpose of this standard, the following definition shall apply.

C-2.1 Water Absorption — The increase in mass (expressed as a percentage of the dry material) of tiles which after determination of the dry mass are placed under water, then boiled and, afterwards, cooled during specified times while still completely immersed, taken out of the water and reweighed after removing excess of water.

C-3 APPARATUS

C-3.1 Drying Oven — Capable of operation at about 110°C.

C-3.2 Heating Apparatus — Constructed of suitable inert material, in which the boiling will take place.

C-3.3 Source of Heat

C-3.4 Balance — Accurate to 0.01 percent of the mass of a test specimen.

C-3.5 De-ionized or Distilled Water

C-3.6 Desiccator

C-3.7 Chamois Leather

C-3.8 Wire Loop, Halter, Basket — Capable of supporting specimens under water for making suspended mass measurements.

C-4 TEST SPECIMENS

C-4.1 A sample for each type of tile under test shall consist of 10 whole tiles.

C-4.2 If the proper surface area of each individual tile is greater than 0.04 m^2, then only 5 whole tiles shall be used for the tests.

C-4.3 When the mass of each individual tile is below 50 g, a sufficient number of tiles shall be taken so that each test specimen reaches a mass of 50 to 100 g.

C-4.4 Tiles with sides larger than 200 mm may be cut up, but all pieces shall be include in the measurement. With polygonal and other non-rectangular tiles, the length and width shall be those of the enclosing rectangles.

C-5 PROCEDURE

C-5.1 Water Impregnation

C-5.1.1 Dry the tiles in the oven at 110 ± 5°C until constant mass is reached, that is, when the difference between two successive weighings at interval of 24 h is less than 0.1 percent.

C-5.1.2 Cool the tiles in the desiccator over silica gel or other suitable desiccant, but not an acid, until cooled to room temperature.

C-5.1.3 Weigh each tile and record the results of the corresponding accuracy shown in Table 3.

Table 3 Tile Mass: Accuracy of Measurement

Sl No.	Mass of Tiles g	Accuracy of Measurements g
(1)	(2)	(3)
i)	0-100	0.02
ii)	101-500	0.05
iii)	501-1 000	0.25
iv)	1 001-3 000	0.50
v)	Above 3 000	1.00

C-5.1.4 Place the tiles vertically, with no contact between them, in water in the heating apparatus/water bath so that there is a depth of 50 mm water above and below the tiles. Maintain the water level of 50 mm above the tiles throughout the test.

C-5.1.5 Heat the water until boiling and continue to boil for 2 h. Then remove the source of heat and allow the tiles to cool, still completely immersed in this water overnight.

C-5.1.6 Remove the surface water from the tile pieces by chamois leather.

C-5.1.7 Immediately after this procedure weigh each tile and record the results to the same accuracy as for the dry state.

C-5.2 Suspended Weight

After water impregnation of the test specimens, determine to the nearest 0.01 g the mass m_3, of each specimen while suspended in water. Perform the weighing by placing the specimen in the wire loop, halter, or basket (*see* **C-3.8**), that is, suspended from one arm of the balance. Before actually weighing, counter balance the scale with the wire loop, halter,

basket in place and immerse in water to the same depth as is used when the specimens are in place.

C-6 EXPRESSION OF RESULTS

C-6.1 Water Absorption

C-6.1.1 For each tile, calculate the water absorption as a percentage of the dry mass using the expression:

$$\frac{m_2 - m_1}{m_1} \times 100$$

where

m_1 = mass of the dry tile; and

m_2 = mass of the wet tile.

C-6.1.2 The results shall be given to the first decimal place.

C-6.1.3 Calculate the average water absorption of the sample as the average of the individual results.

C-6.2 Bulk Density

Bulk density, B, in g/cm^3, of a specimen is the quotient of its dry mass divided by the exterior volume, including pores. Calculate the bulk density as follows:

$$B = (m_1/V)$$

where

m_1 = mass of the dry tile;

V = exterior volume, in cm^3 ($m_2 - m_3$); and

m_3 = mass of suspended tile impregnated by boiling water method.

NOTE — For determination of bulk density by boiling water method, the specimen size should not be more than 0.01 m^2 (100 mm × 100 mm) to facilitate proper weighing of tile under suspended conditions by boiling water method.

C-6.3 Test Report

The test report shall contain the following:

a) A description of the tiles;

b) Water absorption and bulk density of each individual tile; and

c) Average water absorption and bulk density.

ANNEX D

(*Table* 1)

DETERMINATION OF MODULUS OF RUPTURE AND BREAKING STRENGTH

D-1 GENERAL

This Annex covers a method of test for determining the modulus of rupture and breaking strength of all ceramic tiles.

D-2 PRINCIPLE

Determination of modulus of rupture and breaking strength of a whole tile by means of three-point loading, the central point being in contact with the proper surface of the tile.

D-3 APPARATUS

D-3.1 Drying Oven — Capable of operation at 110 ± 5°C.

D-3.2 Recording Gauge — Accurate to 2 percent.

D-3.3 Two Cylindrical Support Rods — It shall be made of metal and the parts in contact with the test specimen shall be covered with rubber having a hardness of 50 ± 5 IRHD, measured in accordance with IS 3400 (Part 2). One rod shall be slightly pivotable (*see* Fig. 1) and the other shall be slightly rotatable about its own axis (*see* Table 1 for relevant dimensions).

D-3.4 Central Cylindrical Rod — It shall be of the same diameter as the support rods and covered with similar rubber, which transmits the load; F. This rod shall also be slightly pivotable (*see* Fig. 8) (*see* Table 4 for relevant dimensions).

Table 4 Diameter of Rods, Thickness of Rubber and Length

Sl No.	Dimension of Tile	Diameter of Rod d	Thickness of Rubber t	Overlap of Tile Beyond the Edge Supports l
	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)
i)	≥ 95	20	5	10
ii)	< 95 ≥ 48	10	2.5	5
iii)	< 48 ≥ 18	5	1	2

D-4 TEST SPECIMENS

D-4.1 Whenever possible, whole tiles shall be tested. However, it may be necessary to cut exceptionally large tiles (that is, those greater than 300 mm in length) and some non-rectangular shapes in order to fit them in the apparatus. Rectangular test specimens of the largest possible size shall then be cut, having their centres coinciding with the centres of tiles.

D-4.2 In case of doubt, results obtained using whole tiles shall always be preferred to results obtained with cut tiles.

D-4.3 The minimum number of test specimens for each sample is given in Table 5.

Table 5 Minimum Number of Test Specimens

Sl No.	Dimension of Tile mm	Minimum Number of Test Specimens
(1)	(2)	(3)
i)	≥ 48	7
ii)	< 48 ≥ 18	10

D-5 PROCEDURE

D-5.1 If cut test specimens are to be measured, dry them in the oven at 110 ± 5°C until constant mass is reached, that is, when the difference between two successive weighing at intervals of 24 h is less than 0.1 percent.

D-5.2 Place a test specimen on two supporting rods, with the glazed or proper surface uppermost so that the test specimen projects by the length *l* (*see* Table 4 and Fig. 9) beyond each support rod.

D-5.3 Position the central rod equidistant between the support rods. Apply the load evenly in such a way as to obtain a rate of increase of stress of 1 ± 0.2 N/mm^2/s; the actual rate per second can be calculated by the expression given in **D-6**.

D-5.4 Note the load to break, *F*.

D-5.5 For extruded tiles, place the tiles so that the projecting ribs are at right angles to the support rods. For all other rectangular tiles the greater side is at right angles to the support rods.

D-5.6 For tiles with relief surfaces, place a second layer of rubber, of the appropriate thickness given in Table 4, on the central rod in contact with the relief surface.

D-6 EXPRESSION OF RESULT

D-6.1 Only the results for test specimens that break within a central portion of length equivalent to the diameter of the central rod shall be used to calculate the average breaking strength and average modulus of rupture.

D-6.2 A minimum of five acceptable results is necessary to calculate the average value.

D-6.3 If there are fewer than five acceptable results, a second sample shall be tested consisting the double the number of tiles.

D-6.4 A minimum of ten acceptable results is then required to calculate the average value.

D-6.5 The breaking strength (*S*), expressed in newtons, is calculated by means of the expression:

$$S = FL/b$$

where

F = load required to break the tile, in N;

L = span of the support rods in mm (*see* Fig. 9); and

b = width of the tile, in mm.

D-6.6 The modulus of rupture (δ), expressed, in N/mm^2 is calculated by means of the expressions:

$$\delta = 3\ FL/2\ bh^2$$

where

F = load required to break, the tile, in N;

L = span of the support rods, in mm (*see* Fig. 9);

b = width of the tile, in mm; and

h = minimum thickness of the test specimen measured after the test along the broken edge, in mm.

NOTE — The calculation of the modulus of rupture is based on a rectangular cross-section. In the case of tiles of variable thickness along the broken edge, approximate results only are produced. The shallower, the relief, the more exact it is possible to make the approximations.

D-6.7 Note all results for breaking strength and modulus of rupture.

D-6.8 Calculate the average breaking strength and average modulus of rupture of the samples as the average of the acceptable results.

D-7 TEST REPORT

The test report shall contain the following:

a) Description of the tile;

b) Number of test specimens;

c) Values of *d, t, l, L* and *F*;

d) Modulus of rupture and breaking strength of each test specimen; and

e) Average modulus of rupture and breaking strength.

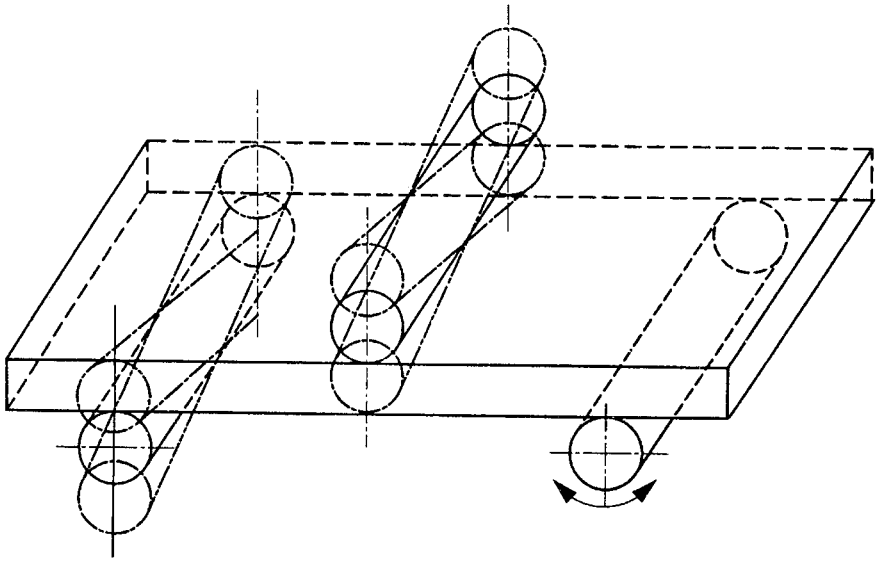


FIG. 8 APPARATUS FOR MEASUREMENT OF MODULUS OF RUPTURE

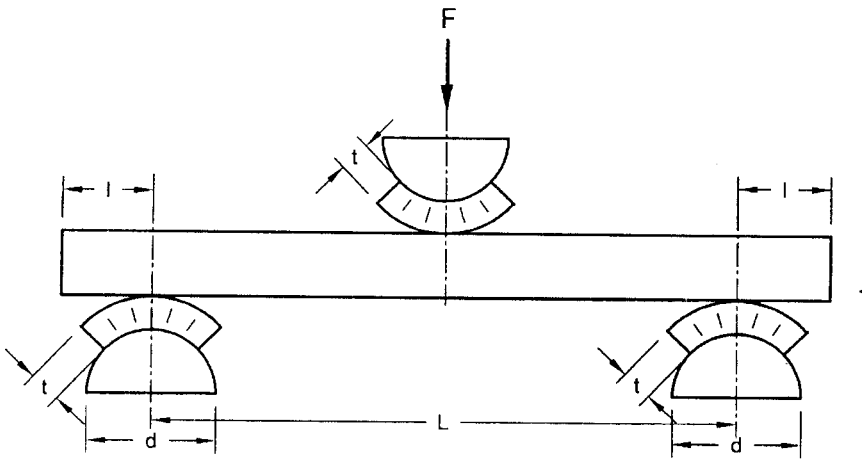


FIG. 9 SECTION ACROSS MODULUS OF RUPTURE APPARATUS

ANNEX E

(*Table* 1)

DETERMINATION OF RESISTANCE TO DEEP ABRASION — UNGLAZED TILES

E-1 GENERAL

This Annex covers a method of test for determining the resistance to deep abrasion of all unglazed ceramic tiles used for floor coverings.

E-2 PRINCIPLE

Determination of the abrasion resistance of unglazed ceramic tiles by measuring the length of the groove produced in the proper surface by means of a rotating disc under given conditions and with the use of abrasive material.

E-3 ABRASIVE MATERIAL

White fused aluminum oxide conforming to the grain size requirement of Grit No. 80 given in Table 1 of IS 11643.

E-4 APPARATUS

E-4.1 Abrasion Apparatus

E-4.1.1 It consists essentially of a rotating disc, a storage hopper with dispensing device for the abrasive material; a test specimen support and a counterweight (*see* Fig. 10).

E-4.1.2 The disc is made of Fe 410-S steel as specified in IS 2062, with a diameter of 200 ± 0.2 mm, and thickness at the edge of 10 ± 0.1 mm, and with a rate of revolution of 75 rev/min. The pressure with which test specimens are held against the steel disc is determined by calibrating the apparatus against Austrian Standard Granite. The pressure is adjusted such that, after 300 revolutions a chord of 32 mm is produced.

E-4.1.3 When the diameter has worn to 199 mm, the steel disc shall be replaced.

E-4.2 Measuring Gauge — Capable of measuring to 0.1 mm.

E-5 TEST SPECIMENS

E-5.1 Types of Test Specimens

Test shall be carried out using whole tiles or test specimens of suitable dimensions. Before testing, small specimens shall be fixed with an adhesive on to a larger background, avoiding joints.

E-5.2 Preparation

Clean, dry test specimens shall be used.

E-5.3 Number of Test Specimens

A minimum of five test specimens shall be tested.

E-6 PROCEDURE

E-6.1 Place a test specimen in the apparatus so that it is tangential against the rotating disc. Ensure that the feed of abrasive material into the grinding zone is uniform at a rate of at least 100 g/100 revolutions.

E-6.2 Rotate the steel disc for 150 revolutions. Remove the test specimen from the apparatus and measure the chord length of the groove by means of the measuring gauge to the nearest 0.5 mm. Test each specimen in at least two places at right angles on its proper surface.

E-6.3 If relief surfaces would interfere with the determination of the abrasion resistance, the projections may be ground off but the results of the test will not be the same as for tiles having plane surfaces.

E-7 EXPRESSION OF RESULTS

E-7.1 The resistance of deep abrasion is expressed as the volume V of material removed, in mm^3. This is calculated from the chord length l of the groove by means of the expression:

$$V = \left(\frac{\pi . \alpha}{180} - \sin \alpha\right) \frac{h.d^2}{8}$$

where

$$\sin \frac{\alpha}{2} = \frac{l}{d}$$

d = diameter of the rotating disc, in mm;

h = thickness of the rotating disc, in mm;

α = angle (in degrees) subtended at the centre of the rotating disc by the chord (*see* Fig. 11); and

l = length of the chord, in mm.

E-7.2 Some equivalent values are given in Table 6.

E-8 TEST REPORT

The test report shall contain the following:

a) Description of the tiles;

b) Chord length l of each groove to the nearest 0.5 mm;

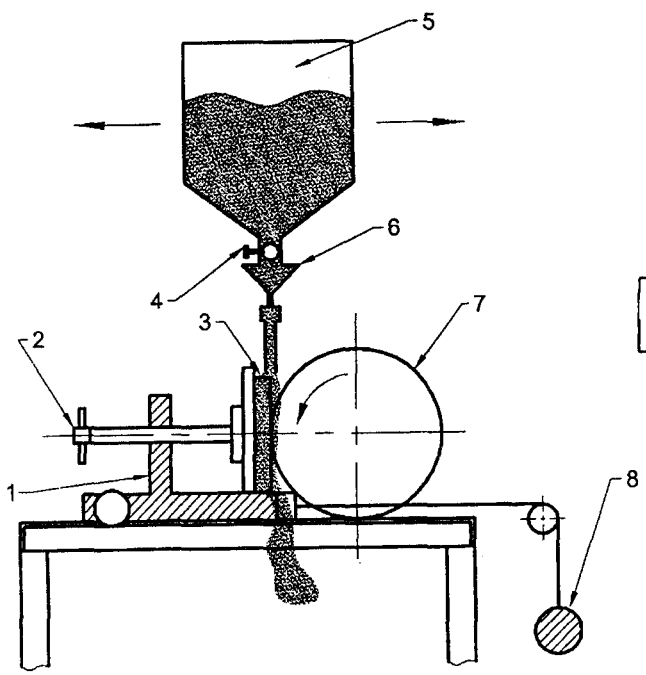
c) Volume V for each individual groove, in mm^3; and

d) Average volume V_m, in mm^3.

Table 6 Equivalent Value

(*Clause* E-7.2)

l mm	*v* mm³	*l* mm	*v* mm³	*l* mm	*v* mm³	*l* mm	*v* mm³	*l* mm	*v* mm³
20.0	67.0	30.0	227	40.0	540	50.0	1 062	60.0	1 851
20.5	72.0	30.5	238	40.5	561	50.5	1 094	60.5	1 899
21.0	77.0	31.0	250	41.0	582	51.0	1 128	61.0	1 947
21.5	83.0	31.5	262	41.5	603	51.5	1 162	61.5	1 996
22.0	89.0	32.0	275	42.0	626	52.0	1 196	62.0	2 046
22.5	95.0	32.5	288	42.5	649	52.5	1 232	62.5	2 097
23.0	102.0	33.0	302	43.0	672	53.0	1 268	63.0	2 149
23.5	109.0	33.5	316	43.5	696	53.5	1 305	63.5	2 202
24.0	116.0	34.0	330	44.0	720	54.0	1 342	64.0	2 256
24.5	123.0	34.5	345	44.5	746	54.5	1 380	64.5	2 310
25.0	131.0	35.0	361	45.0	741	55.0	1 419	65.0	2 365
25.5	139.0	35.5	376	45.5	798	55.5	1 459	65.5	2 432
26.0	147.0	36.0	393	46.0	824	56.0	1 499	66.0	2 479
26.5	156.0	36.5	409	46.5	852	56.5	1 541	66.5	2 537
27.0	165.0	37.0	427	47.0	880	57.0	1 583	67.0	2 595
27.5	174.0	37.5	444	47.5	909	57.5	1 625	67.5	2 636
28.0	184.0	38.0	462	48.0	938	58.0	1 669	68.0	2 717
28.5	194.0	38.5	481	48.5	968	58.5	1 713	68.5	2 779
29.0	205.0	39.0	500	49.0	999	59.0	1 758	69.0	2 842
29.5	216.0	39.5	520	49.5	1 030	59.5	1 804	69.5	2 906



1 – Test Specimen Clamp
2 – Fixing Screw
3 – Test Specimen
4 – Valve
5 – Storage Hopper for Abrasive Material
6 – Even-Flow Funnel
7 – Steel Disc
8 – Counterweight

FIG. 10 ABRASION APPARATUS

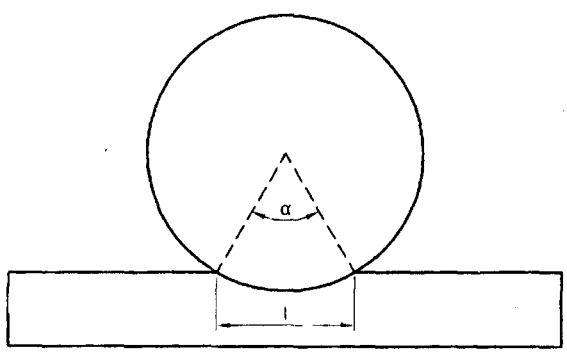


FIG. 11 DEFINITION OF CHORD

ANNEX F

(*Table* 1)

DETERMINATION OF CHEMICAL RESISTANCE — UNGLAZED TILES

F-1 GENERAL

This Annex covers a method of test for determining the chemical resistance of the proper surface of all unglazed ceramic tiles.

F-2 PRINCIPLE

The test specimens are partially immersed in the test solution and attack is determined visually after 28 days.

F-3 AQUEOUS TEST SOLUTIONS

F-3.1 Household Chemicals

a) Ammonium chloride solution, 100g/l.

b) Standard cleaning agent solution prepared from:

1) Anhydrous sodium carbonate : 33 percent (*m/m*)
2) Sodium perborate : 7 percent (*m/m*)
3) Sodium silicate solution of density 1.33 g/cm^3 : 7 percent (*m/m*)
4) Commercial sodium oleate soap flakes : 30 percent (*m/m*)

NOTE — The soap can be prepared from concentrated sodium hydroxide solution and oleic acid in the proportions of 2.6 to 18.5 g, respectively.

5) Distilled water or De-ionized water : 23 percent (*m/m*)

c) 100 g of this standard cleaning agent contain 70 g of dry substance. Use in a concentration of 10 g dry substance per litre. The test solution shall be prepared immediately before use.

F-3.2 Swimming Pool Salts

a) Sodium hypochlorite solution 20 mg/l, prepared from technical grade hypochlorite with about 13 percent active chlorine, and

b) Copper sulphate solution, 20 mg/l.

F-3.3 Acids

a) Sulphuric acid solution, 70 percent (*v/v*) prepared from concentrated sulphuric acid ($d \cong 1.84$). Cautiously add the sulphuric acid to water, cooling the solution and keeping it well mixed during addition, and

b) Lactic acid solution 5 percent (*v/v*) (available in this concentration).

F-3.4 Alkali

Potassium hydroxide solution 200 g/l.

F-4 APPARATUS

F-4.1 Vessel — With a lid, made of borosilicate glass 3.3 conforming to Type 1 when graded according to IS 2303 or any other suitable material.

F-4.2 Drying Oven — Capable of operation at 110 ± 5°C.

F-4.3 Chamois Leather

F-4.4 Balance — Accurate to 0.05 g.

F-5 TEST SPECIMENS

F-5.1 Number of Test Specimens

Five test specimens shall be used with each test solution.

F-5.2 Size of Test Specimens

A square test specimen 50 mm × 50 mm shall be cut from each tile under test in such a manner that one side of each test specimen is not a cut side.

F-5.3 Preparation of Test Specimens

Thoroughly clean the proper surface with a suitable solvent, for example, methanol. Test specimens with surface defects shall be excluded from the test.

F-6 PROCEDURE

F-6.1 Dry the test specimens at 110 ± 5°C until they reach to constant mass when the difference between the successive weighing is less than 0.1 g, and cool to room temperature.

F-6.2 Immerse the test specimens vertically to a depth of 25 mm in the test solution (which may be any of those listed in **F-3**) in the test vessel. The non-cut side of each test specimen shall be fully immersed. Cover with the lid and maintain the test assembly for 28 days at 27± 2°C.

F-6.3 After 28 days subject the test specimens to running water for 7 days and then boil them for 30 min while completely immersed in water. Remove the test specimens from the water and dab with wet but wrung out chamois leather.

F-6.4 Examine the test specimen with naked eye, with spectacles usually worn, for changes on the proper

surface and the non-cut edge. Secondarily examine the parts of the cut edges that were immersed.

F-7 TEST REPORT

The test report shall contain the following:

a) Description of the tile;
b) Test solution(s) used;
c) Number of test specimens;
d) Number of test specimens damaged by each test solutions;
e) Visual changes on the proper surface as a result of the test specified in **6**;
f) Visual changes on the non-cut edges as a result of the test specified in **6**; and
g) Visual changes on the cut-edges as a result of the test specified in **6**.

ANNEX G

(*Table* 1)

DETERMINATION OF ACID RESISTANCE

G-1 APPARATUS

G-1.1 Oven — A circular air oven having thermostatic control that will maintain a temperature of 110 ± 5°C.

G-1.2 Balance — of capacity 100 g with a sensitivity of 0.01g.

G-2 PREPARATION OF TEST SPECIMEN

G-2.1 The test specimen shall be prepared from individual tiles.

G-2.2 Crush the tiles to powder individually in a stoneware mortar. Take 30 g of powder of each tile which passes 850 micron IS Sieve and is retained on 600 micron IS Sieve [*see* IS 460 (Part 1)] for testing. The powder shall be washed free from dust as follows:

Place 30 g of the specimen in a porcelain basin and add about 150 ml of distilled water. Place the basin on a sand bath and heat the mixture in the basin to boiling. Care shall be taken to avoid loss by spurting while boiling and heating shall be continued for 1 h. Decant the water and rinse the particles with cold distilled water. Dry the material to constant mass keeping it in an oven maintained at a temperature of 110°C.

G-3 REAGENTS

The reagents used for the test shall be the following:

a) Concentrated nitric acid conforming to IS 264, and
b) Concentrated sulphuric acid conforming to IS 266.

G-4 PROCEDURE

Weigh 25 g of the prepared specimen accurately to 0.01 g and place in a porcelain basin. Add a mixture of 7 ml nitric acid, 13 ml sulphuric acid and 65 ml distilled water. Place the basin and its contents on a sandbath and heat carefully, avoiding spurting till all nitric acid has evaporated and sulphuric acid starts fuming profusely. Cool the basin and its contents to 27 ± 2°C. Add 90 ml of distilled water and 10 ml of nitric acid. Repeat the heating process, until the sulphuric acid again fumes strongly. Cool the basin and contents and decant the acid carefully. Add about 150 ml of cold distilled water and heat up to boiling and then decant. The cycle of addition of fresh water, boiling and decantation shall continue until decanted liquid is found to be free from sulphuric acid when tested with barium chloride solution. No particle shall be lost during the process. After final decantation, dry the sample in an oven maintained at 110°C to constant mass.

G-5 CALCULATION

$$\text{Loss in mass, percent} = \frac{M_1 - M_2}{M_1} \times 100$$

where

M_1 = initial mass, in g, and
M_2 = final mass, in g.

ANNEX H

(Foreword)

COMMITTEE COMPOSITION

Flooring, Wall Finishing and Roofing Sectional Committee, CED 5

Organization	*Representative(s)*
Institution of Engineers (India), New Delhi	SHRI P. B. VIJAY (***Chairman***)
Builder's Association of India, New Delhi	SHRI PAWAN TALWAR SHRI VIJAY TALWAR (*Alternate*)
Building Materials & Technology Promotion Council, New Delhi	SHRI S. K. GUPTA SHRI PANKAJ GUPTA (*Alternate*)
Central Building Research Institute, Roorkee	SHRI B. K. RAO SHRI ACHAL MITTAL (*Alternate*)
Central Public Works Department, New Delhi	CHIEF ENGINEER (CSQ) SUPERINTENDING ENGINEER (S&S) (*Alternate*)
Central Road Research Institute, New Delhi	SHRI SATENDER KUMAR DR S. D. SHARMA (*Alternate*)
Construction Industry Development Council, New Delhi	SHRI P. R. SWARUP SHRI RAJEEV JAIN (*Alternate*)
Dyna Bricks (I) Pvt Ltd, Noida	SHRI ASHUTOSH DIKSHIT
Engineer-in-Chief's Branch, New Delhi	SHRIMATI UPINDER KAUR SHRIMATI RIVOO MAHINDRU (*Alternate*)
Engineers India Limited, New Delhi	SHRI J. K. BHAGCHANDANI SHRI S. MAJUMDAR (*Alternate*)
Grasim Industries Limited, Jodhpur	SHRI B. C. CHATTOPADHYAYA
H. R. Johnson (India) Limited, Dewas	SHRI S. G. HEGDE SHRI G. S. PATNAIK (*Alternate*)
Indian Institute of Architecture, Mumbai	SHRI JATINDER KUMAR SAIGAL SHRI KAPIL MEHTA (*Alternate*)
Indian Institute of Technology, New Delhi	DR SUPRATIC GUPTA
Llyod Insulation (India) Pvt Limited, New Delhi	SHRI MOHIT KHANNA SHRI K. K. MITRA (*Alternate*)
Masonry Producer Association of India, Chennai	SHRI T. S. MURLI DR CHRISTOPHER SAMUEL (*Alternate*)
Modern Tiles & Marble, New Delhi	SHRI SUBHASH KAPOOR SHRI KAMESWAR RAU (*Alternate*)
National Council for Cement and Building Materials, Ballabgarh	SHRI S. K. BREJA
National Test House (NR), Kolkata	SHRI D. K. KANUNGO
National Tiles Corporation, Panchkula	SHRI PREM CHAND GUPTA SHRI S. R. GARG (*Alternate*)
Premier Polyfilm Ltd, Ghaziabad	DR SANJEEV VERMA
Prodorite Anti-corrosive Limited, Chennai	SHRI M. ANNAMALAI DR P. SACHINDRAPAL (*Alternate*)
Public Works Department, Chennai	SUPERINTENDING ENGINEER (P&D) EXECUTIVE ENGINEER (*Alternate*)
Rashtriya Chemical and Fertilizer Limited, Mumbai	SHRI S. N. PRASAD
Research, Designs and Standards Organization, Lucknow	EXECUTIVE ENGINEER (P&D II) EXECUTIVE ENGINEER (P&D I) (*Alternate*)

Organization	*Representative(s)*
Shalimar Tar Products, Kolkata	REPRESENTATIVE
Super Tiles & Marble Pvt Ltd, Mumbai	SHRI ASHOK RAJPUROHIT SHRI SUDHAKAR MODI (*Alternate*)
In personal capacity (*B-190, Sector 55, Noida 201301*)	SHRI R. S. SHUKLA
In personal capacity [*C-474B, Sushant Lok, Phase-I, Gurgaon 122002* (*Haryana*)]	SHRI O. P. RATRA
BIS Directorate General	SHRI J. C. ARORA, Scientist 'E' and Head (CED) [Representing Director General (*Ex-officio*)]

Member Secretary
SHRI D. BHADRA
Scientist 'B' (CED), BIS

(*Continued from second cover*)

Compressive strength has been deleted from this standard. This is because:

a) compressive strength of ceramic products is several orders of magnitude higher than their tensile strength;
b) measurement of compressive strength is difficult, as several products in this category have uneven/ textured surfaces; and
c) cubicle specimens will be required for precise measurements and hence it is not possible to make the measurement meaningfully on whole tiles.

With higher levels of vitrification and lower water absorption as suggested above, the flexural strength requirements have been revised to higher values.

The test methods and the requirements for acid resistance have been revised taking into consideration current International Standards. While, this standard is adequate it was felt that in the interest of International consumers who may require compliance to International Standards, the tests as prescribed by ISO have been included as a part of the acid resistance test. Also, with this addition, these products shall be more suitable for a wider range of industrial applications such as industrial shop floors, etc.

The section on abrasion resistance has also been brought in line with the current ISO Standards. It was felt that the existing test method was inadequate for testing abrasion resistance of textured surfaces.

As per the current ISO Standards visual inspection test has also been included. Besides technical performance, the visual test is necessary, as these tiles also need to meet aesthetic demands of current-day consumer.

In formulation of this standard considerable assistance have been derived from the following standards:

ISO 10545-2 : 1995 Ceramic tiles — Part 2 : Determination of dimensions and surface quality

ISO 10545-3 : 1995 Ceramic tiles — Part 3 : Determination of water absorption, apparent porosity, apparent relative density and bulk density

ISO 10545-4 : 2004 Ceramic tiles — Part 4 : Determination of modulus of rupture and breaking strength

ISO 10545-6 : 1995 Ceramic tiles — Part 6 : Determination of resistance to deep abrasion for unglazed tiles

ISO 10545-13 : 1995 Ceramic tiles — Part 13 : Determination of chemical resistance

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

ISO 13006 : 1998 Ceramic tiles — Definitions, classification, characteristics and marking

The composition of the Committee responsible for formulation of this standard is given at Annex H.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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