

PHILIPPINE NATIONAL STANDARD

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Ceramic wall and floor tiles – Specification

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Foreword

This Philippine National Standard Specification for Ceramic Wall and Floor Tiles was prepared by the Bureau of Product Standards' Subcommittee on Structural Ceramics, SC-1 and approved by the Technical Committee on Ceramic and Ceramics Products, BPS/TC 29. This standard supersedes PNS 154:1992.

This standard aims to establish a national guide for the manufacture of ceramic tiles and to serve as a basis for fair competition among manufacturers, distributors, purchasers and users. In the revision of this standard, dimension tests under non-destructive were based on ISO 10545-2:1995 and the sampling plan and dimension test for destructive were based on ISO 10545-1:1995.

For ISO and ASTM standards for destructive test, sections on test specimens were excluded for the adoption. All test specimens shall be in accordance with Annex E of this standard.

Ceramic wall and floor tiles – Specification

1 Scope

This standard specifies dimensions and tolerances, physical and chemical characteristics, sampling, testing and marking requirements of ceramic wall and floor tiles and fittings. It applies to both glazed and unglazed ceramic tiles and fittings generally used for wall and floor coverings.

2 References

The title of the standards publications referred to in this standard are listed on the inside back cover.

3 Definitions

For the purpose of this standard, the following definitions apply:

3.1**ceramic tile**

thin slabs made from clays and/or other inorganic raw materials, generally used as coverings for floors and walls, usually shaped by extruding or pressing at room temperature but may be formed by other processes, then dried and subsequently fired at temperatures sufficient to develop the required properties; tiles can be glazed or unglazed and are incombustible and unaffected by light

3.2**cushion edge**

a slight radius formed at the periphery of the glazed surface of a tile

3.3**decorative tile**

a glazed tile that is either vitreous or non-vitreous and is suitable for decorative use on floor or wall

3.4**dust-pressed/dry-pressed tile**

tile formed from a finely milled body mixture and shaped in moulds at high pressure

3.5**engobed surface**

clay-based covering with a matt finish which can be permeable or impermeable

3.6**extrusion**

process of shaping plastic clay material by forcing through a die or mould

3.7

floor tile

a glazed or unglazed porcelain or natural clay tile formed by dust-pressed or plastic forming method for floor application

3.8

glazed tile

a tile which has one face glazed and the opposite face and other edges unglazed

3.9

mosaic tile

a tile formed by the dust-pressed or plastic forming method which is pre-mounted to form pattern

3.10

mounted tiles

tiles assembled into units or sheets by suitable material to facilitate handling and installation. Tiles may be face-mounted, back-mounted or edge-mounted

3.10.1

face-mounted tiles

tile assemblies having paper or suitable material applied to the face of each tile by water soluble adhesive easily removable after installation but prior to grouting of the joints

3.10.2

back-mounted tiles

tile assemblies which may have perforated paper fiber-mesh or other suitable material bonded to the back of each tile which becomes an integral part of the tile installation

3.10.3

edge-mounted tile

a type of mounted tile wherein tile is assembled into units or sheets and are bonded to each other at the edges or corners of the back of the tiles by an elastomeric or resinous material which becomes an integral part of the tile installation. Units or sheets must meet criteria of back-mounted sheets

3.11

natural clay tile

a ceramic tile made by either extrusion process or plastic forming method from clays that produce a dense body having a distinctive slightly textured appearance

3.12

nominal dimension

the approximate facial size and thickness of tile expressed in millimetres

3.13

plastic forming method

method of manufacturing ceramic tiles in which the body is shaped in a plastic state

3.14

polished surface

surface of an unglazed tile which has been given a glossy finish by mechanical polishing as the last stage of manufacture

3.15

porcelain tile

unglazed tile

a ceramic tile that is generally made by the dust-pressed method resulting in a tile that is dense, impervious, and smooth with sharply formed face

3.16

sampling

the method of obtaining tile for testing from an agreed lot

3.17

shivering

fracture of the glaze usually running along the edge and which may cause spalling from the body

3.18

slip-resistant tile

a tile having greater slip resistance characteristics, due to an abrasive admixture/abrasive particles on the surface or grooves or patterns on the surface

3.19

spacer lugs

continuous or discontinuous protuberance on the sides which automatically space the tile for grout joints

3.20

special purpose tile

a tile, either glazed or unglazed, made to meet or to have special physical design or appearance characteristics such as size, thickness, shape, color, or decoration; keys or lugs; back or sides; pregrouted assemblies or sheets; special resistance to staining, frost, alkalis, acids, thermal shock, physical impact, or high coefficient of friction

3.21

split tiles

tiles, glazed or unglazed weatherproof and corrosion resistant components of high mechanical strength for either wall or floor coverings made by the extrusion process in the form of double tiles, dried and fired, which are split into single tiles after firing. The resulting ribs on the rear in dovetail form provide secure adhesion

3.22

structural defects

cracks or laminations in the body of the tile which detract from the structural soundness of the tile installation

3.23

surface defect

that portion of the tile surface which is readily observed to be non-conforming and which detracts from the aesthetic appearance or serviceability of the installed tile

3.23.1

blister

small surface bubble or blow out resulting from the expulsion of gas during firing

3.23.2

bloat

occurrence of lump-like finish on the surface of the tile

3.23.3

chip

fragment broken off from the edges, corners or surface of a tile

3.23.4

cooling crack

glaze cracks caused by abrupt temperature changes inside the kiln

3.23.5

cracks

any fracture in the body of the tile visible on the face or the back or both

3.23.6

crawling

non adherence of glaze on the tile surface due to spread of soluble salts

3.23.7

crazing

irregular hairline cracks in the glaze

3.23.8

decorative fault

any apparent fault in decoration

3.23.9

dent

dimple-like depression found on the surface

3.23.10

dropper

round spot of glaze, engobe or water which is visible after firing

3.23.11

dryspot

areas on the face of a glazed tile which have no glaze

3.23.12

press mark

depression or protrusion on the tile surface occurring during pressing process

3.23.13

pin hole

tiny pit in the surface of a glazed tile

3.23.14

rough edge

any unintentional irregularity along the edge of a tile

3.23.15

scratch

a chaffed mark made by an object on the tile surface

3.23.16

specks or spot

any unintentional visually contrasting areas in the face

3.23.17

stuck-up

adhesion of tiles brought by overlapping of tiles inside the kiln

3.23.18

underglaze fault

any apparent fault covered by glazed

3.23.19

wavy

uneven glaze surface

3.23.20

welt

usually heavy accumulation of glaze in the form of a ridge along the edge

3.24

surface flatness

defined by measurements in three positions on the surface of tiles

Tiles that have relief on the proper surface shall have preventing measurement on that surface shall, where possible, be measured on the back

3.24.1

center curvature

the departure of the center of a tile from the plane in which three of four corners lie

3.24.2

edge curvature

the departure of the center of one edge of a tile from the plane in which three of the four corners lie

3.24.3

warpage

the departure of the fourth corner of the tile from the plane which the other corners lie

3.25

tile

a square rectangular, round or any polygon shaped ceramic surfacing unit relatively thin in relation to facial area produced from any suitable combination of clays and/or inorganic materials having either a glazed or unglazed face, matured by firing above red heat, free from imperfections which may affect appearance and serviceability

3.26

tile fitting

a body produced in the same way as a tile having one or more surfaces glazed which is used in combination with a tile

3.27

vittrification, degree of

3.27.1

impervious tile

a ceramic tile which has a 0.5 % or less water absorption

3.27.2

vitreous tile

a ceramic tile which has greater than 0.5 % to 3 % water absorption

3.27.3

semi-vitreous tile

a ceramic tile which has greater than 3 % to 7 % water absorption

3.27.4

non-vitreous tile

a ceramic tile which has more than 10 % water absorption

3.28

wall tile

a glazed tile with a body that is suitable for interior use and which is usually non-vitreous, and is not required nor expected to withstand excessive impact or be subjected to freezing and thawing conditions

3.29

wedging

the difference between two spaced measurements of the length or width of the tile

4 Classification

Ceramic tiles shall be classified according to manufacture and usage as specified in Table 1.

Table 1 – Classification of ceramic tiles

Manufacture	Usage
Glazed	Wall tiles and fittings Mosaic tiles and fittings
Unglazed	Floor (paver) tiles and fittings

5 Grade

Ceramic tiles and fittings shall be graded according to the following:

5.24 Grade A – Ceramic tiles that meet all the requirements of this standard.

5.25 Grade B – Ceramic tiles that meet all the requirements of this standard except those with surface defects visible at a distance of 100 cm.

6 Requirements

6.24 Materials

6.1.1 Ceramic tiles shall be made of clays with mineral aggregates and stains or pigments. The mixture can either be formed by extrusion or pressing in plastic condition or by semi-dry dust pressing in the forms of tiles.

6.1.2 Ceramic tiles, whether glazed or unglazed, shall be weather-proof and corrosion-resistant and of adequate mechanical strength for covering walls and floors.

6.2 Nominal dimensions and tolerances

6.2.1 Nominal dimensions of ceramic tiles shall be in accordance with Table 2.

Table 2 – Nominal dimensions and tolerances

Nominal dimensions	Size	Tolerances
Length and width	Shall be specified in the label; the recommended sizes are shown in Annex A.	The average length and width of each tile shall not vary by that prescribed in Table 3.
Thickness	Shall be specified in the label; the recommended thickness are shown in Annex A.	NOTE Thickness tolerance shall be computed using the formula specified in C.2.3.

6.2.2 Fittings (if applicable) – Sizes of fittings shall be in accordance with Annex B.

NOTE Thickness is applicable only to flat portions to be measured 12.7 mm from the edges or from the line of tangency between the flat and curved surfaces.

6.3 Characteristics determined by non-destructive tests

6.3.1 Face – Unless otherwise specified, the face of the tile and fittings shall be plain with either square or cushion edges.

6.3.2 Back – The back of the tile may be plain or have raised or depressed pattern.

6.3.3 Spacer – Flat wall tile may have lugs on all edges to provide uniform spacing.

6.3.4 Warpage – When measured as described, calling convex plus and concave minus, the algebraic averages of all edge warpages and all diagonal warpages shall not exceed the values specified in Table 4.

6.3.5 Wedging – When measured as described, wedging of each tile shall not exceed the values specified in Table 4.

6.3.6 Mounting – Tiles shall be uniformly mounted in patterns. Joints between tiles shall be uniform within the tolerance of tile size and wedging.

Back-mounted and edge-mounted tile assemblies shall have a sufficient exposure of tile and joints surrounding each tile.

Table 3 – Tolerance on length and width

Variance	Mosaic tile		Wall tile	Floor tile	
Average length and width per tile and fittings	Unglazed ± 1.75%	Glazed ±1.75%	±0.75%	Unglazed ±1%	Glazed ±1%
Range of average Individual length and width					
Tile	3.5 % of the largest side	3.5 % of the largest side	0.6 % of the largest side	1.5 % of the largest side	1.5 % of the largest side
Fitting	5 % of the largest side	4 % of the largest side	0.8 % of the largest side	1.5 % of the largest side	1.5 % of the largest side

Table 4 – Limits for surface flatness and wedging, % maximum

	Mosaic tile		Wall tile	Floor tile	
	Unglazed	Glazed		Unglazed	Glazed
A. Surface flatness					
1. Edge curvature			0.7	0.7	0.7
Tile Fitting ^a	N/A	N/A	1.0	1.75	0.75
2. Center curvature	N/A	N/A	0.7	0.7	0.7
3. Warpage	N/A	N/A	0.7	0.7	0.7
B. Wedging					
Tile Fitting ^b	N/A	N/A	0.60	0.8	0.8
	N/A	N/A	0.60		1.0
^a Applicable only to flat patterns of the face 9.5 mm from edge or 12.7 mm from the line of tangency between the flat and curved surface. Diagonal warpage is not applicable. ^b Only wedging of sides perpendicular to the curved side is applicable.					

6.4 Physical characteristics determined by destructive test

The physical characteristics determined by destructive test shall be in accordance with Table 5.

Table 5 – Physical characteristics determined by destructive test

Physical characteristics	Mosaic tile		Wall tile	Floor tile		Test method
	Unglazed	Glazed		Unglazed	Glazed	
A. Water absorption % max.						
1. Impervious	0.5	0.5	N/A	0.5	0.5	PNS ISO 10545-3
2. Vitreous	3	3	N/A	3	3	
3. Semi-vitreous	N/A	N/A	N/A	N/A	7	
4. Non-vitreous	N/A	N/A	18	N/A	N/A	
B. Modulus of rupture, N/mm ² , min	30	30	15	35	30	PNS ISO 10545-4
C. Craze resistance	N/A	resistant	resistant	N/A	resistant	PNS ISO 10545-11
D. Thermal shock	N/A	resistant	resistant	N/A	resistant	PNS ISO 10545-9
E. Abrasion resistance mm ³ , max.	175*	See PNS ISO 10545-7 Table 1	N/A	175*	See PNS ISO 10545-7 Table 1	PNS ISO 10545-6 – for unglazed PNS ISO 10545-7 – for glazed
F. Chemical resistance	resistant	resistant	resistant	resistant	resistant	PNS ASTM C-650
G. Stain resistance	N/A	resistant	resistant	resistant	resistant	PNS ISO 10545-14
NOTE N/mm ² = 10 kg/cm ² * Loss in volume; mm ³ (max)						

7 Special purpose tile

As defined in 3.20, these tiles shall be produced, graded and packed according to buyer and seller agreement. These are generally classified into grades A and B. Compliance shall be determined following the procedures in clauses 8 and 9.

8 Sampling

Sampling shall be in accordance with Annex E and Annex F.

9 Test methods

9.1 Destructive test shall be in accordance with Annex C.

9.2 Non-destructive tests shall be in accordance with Annex D.

10 Marking

10.1 Name and/or trademark of manufacturer shall be legibly and indelibly impressed on each glazed and unglazed ceramic wall and floor tiles.

10.2 The above information and the following shall be marked on the box:

10.2.1 Manufacturer, usage (text and/or symbol) and grade;

NOTE See Annex G for informative symbols.

10.2.2 Nominal dimensions (length, width and thickness); and

10.2.3 Address of the manufacturer.

10.3 The words “Made in the Philippines” or “Made in PHILIPPINES” or “PHILIPPINES” or country of origin shall be specified in the tile and /or in the packaging.

Annex A
Nominal dimensions
(Informative)

Table A.1 – Nominal dimensions of glazed wall tiles

Unit: mm

Width x Length	Thickness, min.
75 x 75	4.0
50 x 150	5.0
50 x 200	5.0
65 x 150	5.0
65 x 200	5.5
75 x 150	5.5
75 x 200	5.5
100 x 100	4.0
108 x 108	4.5
100 x 150	5.0
100 x 200	5.0
150 x 150	5.0
150 x 200	5.5
200 x 200	6.0
200 x 250	6.0
200 x 300	6.0
250 x 250	6.0
300 x 300	7.0
250 x 400	8.0
400 x 400	8.0
450 x 450	8.0
500 x 500	9.0
600 x 600	9.5
NOTE 1 For discontinuous lugs, facial dimension does not include spacers lugs. For continuous lugs, facial dimension include spacer lugs.	
NOTE 2 Thickness include depth of back pattern.	

Table A.2 – Nominal dimensions of glazed and unglazed ceramic mosaic tiles

Unit: mm

Width x Length	Thickness, min.
20 x 20	4.0
25 x 25	4.0
50 x 25	4.0
38 x 38	4.0
50 x 50	4.0
55 x 55	4.0
50 x 75	4.0
50 x 100	4.0
60 x 60	4.0
75 x 75	4.0

NOTE Dimension of tiles other than rectangular and square shall be classified in terms of their equivalent area.

Table A.3 – Nominal dimensions of floor tiles

Unit: mm

Width x Length	Thickness, min.
75 x 100	5
100 x 100	5
108 x 108	5
150 x 150	6
100 x 200	6
150 x 200	6
200 x 200	6
250 x 250	7
200 x 300	7
300 x 300	7
400 x 400	8
450 x 450	8
500 x 500	9
600 x 600	10

Annex B
Wall tile fittings
(Informative)

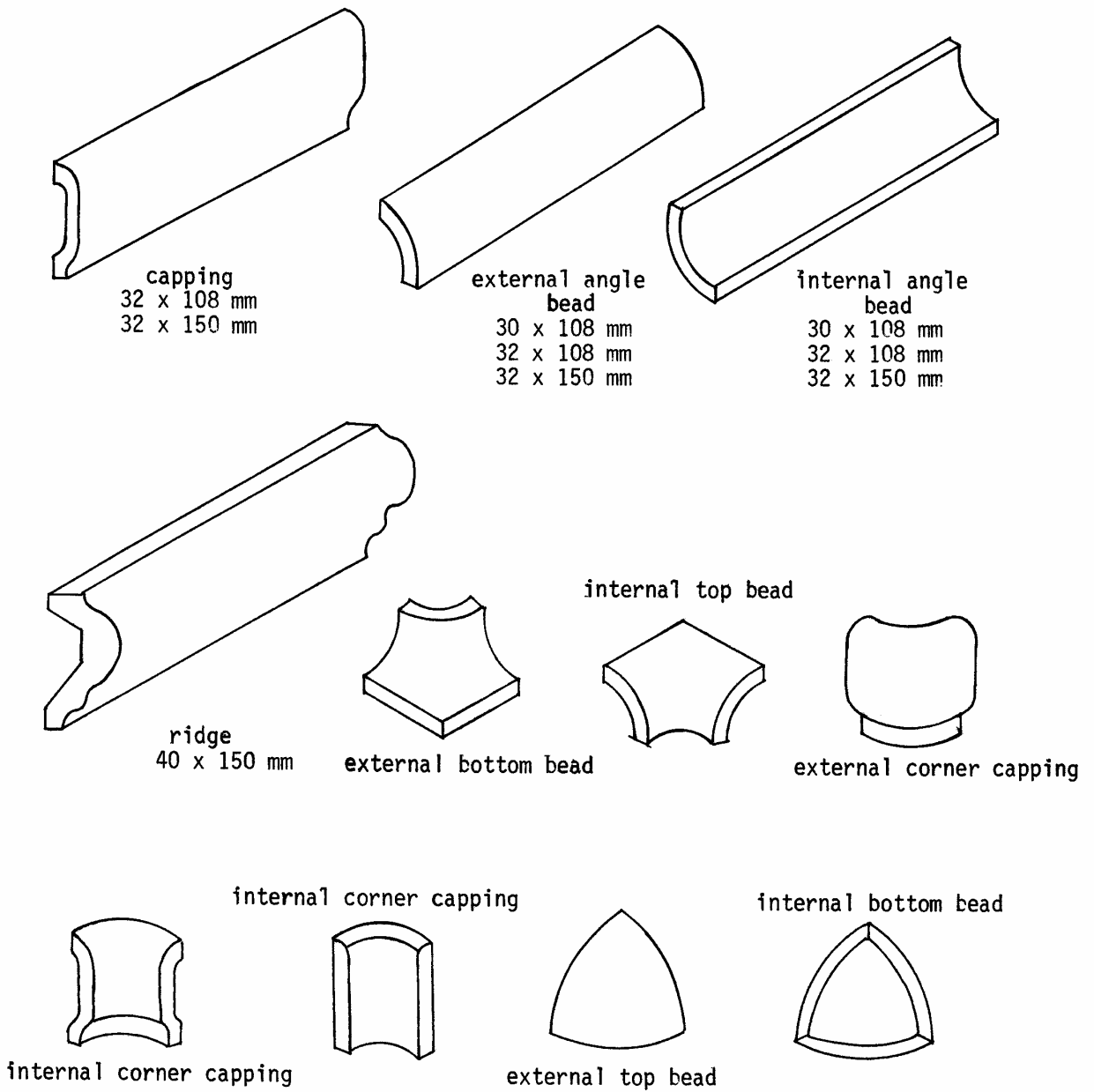
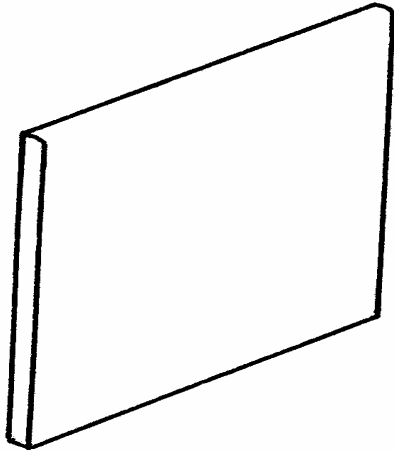
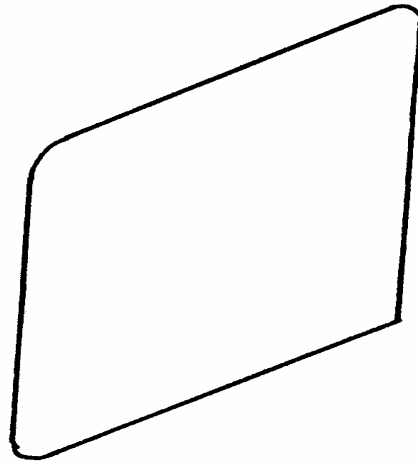


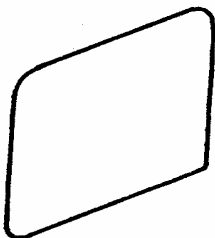
Figure B – Wall tile fittings



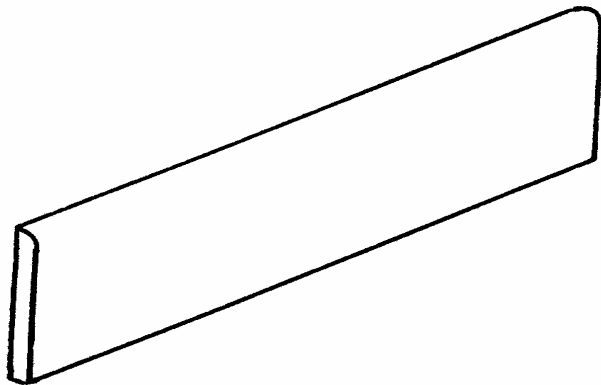
108 x 108 mm
one round edge



108 x 108 mm
two round edges



50 x 50 mm
two round edges



50 x 150 mm
one round edge

Figure B (Continued)

Annex C
Non-destructive test
(Normative)

C.1 Visual inspection for structural defects and surface quality

C.1.1 Get sample tiles randomly picked from a pallet according to Table E.1.

C.1.2 Check each tile and segregate those with the surface defects described in the Table E.1.

C.1.3 Check the color/shade of the tile by laying out 4 pcs. Randomly picked on the pallet and compare them with the standard shade. Intensity of light shall not be lower than 300lux.

NOTE For floor tiles, samples shall be laid on the floor while for wall tile, it shall be evaluated on the board support having an angle of 70°-80° from the horizontal

C.1.4 Draw a line 6 mm wide on the floor at a distance of 100 cm from a vertical plane through the bottom edge of the inspection board. Inspector is to stand erect without leaning and having his position behind the line, but as close to the line as practical, and centered left to right in front of this board while viewing the tile array.

C.1.5 The inspector should not be color blind and with 20/20 to 20/40, or corrected to 20/20 to 20/40 vision.

C.1.6 Record and add the number of defective tiles in accordance with the Table E.1.

C.2 Dimension

C.2.1 Measurement of size (length and width)

C.2.1.1 Apparatus – Vernier caliper or other suitable apparatus for linear measurement.

C.2.1.2 Test specimens – Test specimens shall be in accordance with Table E.1.

C.2.1.3 Procedure – Measure to the nearest 0.1 mm, each side of the tile under test at positions 5 mm from the corners. Continuous spacer lugs shall be considered when measuring length, and width.

C.2.1.4 Expression of results – The average dimension of square tiles is the average of four measurements. For rectangular tiles, each similar pair of sides of a tile provides the appropriate average dimension of the tile, i.e. an average of two measurements.

Percent of size variation is calculated according to the formula:

$$\% \text{ SV} = \frac{\text{AV} - \text{NS}}{\text{NS}} \times 100$$

where

AV is the average value,
NS is the nominal size, and
SV is the size variation.

C.2.1.5 Test report – The test report shall include the following information:

- a) a description of the tiles;
- b) all individual measurements of length and width; and
- c) the average size of each test specimens for square tiles, and the average length and width for each rectangular tile.

C.2.2 Measurement of wedging

C.2.2.1 Apparatus – Vernier caliper or other suitable apparatus for linear measurement.

C.2.2.2 Test specimens – Test specimens shall be in accordance with Table E.1.

C.2.2.3 Procedure – After the lengths of all sides of the tile are measured to the nearest 0.02 mm, wedging is determined by taking the difference between the longest and the shortest side for a square tile, while for a rectangular tile, it is determined by taking the difference in lengths of the opposite sides.

C.2.2.4 Expression of result – Wedging is expressed as a percentage wedging variation.

Percent wedging variation is calculated according to the formula;

$$\% \text{ WV} = \frac{\text{WI}}{\text{NS}} \times 100$$

where

WI is the wedge index,
NS is the nominal size, and
WV is the wedging variation.

C.2.2.4 Test report – The test report shall include the following information:

- a) a description of the tiles;
- b) all individual measurements of length and width;
- c) the average size of each test specimens for square tiles, and the average length and width for each rectangular tile; and
- d) wedging percentage.

C.2.3 Measurement of thickness

C.2.3.1 Apparatus – Micrometer screw gauge with anvils of 5 mm to 10 mm diameter, or other suitable apparatus.

C.2.3.2 Test specimens – shall be in accordance with Table E.2.

C.2.3.3 Procedure – For all tiles, except those with uneven surfaces, draw diagonals between the corners and measure the thickness at the thickest point within each of the four segments. Measure, to the nearest 0.1 mm, the thickness of each tile under test in four positions. For tiles with uneven surfaces, measure the thickness at the thickest point on each line.

C.2.3.4 Expression of results – For all tiles except those with uneven surface the average dimension of each individual tile is the average of four measurements. For uneven surface tiles, the measurement is at the thickest point.

Tolerance thickness is calculated according to the formula;

$$TT = \frac{AT - NT}{NT} \times 100$$

where

AT is the actual thickness,

NT is the nominal thickness; (as specified by the manufacturers), and

TT is the tolerance thickness.

C.2.3.5 Test report – The test report shall include the following information:

- a) a description of the tiles;
- b) all individual measurements of thickness;
- c) the average thickness of each tile; and
- d) the deviation, as percentage of the average thickness of each tile from the work size thickness.

C.2.4 Measurement of surface flatness

C.2.4.1 Apparatus – The plucometro shown in Figure D.1 or any other suitable apparatus.

A perfectly flat calibrating plate, of metal or glass, and at least 10 mm thick for the apparatus described in Figure D.2.

C.2.4.2 Test specimens - shall be in accordance with Table E.2.

C.2.4.3 Procedure

Measure to the nearest 0.1 mm, each side of the tile under test, at positions 5 mm from the corners.

C.2.4.3.1 For tiles larger than 40 mm x 40 mm

Select an apparatus of the appropriate size and place the corresponding calibrating plate exactly into position on top of the three accurately positioned studs (S_A , S_B , S_C) (see Figure D.3). The center of each stud shall be 10 mm from the side of the tile, and the two outer dial gauges (D_E , D_C) shall be 10 mm from the sides of the tile.

Adjust the three dial gauges (D_D , D_E , D_C) to a suitable known value.

Remove the calibrating plate, place a tile on the apparatus with the glaze or proper surface downwards, and record the three dial gauge readings. If the tile is square, rotate it to obtain four measurements of each tile being tested. For oblong tiles, use separate instrument of the appropriate dimensions. Record the maximum center curvature (D_D), edge curvature (D_E) and warpage (D_C) for each tile.

C.2.4.3.2 For tiles of dimensions 40 mm x 40 mm or less

In order to measure edge curvature, place a straightedge across the edge and measure the gap under the straightedge using the feeler gauges. Determine the center curvature in the same manner, but along diagonals.

There shall be no warpage measurement.

C.2.4.4 Expression of results – Center curvature is expressed as a percentage of the length of the diagonal.

Edge curvature is expressed as a percentage of;

- the length and width for oblong tiles, and
- the size for square tiles.

$$\% C_C = \frac{D_D}{D_M} \times 100$$

$$\% E_C = \frac{D_E}{S_M} \times 100$$

$$\% W_P = \frac{D_C}{D_M} \times 100$$

where

$\% C_C$ is the percent center curvature,

D_D is the dial gauge reading for center curvature,
 D_M is the diagonal measurement,
 $\%E_C$ is the percent edge curvature,
 D_E is the dial gauge reading for edge curvature,
 S_M is the side measurement,
 $\% W_P$ is the warpage, and
 D_C is the dial gauge reading for warpage.

C.2.4.4 Test report – The test report shall include the following information:

- a) a description of tiles;
- b) all individual measurements of center curvature;
- c) all individual measurements of edge curvature;
- d) all measurements of warpage;
- e) the maximum center curvature, as a percentage or in millimetres (as required by the product standard), related to the diagonal calculated from the work size;
- f) the maximum edge curvature, as percentage or in millimetres (as required by the product standard), related to the corresponding work size; and
- g) the maximum warpage, as a percentage or in millimetres (as required by the product standard), related to the diagonal calculated from the work size.

Annex D
Destructive tests
(Normative)

D.1 Water absorption – The test method for water absorption shall be in accordance with PNS ISO 10545-3 excluding the test specimens requirements. The test specimens shall be in accordance with Annex E of this standard.

D.2 Modulus of rupture – The test method for modulus of rupture shall be in accordance with PNS ISO 10545-4 excluding the test specimens requirements. The test specimens shall be in accordance with Annex E of this standard. See Figure D.4 for the sample of Flexometer.

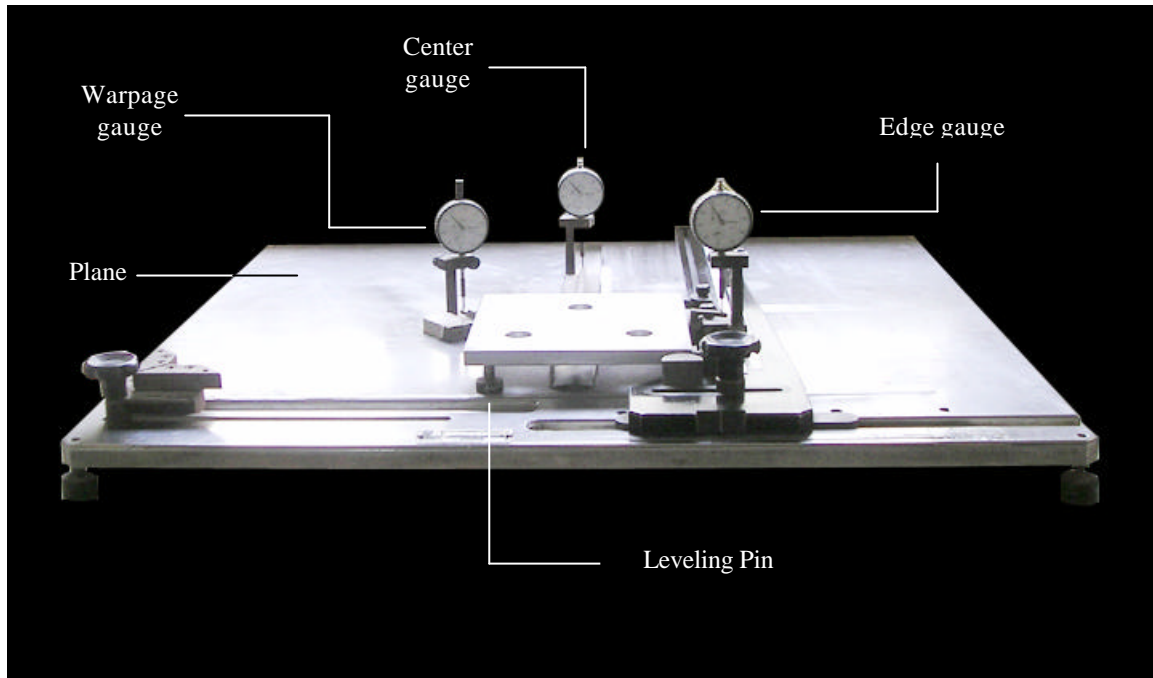
D.3 Crazing resistance – The test method for crazing resistance shall be in accordance with PNS ISO 10545-11 excluding the test specimens requirements. The test specimens shall be in accordance with Annex E of this standard.

D.4 Thermal shock resistance – The test method for thermal shock resistance shall be in accordance with PNS ISO 10545-9 excluding the test specimens requirements. The test specimens shall be in accordance with Annex E of this standard.

D.5 Abrasion test – Abrasion test shall be in accordance with PNS ISO 10545-6 for unglazed tile and PNS ISO 10545-7 for glazed tile excluding the test specimens requirements. The test specimens shall be in accordance with Annex E of this standard.

D.6 Chemical resistance – The test method for chemical resistance shall be in accordance with PNS ASTM C 650 excluding the sampling requirement. Sampling requirement shall be in accordance with Annex E of this standard.

D.7 Stain Resistance – The test method for stain resistance shall be in accordance with PNS ISO 10545-14. Sampling requirement shall be in accordance with Annex E of this standard.



**Figure D.1 – Warpage testing apparatus (plucometro)
(Informative)**

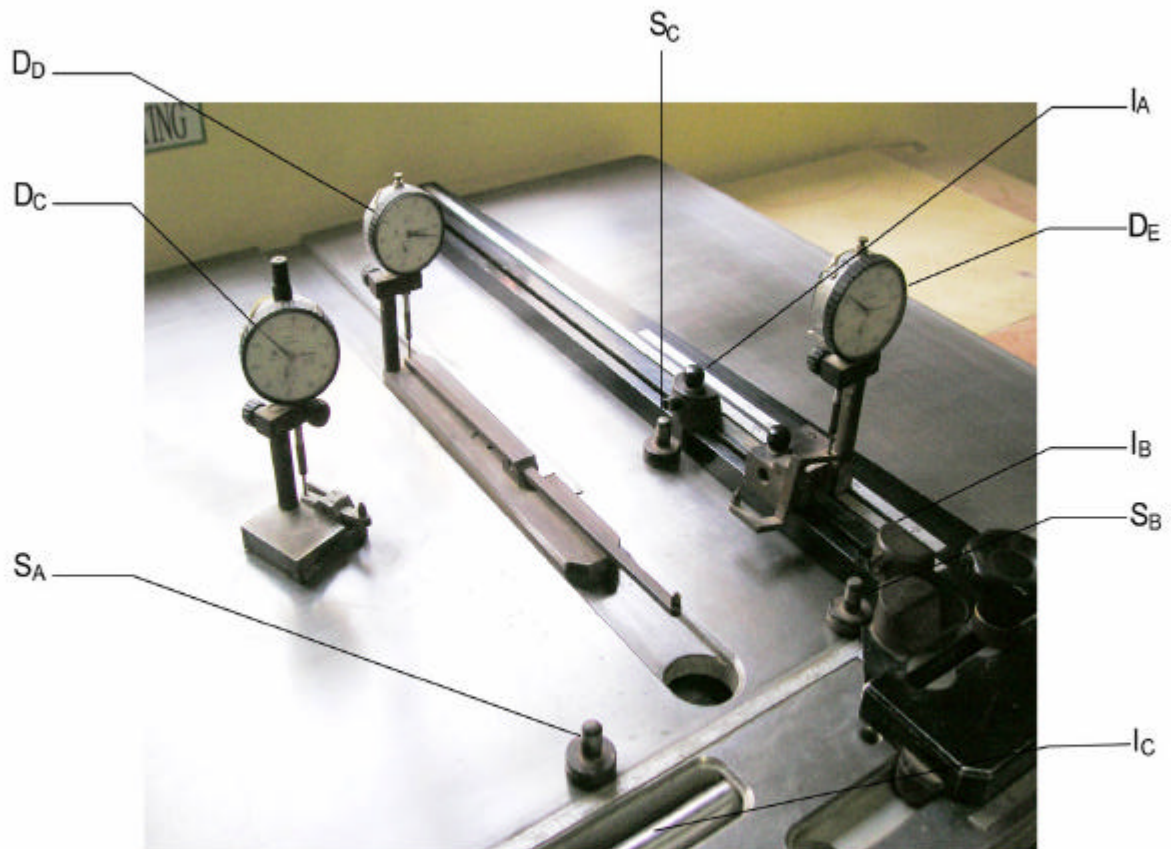
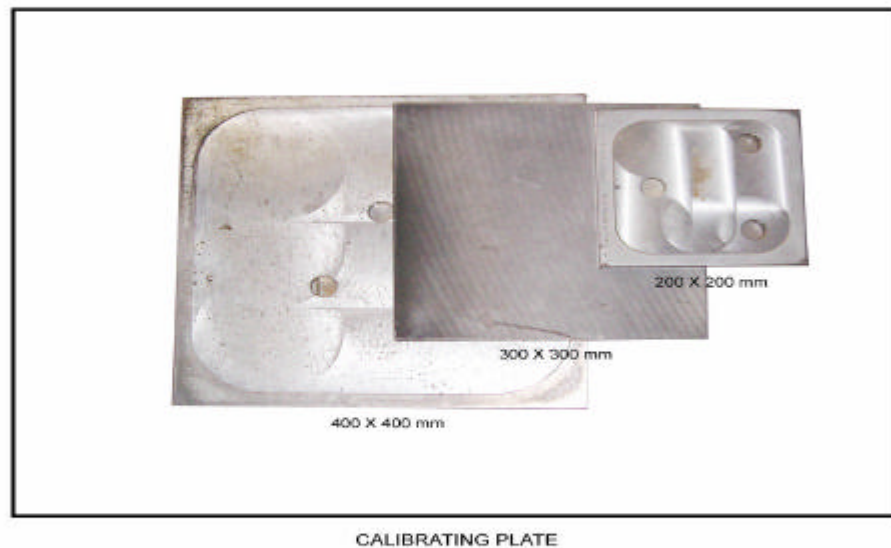
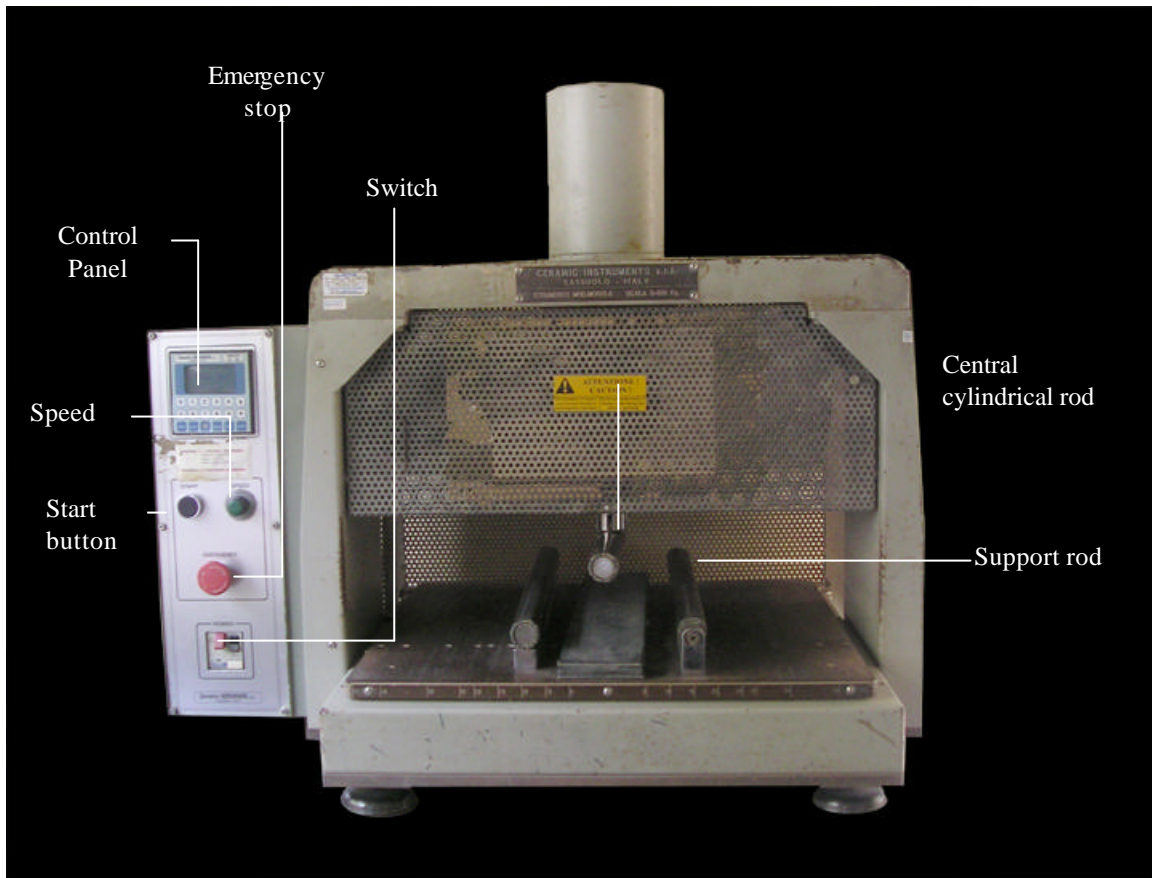


Figure D.2 – Warpage testing apparatus (plucometro) with supporting studs (S_A, S_B, S_C) and three dial gauges (D_D, D_E, D_C) (Informative)



**Figure D.3 – Flat calibrating plate
(Informative)**



**Figure D.4 – Bending strength apparatus (flexometer)
(Informative)**

Annex E
Sampling procedure for ceramic tiles except mosaic tiles
(Normative)

E.1 Lot size – The lot size shall be so specified by the manufacturer , otherwise the lot size shall be a single shipment of tile.

E.2 Sampling plan – The sampling plan for visual inspection shall be in accordance with MIL-STD-105 (Military Standard) AQL (Accepted Quality Level) of 2.5% as specified in Table E.1. For destructive and dimension tests, Table E.2 shall be used.

Table E.1 – Sampling plan for visual inspection for structural defects and surface quality

Sampling plan for surface quality and structural defects			
Lot size	Sample size	Accept	Reject
2 to 8	2	0	1
9 to 15	3	0	1
16 to 25	5	0	1
26 to 50	8	0	1
51 to 90	13	1	2
91 to 150	20	1	2
151 to 280	32	2	3
281 to 500	50	3	4
501 to 1200	80	5	6
1201 to 3200	125	7	8
3201 to 10000	200	10	11
10001 to 35000	315	14	15
35001 to 150000	500	21	22
150001 to 500000	800	21	22
500001 and over	1250	21	22

Table E.2 – Sampling plan for destructive test and dimension test

Properties	Surface area (m ²)	Minimum no. of samples		Inspection by attributes				Inspection by average value			
				1st sampling		1st + 2nd sampling		1st sampling		1st + 2nd sampling	
		1st sampling	2nd sampling	Accept	Reject	Accept	Reject	Acceptable if	2nd sample to be drawn if	Acceptable if	Rejection justified if
1. Dimension (mm)	Area < 0.04	10	10	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.04 - 0.08	8	8	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.09 - 0.12	5	5	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.13 - 0.22	3	3	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	Area > 0.22	2	2	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
2. Surface Flatness (mm)	Area < 0.04	10	10	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.04 - 0.08	8	8	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.09 - 0.12	5	5	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.13 - 0.22	3	3	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	Area > 0.22	2	2	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
3. Water Absorption (%)	Area < 0.04	10	10	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.04 - 0.08	8	8	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.09 - 0.12	5	5	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.13 - 0.22	3	3	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	Area > 0.22	2	2	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
4. Modulus of Rupture (kg/cm ²)	Area < 0.04	10	10	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.04 - 0.08	8	8	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.09 - 0.12	5	5	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	0.13 - 0.22	3	3	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
	Area > 0.22	2	2	-	-	-	-	x ₁ > std	x ₁ < std	x ₂ > std	x ₂ < std
5. Crazing Resistance	Area < 0.04	4	4	0	1	1	2	-	-	-	-
	0.04 - 0.08	4	4	0	1	1	2	-	-	-	-
	0.09 - 0.12	3	3	0	1	1	2	-	-	-	-
	0.13 - 0.22	3	3	0	1	1	2	-	-	-	-
	Area > 0.22	2	2	0	1	1	2	-	-	-	-

Table E.1 (Continued Table E.1)

6. Chemical Resistance	Area < 0.04	1	1	0	1	0	1	-	-	-	-
	0.04 - 0.08	1	1	0	1	0	1	-	-	-	-
	0.09 - 0.12	1	1	0	1	0	1	-	-	-	-
	0.13 - 0.22	1	1	0	1	0	1	-	-	-	-
	Area > 0.22	1	1	0	1	0	1	-	-	-	-
7. Thermal Shock	Area < 0.04	4	4	0	1	1	2	-	-	-	-
	0.04 - 0.08	4	4	0	1	1	2	-	-	-	-
	0.09 - 0.12	3	3	0	1	1	2	-	-	-	-
	0.13 - 0.22	3	3	0	1	1	2	-	-	-	-
	Area > 0.22	2	2	0	1	1	2	-	-	-	-
8. Resistance to Deep Abrasion (unglazed)	Area < 0.04	4	4	0	1	1	2	-	-	-	-
	0.04 - 0.08	4	4	0	1	1	2	-	-	-	-
	0.09 - 0.12	3	3	0	1	1	2	-	-	-	-
	0.13 - 0.22	3	3	0	1	1	2	-	-	-	-
	Area > 0.22	2	2	0	1	1	2	-	-	-	-
9. Resistance to Abrasion (glazed)	Area < 0.04	4	4	-	Attribution by manufacturer's declaration						
	0.04 - 0.08	4	4	-							
	0.09 - 0.12	3	3	-							
	0.13 - 0.22	3	3	-							
	Area > 0.22	2	2	-							

note(s)

- x₁ average of the 1st sampling
- x₂ average of the samples from 1st + 2nd sampling

1. If the average value (x₁) of the test results of the 1st sampling meets the requirements, the lot shall be considered acceptable (column 9)
2. If the average value (x₁) does not meet the requirements, 2nd sampling of the same size as the initial shall be taken (column 10)
3. If the average value (x₂) of the test results of the combined 1st and 2nd sampling meets the requirements, the lot shall be considered acceptable (column 11)
4. If the average value (x₂) does not meet the requirements, this justifies rejection of the lot (column 12)

Annex F
Sampling procedure
for mosaic tiles
(Normative)

F.1 Lot size – The lot size shall be so specified by the seller of the ceramic tile, otherwise the lot size shall be a single shipment of tile.

F.2 Sampling plan – The sampling plan is based on acceptance numbers at 2.5 % AQL (Acceptance Quality Level) for facial characteristics and dimensional properties and 1.5 % AQL for physical property testing.

F.3 Sample size – The sample size will be twenty (20) sheets and mounted ceramic mosaic tiles and twenty (20) strips of each type of mounted ceramic mosaic trim tiles; or 80 loose or mounted tiles when sampling flat or trim glazed wall tiles, floor tiles or special purpose tiles. The sample may be taken from one, two or three cartons as necessary to obtain the required number of tiles.

F.4 Procedure

F.4.1 Facial and structural defects

F.4.1.1 The tiles in the sample shall be examined for facial and structural defects before performing any other test. A tile having several defects shall be counted as one defective tile.

F.4.1.2 The face side of each of the 20 sheets of mounted ceramic mosaic tiles shall be examined individually for facial defects and a count shall be taken from the number of defective tiles in the sheet. It is important that the identity of the tile “face” and tile “back” be preserved in the visual inspection.

A 50-tile subsample of ceramic mosaic tiles, taken at random from the 20-sheet samples at random shall be examined for structural defects.

F.4.1.3 The face side of 80 glazed wall tiles, floor tiles or special purpose tiles shall be examined for both facial and structural defects.

F.4.2 Non-destructive tests – These consist of tests on thickness, facial dimensions, warpage and wedging of tiles.

F.4.2.1 The 50-tile sub-sample of ceramic mosaic tiles taken at random from the original 20-sheet samples shall be examined for dimensional characteristics. When tiles of different sizes are contained in the mounted sheets, the sub-sample of 50 tiles shall contain the different sizes in the same proportions as they appear in the sheets.

For warpage, the number of individual warpage measurements (consider edge warpage and diagonal warpages separately) as the sample n and accept or reject the sample based on the acceptance number (c) from Table D 1.

F.4.2.2 The entire sample of 80 glazed wall tiles, floor tiles or special purpose tiles, shall be examined for dimensional characteristics.

F.4.3 Destructive tests – See Table 5.

For each test, pieces are selected at random from the sample. The number of pieces selected shall be eight unless a different number of tiles is required by the testing procedure.

F.5 Basis for acceptance – For mosaic tiles a decision as to whether or not to accept the sample is made with the aid of Table E.2 in which n refers to the total number of tiles regardless of tile size(s) and c is the acceptance number. For other tiles, it shall be as specified in the following sub-clauses:

F.5.1 Facial and structural defects – The number of defective tiles is the sum of those facially and structurally defective tiles.

F.5.1.1 Glazed wall tile and floor tile each require a sample size of $n = 80$ and the acceptance number of $C = 5$ (tiles); five or less defective tiles permit acceptance of the lot and 6 or more defective tiles cause rejection of the lot.

F.5.1.2 Mounted sheets of ceramic mosaic floor tiles are accepted or rejected as whole sheets. One defective sheet in the 20-sheet sample is allowed. Two or more defective sheets cause the sample lot to be rejected. Separate sheets are accepted or rejected on the basis of the number of defective tiles in each sheet, using the acceptance number (c) for the number of tiles in the sheet (n) from Table E.2.

EXAMPLE In the case of 25 mm x 25 mm ceramic mosaic tile, a 300 mm x 600 mm sheet will contain 288 pieces of tiles; therefore $n = 288$ and the acceptance number is 13. Thirteen or less defective tiles will permit acceptance of the sheet while 14 or more defective tiles will reject the sheet.

F.5.2 Non-destructive tests – The acceptance number for a 50-tile sample shall be $c = 3$ tiles. The acceptance number for an 80-tile sample shall be $c = 5$ tiles. These criteria apply separately for each characteristic under test.

F.5.3 Destructive test – The acceptance shall be determined as specified in the applicable paragraph which describes the test method and requirements.

Annex G
Symbols for intended use
(Informative)

The use of symbols on packing and/or literature is not a requirement except where stated, but the symbols shown in Figure G are recommended to indicate intended use:

a) tile suitable for use on floors;

b) tile suitable for use on wall;



a)



b)

Figure G – Symbols for intended use

References

PNS 154:2005

PNS ISO 10545-3: 2005, Cor 1: 1997 Ceramic tiles -- Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density

PNS ISO 10545-4:2005, Ceramic tiles -- Part 4: Determination of modulus of rupture and breaking strength

PNS ISO 10545-11:2005, Ceramic tiles -- Part 11: Determination of crazing resistance for glazed tiles

PNS ISO 10545-9: 2005, Ceramic tiles -- Part 9: Determination of resistance to thermal shock

PNS ISO 10545-7:2005, Ceramic tiles -- Part 7: Determination of resistance to surface abrasion for glazed tiles

PNS ISO 10545-6:2005, Ceramic tiles -- Part 6: Determination of resistance to deep abrasion for unglazed tiles

PNS ISO 10545-14:2005, Cor.1:1997 Ceramic tiles -- Part 14: Determination of resistance to stains

PNS ASTM C 650:2005, Standard test method for resistance of ceramic tile to chemical substances

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