Draft Sri Lanka Standard
SPECIFICATION FOR SANITARY APPLICANCES (VITREOUS CHINA)
(First Revision)

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SRI LANKA

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FOREWORD

This standard was approved by the Sectoral Committee on Building and Construction Materials and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 20XX-XX-XX.

Sri Lanka Standard for Specification for Sanitary Appliances (Vitreous China) first published in 1973 and amended in 1987 is superseded by this first revision. Subsequent introduction of new production technologies accompanied by the requirements generated by export and import demands necessitated this revision.

For the purpose of deciding whether a particular requirement of this standard is complied with, final value, observed or calculated expressing the result of a test or an analysis, shall be rounded off in accordance with SLS 102. The number of significant figures retained in the rounded off value shall be the same as that of the specified value in this standard.

In the preparation of this standard the assistance derived from the publications of the British Standards Institution (BSI) and the Bureau of Indian Standards (BIS) is gratefully acknowledged.

1. SCOPE

This standard covers the general requirements for materials, manufacture, methods of test, inspection and marking of all vitreous sanitary appliances.

2. REFERENCES

BS 3402	:Specification for Quality of Vitreous China Sanitary Appliances
IS 2556 - 1	:Vitreous Sanitary Appliances (vitreous China)—Specification Part 1 general Requirements
SLS 102	: Rules for rounding off numerical values
SLS 428	: Random sampling methods
SLS ISO 2859-1	: Sampling procedures for inspection by attributes -- Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

3. DEFINITIONS

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

3.1 blister: A raised portion of the surface protruding not more than 1 mm above the surface and not greater than 3 mm in its maximum dimension.

3.2 bubble: A raised portion of the surface less than 1 mm maximum diameter.

3.3 craze or crazing: Fine cracks in the glaze .

3.4 discolouration: A coloured spot greater than 6 mm in its maximum dimension or a concentrated number of specks or spots to give the effect of a change in colour.

3.5 dull finish: Undeveloped glaze, slightly matt in appearance or a non-glossy finish on a visible surface.

3.6 dunt: A hair-line fracture extending through the body of the appliance.

3.7 egg shell finish: A uniform semi-matt glaze.

3.8 exposed body: Unglazed portion 1.5 mm or more in its maximum dimension.

3.9 finish: The texture and condition of a surface other than its colour.

3.10 fire crack: A fine shallow crack in the body, not covered with, glaze. (Fire crack, where not on a visible surface, may not necessarily be detrimental).

3.11 flushing surface: The surface visible after installation and which becomes wet during the operation of the appliance.

3.12 grouping: A number of spots ,blisters, pinholes or specks within any pottery square.

3.13 kiln support marks: Large unglazed surfaces resulting from blocks or pins necessary to support the appliance while firing but not visible after installation of the appliance.

3.14 Lot: A group constituting 200 pieces or less of all the appliances of the same type and size in any consignment.

3.15 pinhole: A hole in the body less than 1.5 mm in its maximum dimensions.

3.16 polishing mark: A spot where some minor blemish has been ground off and surface polished, the area of the spot not exceeding the area of a 10 mm diameter circle.

3.17 pottery square: A square of dimensions 50 mm x 50 mm selected on the appliances for examining visual defects.

3.18 projection: A raised portion of not less than 6 mm in its maximum dimension on a visible surface.

3.19 sagger: A fire clay container.

3.20 sample: Number of appliances taken on random or in accordance with a specified sampling plan, from a large quantity or from a fixed lot, relating to the intended tests.

3.21 speck: An area of contrasting colour less than 1 mm maximum dimension. (Speck less than 0.25 mm maximum dimension, do not constitute a defect unless sufficient in number to form a discolouration.

3.22 spot: An area of contrasting colour on the visible surface more than 1 mm but less than 3 mm in its maximum dimension.

3.23 visible surface : The surface, which after installation of the appliance, is readily visible to an observer in a normal standing position.

3.24 warpage: Distortion of original shape during the manufacturing process.

3.25 wavy finish: A defect in the finish having the appearance of numerous runs in the glaze; irregular or mottled finish.

4. MATERIAL AND MANUFACTURE

Vitreous sanitaryware is a strong partially fused ceramic ware made from a mixture of suitable clays and finely ground minerals such as quartz and feldspar. After firing at a high temperature the ware shall not, even when unglazed, have a mean value of water absorption greater than 0.5 percent of the dry weight of the ware, when tested in accordance with **10.3**. It shall be coated on all exposed surfaces with impervious non-crazing vitreous glaze giving a white or coloured finish.

5. APPLICATION OF GLAZING

5.1 The vitreous glazing medium shall be thoroughly fused to the body. Subject to exceptions, given in **5.1.1, 5.1.2** and **5.1.3** all exposed surfaces of an appliance shall be uniformly glazed, shall be free from craze and discolouration and shall possess an impervious surface. It shall have a high gloss and be of such a thickness and opacity as to give a uniform colour and finish to the surface.

5.1.1 Surfaces coming into contact with walls and floors may be without glaze.

5.1.2 On wash basins set away from walls, those portions of the rear aprons used for supporting the appliances in kilns; the backs of overflows and the undersides of outlet bosses may be without glaze.

5.1.3 Appliances may have unglazed portions but the unglazed surfaces shall not be visible when the appliance is installed in the normal manner.

5.2 The materials used for making glaze shall not contain lead or a lead compound. In case of certain colouring oxides used for making coloured glaze, the lead content, if any, shall not exceed 5 percent of the weight of the glaze when tested as per method described in Annex **A**.

6. PERMISSIBLE BLEMISHES OR DEFECTS

6.1 WC pans, Bidets, Squatting Pans, Urinals, Partition Plates, Pedestals, Short Pedestals and Accessories

When examined from any point on the viewing circle as illustrated in Figure **1**, the appliance shall not show, to the unaided eye of a trained observer, blemishes or defects in excess of those listed in Table **1**.

6.2 Wash Basins, Laboratory Sinks and Drinking Fountains

When examined from a distance of 600 mm, (see Figure **1**) the surface of the appliance shall not show to the unaided eye of a trained observer, blemishes or defects in excess of those listed in Table **2**.

6.3 Flushing Cisterns, Auto cisterns and Covers

When examined from a distance of 600 mm (see Figure **1**), the outer surface of the cistern and its cover when assembled shall not show, to the unaided eye of a trained observer, blemishes or defects in excess of those given in Table **3**.

6.4 Illumination During Visual Examination

When checking an appliance by visual examination, either in natural or artificial light, the uniform light intensity at the surface of the appliance shall be 300 lx when checked with a light meter. Artificial lighting when used, shall be provided by one or more fluorescent lamps of colour temperature 6 500 K, positioned 2 m minimum above the top of the appliance. The appliance shall be positioned so that it is between the light source and the observer.

NOTE: *Minor imperfections which do not affect the appearance or efficiency of the appliance shall not constitute valid reasons for rejection.*

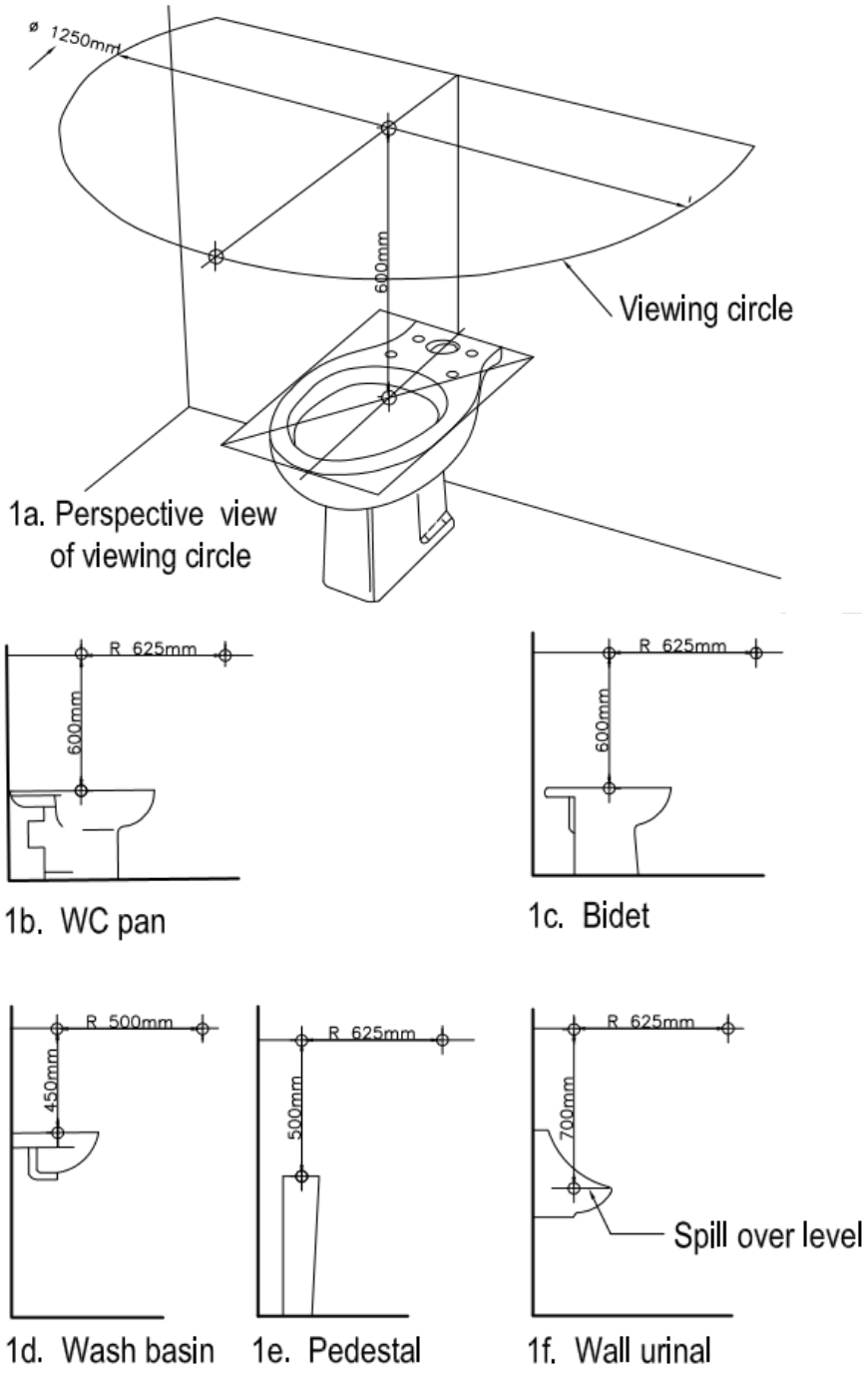

FIGURE 1 – Viewing Circle for WC Pans, Bidets, Wash Basins, Pedestals and Urinals

Table 1 Blemishes or Defects Permitted in WC Pans, Bidets, Squatting Pans, Urinals Partition Plates, Pedestals, Short Pedestals and Accessories

Location	Blemish or Defect	Maximum Permitted
General	**Wavy finish**	None on all visible surfaces
	Warpage: WC pan and bidets Squatting pans	Not more than 6 mm a) Not more than 6 mm for long patterns of 580 mm size b) Not more than 10 mm for long pattern of 630 mm size and Orissa patterns of 580 mm and 630 mm size
	Other appliances	Not more than 1 mm per 100 mm; total warpage not more than 6 mm
	Accessories	Not to exceed 5 mm on any plane.
	Discolouration	None on all visible surfaces
Flushing surface and horizontal face of rims of WC pans, squatting pans bidets and urinals	**Spots, blisters and pinholes**	A total of not over three; no grouping; for coloured appliances, blister and pinhole limited to one each.
	Bubbles and specks	Not over two in one pottery square; a total of not over four. For coloured appliances, a total not over two
Visible surfaces other than above	**Polishing marks**	One only; none permitted for coloured appliances
	Spots, blisters and pinholes	A total of not over five; no grouping. For coloured appliances, no blisters are permitted and pinhole are limited to a total of two.
	Bubbles and specks	Not over three in one pottery square; a total of not over ten.
	Polishing marks	Two only. One permitted for coloured appliances

Table 2 Blemishes or Defects Permitted in Wash Basins, Laboratory Sinks and Drinking Fountains

Location	Blemish or Defect	Maximum Permitted
General	**Wavy finish**	None on all visible surfaces
	Warpage;	
	-Wash basins and drinking fountains	Warpage of slab out of horizontal plane not to exceed 6 mm on all sizes (warpage of backs of wash basins which are attached to the wall not to exceed 3 mm)
	- Laboratory sinks	Warpage not to exceed ± 3 percent on all planes
	Discolouration	None on all visible surfaces
Service space, top of slab, inside of bowl, front of fascia	**Spots, blisters and pinholes**	A total of not over two; no grouping. for coloured appliances no blisters are permitted and pinhole limited to one only.
	Bubbles and specks	A total of not over four; no grouping For coloured appliances, a total of not over two
	Polishing marks	One only, none permitted for coloured appliance
Face of internal, back and side	**Spots, blisters and pinholes**	One only; on back or on either side; a total of not over three. For coloured appliances no blisters are permitted and pinholes are limited to a total of two .
	Bubbles and specks	A total of not over four; no grouping
	Polishing marks	Two only. One permitted for coloured appliances

Table 3 Blemishes or Defects Permitted in Flushing Cisterns, Auto Cisterns and Covers when assembled

Location	Blemish or Defect	Maximum Permitted
General	**Warpage**	Warpage of the flat back portion in case of cisterns not to exceed 5 mm and for bottom portion in case of coupled cistern not to exceed 3 mm.
	Discolouration	None on all visible surfaces
Visible surface	**Wavy finish**	Not more than 2 500 mm^2,on ends only; none on cover
	Spots, blisters and pinholes	A total of not over four; on grouping, However, a total of not over one on covers. For coloured appliances, blister and pinholes limited to one each, none on covers.
	Bubbles and specks	Not over two in one pottery square; total of not over six; including not over two on cover.
	Polishing marks	One only; none on cover; none permitted for coloured appliance.

7. MINIMUM THICKNESS

The thickness at any place in an appliance shall not be less than 6 mm.

8. TOLERANCES

Except where otherwise specified in various parts of this standard, the following tolerances, shall apply

a) On dimensions 75 mm and more; ± 2 percent of the specified dimension or ± 2 mm whichever is more

b) On dimensions less than 75 mm; ± 5 percent of the specified dimension or ± 2 mm whichever is more.

c) On the height of the flush outlet of P-traps, or horizontal outlets; ±5 mm; and

d) On all angles; ± 3^0.

9. PERFORMANCE REQUIREMENTS

9.1 Warpage

The appliance shall be considered to be within the warpage limits, if a feeler gauge of thickness equal to the maximum warpage specified (see Tables **1**, **2** or **3**) does not slide under the appliances without application of force, as detailed in **10.1**

9.2 Crazing

When tested in accordance with the procedure given in **10.2**, none of the test piece shall show crazing.

9.3 Water Absorption

The average value of water absorption of the test piece, when evaluated as given in **10.3** shall not exceed 0.5 percent. No individual result shall exceed 0.75 percent.

9.4 Modulus of Rupture

The average modulus of rupture of ten samples when teste by the method described in **10.4** shall not be less than 60 MPa**.**

9.4.1 Values taken for determination of the average shall not vary more than ± 20 percent of the average value. Values above or below 20 percent of the average may be discarded for the calculation of the average value. If the fractured surface of test pieces shows lamination, crack or a cavity at the centre or any other defect, those test pieces shall be rejected but minimum ten test pieces shall be available for working out the average value.

9.5 Chemical Resistance

When tested by the method described in Annex **B**, none of the test pieces shall appear to the unaided eye of a trained observer to have suffered any loss of reflectivity of the glaze when compared with the control sample.

9.6 Resistance to Staining and Burning

When tested by the method described in Annex **C**, no stain shall remain on either of the test piece.

9.7 Functional Requirements

Functional Requirements of ceramic flushing cisterns and ceramic pedestal wash -down water closet pans shall conform to the requirements of **SLS 864** and **SLS 792** respectively.

10 TEST PROCEDURE

10.1 Warpage

The appliance shall be placed face down on a flat surface, preferably a surface plate to ascertain the amount of deviation from the horizontal plane that exists at the edges of the appliance. If the appliance rocks, on two points, a horizontal plane shall be determined by placing the feeler gauge of a thickness equal to the maximum warpage permitted for the appliance (see table 1,2 or 3) under one low corner and forcing the appliance down on this gauge. If a second feeler gauge of the same thickness does not slide at any other point, the appliance shall be considered as not warped out of the horizontal plane and to be in conformity with the permissible warpage limits.

10.2 Crazing

10.2.1 *Test Pieces*

The test sample consists of three pieces broken from widely separated parts of the article, each piece having a total surface area of approximately 25,000 mm^2. At least on major surface shall be unglazed and freshly broken.

The test pieces are briefly immersed in methylene blue dye solution to reveal any cracks in the glaze or body. Whenever possible crack-free test pieces should be used for the crazing test. If a sufficient number of such test pieces are not available, any cracks revealed by dye immersion are marked prior to steam treatment.

10.2.2 *Test Procedure*

The test pieces shall be placed for 10 hours or, for two periods of five hours each, in a vessel in an autoclave in which saturated steam is maintained at a pressure between 0.34 to 0.37 MPa. The test pieces shall be allowed to cool to room temperature inside the autoclave and afterwards soaked for 12 hours in a solution of dye to which a small quantity of wetting agent has been added. Examine the test pieces for crazing.

10.3 Water Absorption Test

10.3.1 *Test Pieces*

The test sample shall consist of three pieces, each having a surface area of approximately 10,000 mm^2, taken from widely separated parts of the appliance. At least one major surface shall be a glazed surface. Surfaces other than major surfaces shall be unglazed and freshly broken. Care shall be taken not to produce cracks either in the body or in the glaze. Such test pieces with cracks shall be discarded. Alternatively, test pieces of the same surface area and 10 mm minimum thickness with one major surface glazed shall be separately made used in making of the appliances of the batch and put through the kiln along with the appliances. In the unglazed faces of the alternative pieces, grooves of 2 mm deep shall be cut with grinding wheels to expose the inside of the body.

10.3.2 *Test Procedure*

The test pieces shall be dried to a constant mass at a temperature between 110 ^{0}C and 115 ^{0}C and then cooled to room temperature in a desiccator. The pieces shall be weighed to an accuracy of not less than 0.01 g and placed in a vessel from which the air can be removed, maintaining the pressure at less than 0.0042 MPa for one hour. Cold freshly boiled distilled water shall then be admitted to the vessel without reducing the vacuum until the pieces are covered. Air is then admitted to the vessel and the pieces removed and boiled in distilled water for not less than 20 minutes. The pieces shall then be allowed to cool and remain in this water overnight. The test pieces shall be wiped dry with a damp and smooth cloth in such a manner as to remove the surface water only and then weighed.

10.3.3 *Evaluation of Test Pieces*

Water absorption of the test pieces shall be calculated as follows:

Percentage of water absorption = $\frac{M_2 - M_1}{M_1} \times 100$

Where,

M_2 = Mass of test piece after treatment, and

M_1 = Mass of the dry test piece

10.4 Modulus of Rupture

10.4.1 *Test Pieces*

Sample test bars shall be separately prepared, using the same body materials as used in making the appliances of a batch and shall be fired in the same kiln along with the appliances. They shall be square or circular in section and the cross sectional area shall not be less than 150 mm^2 and 150 mm long and shall not be glazed.

10.4.2 *Test Procedure*

The modulus of rupture shall be determined by using at least 10 of these bars mounted on supports, 125 mm apart, and loaded rapidly (approximately 5 kg/s) at the mid-point.

10.4.3 *Evaluation of Results*

The modulus of rupture shall be calculated from the formula:

$$S = \frac{0.15\,PL}{bd^2} \; for\; rectangular\; cross\; section, or$$

$$S = \frac{8\,PL}{D^2} \; for\; circular\; cross\; section$$

Where;

S = Modulus of rupture

P = total load in N,

L = length of span in mm,

b = width of test bar (in mm) to the nearest 0.1 mm

d = depth of test bar (in mm) to the nearest 0.1 mm

D = diameter of test bar in mm.

10.5 Procedure for Taking Samples for Test

Sample for crazing, water absorption, and modulus of rupture tests shall be taken as follows:

a) In the case of tunnel kilns, two test pieces for crazing test and two test pieces for water absorption test shall be kept in one trolley during a shift of 8 h. A lot of 20 pieces shall be kept in the centre of the trolley or in different parts of the platform for the purpose of carrying out modulus of rupture test on minimum of 10 pieces twice a week.

b) If the firing is done in intermittent kiln/ batch type furnaces, the samples for all tests should be kept at least at 12 places. The samples after firing shall be collected and stored.

c) Number of samples as specified under each test shall be selected out of the tests pieces obtained from (a) and (b) above.

11.MARKING

Appliance shall be clearly and indelibly marked at a prominent place, visible even after the appliances are installed with the following:

1. Name or trade mark of the manufacturer
2. Batch or code number

NOTE *Attention is drawn to the certification facilities offered by the Sri Lanka Standards Institution. See the inside back cover of this standard.*

ANNEX A

LEAD SOLUBILITY TEST

A.1 A weighted quantity of material (glaze) dried at 100 ^{0}C shall be shaken continuously for one hour (at room temperature) with 1 000 times its weight of dilute hydrochloric acid (50 percent dilution, specific gravity 1.18). Thereafter, it shall be allowed to stand for one hour and then filtered. The lead salt contained in the clear filtrate shall be precipitated as lead sulphate. The weight of lead sulphate calculated as lead monoxide shall not exceed 5 percent of the dry weight of the sample taken for the test.

ANNEX B

TESTS FOR CHEMICAL RESISTANCE

B.1 CONTROL TEST PIECE SIZE

B.1.1 The test sample shall consist of eight pieces each not smaller than 75 mm x 25 mm x 6 mm taken from the glazed part of the appliance. One piece placed in a desiccator and is used as a control test piece.

B.2 PROCEDURE

B.2.1 The other seven test pieces are partially immersed, one in each of the seven solutions listed in Table 4. The strength of solution, lengths of time for immersion and the temperature shall be as stated in Table 4. Solution are all aqueous.

Table 4 Chemical Solutions

SI NO. (1)	Name of Chemical (2)	Strength of Solution Percent (3)	Time Hours (4)	Temperature ^{0}C (5)
i	Acetic acid	10	16	100
ii	Citric acid	10	16	100
iii	Detergent (Note 1)	(See Note 1)	48	60
iv	Hydrochloric acid	(See Note 2)	48	25-35
v	Sodium hydroxide	5	0.5	60
vi	Sodium stearate	0.15	48	60
vii	Sulphuric acid	3	16	100

NOTES

1. *This consists of an aqueous solution containing 0.04 percent (w/v) of a condensation product of nonyl-phenol with 8-10 molecules of ethylene oxide.*

   A suitable solution is commercially obtainable under the trade names 'Lissapol N' and 'Synperonic MP 8'. A solution which contains a minimum of 0.15% (m/v) should be used for this test.

2. *This solution consists of equal volumes of water and of hydrochloric acid of specific gravity 1.18.*

ANNEX C

TESTS FOR RESISTANCE TO STAINING AND BURNING

C.1 TEST PIECE SIZE

C.1.1 The test sample shall consist of two pieces, each not smaller than 75 mm x 25 mm x 6 mm taken from the glazed part of the appliance.

C.2 PROCEDURE

C.2.1 One of the test pieces is placed, at room temperature, with a glazed surface level, uppermost, clean and dry. One spot, not less than 10 mm diameter, of each of the six chemicals listed in C.2.2 is then placed on the glazed surface and allowed to dry. Any residue is then removed with a clean cloth which has been moistened with distilled water only.

C.2.2 The chemicals are the following;

a) 0.5 percent aqueous solution of methylene blue.

b) A solution of sodium hypochlorite, 10-14 percent w/v available chlorine. A 10 percent dilution is prepared for the test

c) 3 percent aqueous solution of hydrogen peroxide,

d) Amyl acetate,

e) Methylene chloride or Perchloro ethylene or Tri chloro ethylene, and

f) 13 g of iodine in 1 litre of ethanol.

C.2.3 The other piece is placed, at room temperature, with a glazed surface level uppermost, clean and dry.
A light cigarette is placed on the glazed surface, and allowed to remain for 15 minutes and then removed. The stained area is wiped with a clean cloth which has been moistened with distilled water only.

APPENDIX D

SAMPLING AND CRITERIA FOR CONFORMITY

Samples shall be drawn from each lot as per the sampling scheme and shall be tested separately for ascertaining the conformity of the lot to the requirements of this specification.

D.1 SCALE OF SAMPLING

D.1.1 The number of appliances to be selected from the lot shall be in accordance with column **2** of Table **D1.** The appliances shall be selected at random. In order to ensure randomness of selection, random number tables as given in **SLS 428** shall be used.

TABLE D1 – Scale of sampling

	Number of appliances in a lot **(1)**	**Number of appliances to be selected** **(2)**	**Permissible number of defects** **(3)**
(a) For finish, glazing and warpage	2 to 8	02	0
	9 to 15	03	0
	16 to 25	05	0
	26 to 50	08	0
	51 to 100	13	01
	101 and above	20	02
(b) For minimum thickness	Up to 25	08	01
	26 to 50	13	02
	51 to 100	20	03
	101 and above	32	05

NOTE
*The Table **D1** was prepared in accordance with **ISO 2859-1:1999**, General inspection level II AQL=1.5%.*

D.1.2 When the tests are required to be performed on regulatory requirement/s, the additional sub sample/s of size/s given in test method/s specified by the relevant regulation/s shall be selected as appropriate, in addition to the samples selected as per **D.1.1**.

D.2 NUMBER OF TESTS

D.2.1 Each tile selected as in **D.1.1** shall be inspected for following requirements as appropriate;

D.2.1.1 crazing, water absorption, chemical resistance modules of rupture and resistance to staining and burning - Two test pieces for crazing test and two test pieces for water absorption test shall be kept in one trolley during a shift of 8 hours.

A lot of 18 pieces shall be kept in the centre of the trolley or in different parts of the platform for the purpose of modulus of rupture test, once a month.

D.2.1.2 Number of tests and criteria for conformity for finish, thickness, glazing and warpage – The number of appliances to be selected shall depend upon the size of the lot and shall be in accordance with cols. 1 and 2 of Table 3.

D.2.1.3 The appliances shall be selected at random form the lot and in order to ensure the randomness of selection, random number tables may be used. In case random number tables are not available the following procedure shall be adopted.

Starting from any appliances in the lot count them as 1,2,3 …… up to r and so on, in one order, where r is the integral part of N/n (N being the lot size and n being the sample size). Every r th appliance thus counted shall be withdrawn to constitute a sample.

D.2.1.4 Each of the appliances selected in the sample shall be inspected for finish, thickness, glazing and warpage. Any appliances failing to meet any one or more requirements of the above characteristics shall be considered as defective.

D.2.1.5 If the number of defective appliances found is less than or equal to the corresponding permissible number in (3) of Table **D1**, the lot shall be considered as conforming to the requirements of the above characteristics, otherwise not.