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SPECIFICATION FOR
GENERAL REQUIREMENTS FOR ENAMELLED
CAST IRON SANITARY APPLIANCES

(Second Revision)

(Incorporating Amendment No. 1)

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

Price Group 3

Indian Standard
**SPECIFICATION FOR
 GENERAL REQUIREMENTS FOR ENAMELLED
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(Second Revision)

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Indian Standard
SPECIFICATION FOR
GENERAL REQUIREMENTS FOR ENAMELLED
CAST IRON SANITARY APPLIANCES
(*Second Revision*)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 22 March 1973, after the draft finalized by the Sanitary Appliances and Water Fittings Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This Indian Standard was first published in 1956 and was revised in 1962. The second revision incorporates a few changes found necessary in the light of the comments received on the standard from users and manufacturers of enamelled cast iron appliances and incorporates Amendment No. 1 issued to the standard in March 1966.

0.3 This edition 3.1 incorporates Amendment No. 1 (October 1979). Side bar indicates modification of the text as the result of incorporation of the amendment.

0.4 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*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard lays down the general requirements, such as material, thickness, warpage, enamelling, acid and alkali resistance, inspection rules and marking, for enamelled cast iron sanitary appliances like water closets and commodes.

2. TERMINOLOGY

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

*Rules for rounding off numerical values (*revised*).

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2.1 Inspection Window — A circle 75 mm in diameter, cut from a small sheet of any flexible material, such as rubber or paper, for convenience in sliding over irregular surfaces to determine defects.

2.2 Defects — Flaws and blemishes occurring in enamelled cast iron sanitary appliances.

2.2.1 Flaws

2.2.1.1 Cracked ware — An appliance with a rupture extending through both the casting and the enamel.

2.2.1.2 Craze — Crack in the enamelled surface.

2.2.1.3 Chip — An area of metal base from which the enamel has separated.

2.2.1.4 Pinhole — A hole which extends through the enamel to the metal base.

2.2.1.5 Flaw small — A flaw with its maximum dimensions varying from 0.2 to 0.5 mm.

2.2.1.6 Flaw medium — A flaw with its maximum dimensions varying from 0.5 to 0.8 mm.

2.2.1.7 Flaw large — A flaw with its dimensions over 0.8 mm.

2.2.2 Blemishes

2.2.2.1 Dimple — A slight depression in the enamel surface.

2.2.2.2 Lump — A raised portion of the enamel surface.

2.2.2.3 Speck — A particle of foreign matter which produces coloured spots on the surface of the appliance.

3. MATERIAL

3.1 Material for Base — The base shall be of cast iron conforming to Grade 15 of IS : 210-1970* and shall be in one piece. It shall be sound, true to form and free from porosity or other defects which affect the serviceability of the appliance.

4. MANUFACTURE

4.1 Thickness of the Base Metal — The thickness of the cast iron base shall be not less than 6.5 mm.

*Specification for grey iron castings (*second revision*).

4.2 Dimensions and Tolerances — The appliances shall conform to the specified dimensions, subject to a variation of ± 3 percent except where dimensions are specified as 'maximum', 'minimum' or 'approximate'.

4.3 Warpage — Warpage of edges set against wall or floor and edges of roll rims shall not exceed 5.0 mm per metre when tested as described under **4.3.1**. Warpage of all other edges shall not exceed 7.5 mm per metre when tested by the same method.

4.3.1 The appliance shall be placed on a flat surface so as to ascertain the amount of deviation from the horizontal plane at the edges. If a feeler gauge of thickness equal to the total allowable warpage does not slide under the appliance without forcing, the appliance shall be considered to be within the warpage limitations. If the appliance rocks on two opposite high corners, the horizontal plane shall be determined by placing one feeler gauge of the total warpage allowed under one low corner, holding the appliances firmly on this gauge. If a second feeler gauge of the same thickness does not slide under the appliance at any other point, the appliance shall be considered as not warped out of the horizontal plane and that it falls within the warpage limitations.

4.4 Finishing — The surface of the appliance shall be coated with vitreous enamel thoroughly fused to the cast iron base. The enamel coating shall be adequate and even, and shall cover the entire surface. The surface of the appliance shall be glossy, smooth and free from cracks, craze, chips and other defects which affect the appearance or the serviceability of the appliance, and their permissible limits are given in **4.4.1**.

4.4.1 Defects — Enamelled cast iron appliances shall be liable to rejection if the finish shows any of the following defects when examined through the inspection window unless otherwise specified and there shall be not more than one defect:

- a) *Crazing* — (Not to be confused with mechanical scratching, which will exhibit an irregular edge under a magnifying glass).
- b) *Dimples, rundown, sagging* — Unless not readily attracting attention when viewed from normal eye level under natural light.
- c) *Blisters* — Not more than two in number on the interior surface shall be permitted provided they cannot be broken by a pressure of a finger nail.
- d) *Pinholes* — Pinholes not more than two in number for coloured wares and not more than four for white wares shall be permissible. There shall be no grouping of pinholes and they shall not penetrate to the metal.
- e) *Specks* — Specks shall be less than one millimetre in size and maximum five in number and there shall be no grouping. Specks less than 0.25 mm in size shall not be treated as defect unless in sufficient number to form discolouration.

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f) *Flaw* — There shall be no grouping of flaws and their number shall not exceed the following limits:

Flaw small	2, <i>Max</i>
Flaw medium	2, <i>Max</i>
Flaw large	None

4.5 The thickness of the enamel as measured on a flat surface shall be not less than 0.5 mm when measured by a layer thickness measuring instrument (electric magnetic).

4.6 The enamel shall be of acid and alkali-resisting quality and shall pass the tests specified under **5**.

5. TESTS FOR ENAMEL

5.1 Abrasion Test — The enamel shall withstand the test for resistance to scratching as described under **5.1.1** by Powder No. 5 on the following scale of powders of increasing hardness (Mohs' scale).

<i>Powder No.</i>	<i>Material</i>
1	Talc
2	Gypsum
3	Calcite
4	Fluorite
5	Apatite
6	Orthoclase
7	Quartz
8	Topaz
9	Corundum
10	Diamond

5.1.1 The particle size of the abrasive powder shall be such that it passes through a 250-micron IS Sieve (see IS : 460-1962*) but is retained on a 212-micron IS Sieve. The powder shall be sprinkled over an area of approximately 1.6 cm² and covered with a small piece of chamois leather. A one kilogram weight having a circular base and 1.6 cm² surface area, shall then be placed on the chamois leather over the powder and drawn to and from 10 to 12 times, without bringing additional pressure over a 13-mm travel of the enamel surface. The surface shall then be examined for scratches with the aid of a magnifier of magnification 8. It shall be of such a pattern that the surface under test may be illuminated when the microscope is placed flat on the enamel surface. When examined as above, the surface shall not exhibit any visible scratching. The test shall be conducted on an inconspicuous portion of the appliance in order to prevent disfiguration.

NOTE — Separate chamois leather pieces shall be used with each powder.

*Specification for test sieves (*revised*).

5.2 Acid Resistance Test — For acid resistance the enamel may be subjected to the citric acid test, as described under **5.2.1**.

5.2.1 Citric Acid Test — The test shall be made on an inconspicuous portion of the article under test. The reagent shall consist of a solution of citric acid, made by dissolving 31.5 g of chemically pure citric acid crystals in 450 ml of distilled water. The solution and the enamel specimen shall be at room temperature. A drop of solution shall be placed in the form of a circular spot approximately 1.5 mm in diameter on the enamel of the article to be tested and shall be immediately covered by a watch-glass. This shall be allowed to remain undisturbed for 5 min. The solution shall then be removed and the enamelled surface examined. For satisfactory compliances to this test the spot shall not show any signs of dulling, loss of gloss or etching.

5.3 Alkali Resistance Test — When tested by the method described in Appendix A, the surfaces of the test specimen shall not show any colour strain.

6. SAMPLING

6.1 Lot — In any consignment all the appliances from the same batch of manufacture shall be grouped together to constitute a lot.

6.2 The number of appliances to be selected from a lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table 1.

6.3 The appliances for sample shall be selected at random from the lot. In order to ensure the randomness of selection, the procedure given in IS : 4905-1968* shall be adopted.

6.4 All the appliances selected as in col 2 of Table 1 shall be examined for material for base (see **3.1**), visual defects (see **4.4** and **4.4.1**), thickness of the base (see **4.1**), dimensions and tolerances (see **4.2**) and thickness of the enamel (see **4.5**).

6.5 The lot shall be considered as conforming to the requirements of this specification for the characteristics listed in **6.4**, if the number of appliances out of those examined under **6.4** failing to satisfy in one or more of the requirements does not exceed the corresponding permissible number of defectives given in col 3 of Table 1.

*Methods for random sampling.

TABLE 1 SAMPLE SIZE AND CRITERIA OF ACCEPTANCE

(Clause 6.2)

LOT SIZE	SAMPLE SIZE	PERMISSIBLE NUMBER OF DEFECTIVES FOR CHARACTERISTICS LISTED IN 6.4	SUB-SAMPLE	PERMISSIBLE NO. OF DEFECTIVES FOR CHARACTERISTICS LISTED IN 6.6
(1)	(2)	(3)	(4)	(5)
Up to 100	8	0	3	0
101 ,, 150	13	0	5	0
151 ,, 300	20	1	8	0
301 ,, 500	32	2	13	0
501 ,, 1 000	50	3	20	1
1 001 and above	80	5	32	2

6.6 The lot having been found conforming under **6.5** shall be further examined for warpage (see **4.3**), abrasion test (see **5.1**) and resistance to acid and alkali (see **5.2** and **5.3**). For this examination a sub-sample from the appliances already inspected under **6.4** shall be selected at random. The size of the sub-sample shall be in accordance with col 4 of Table 1.

6.7 A lot shall be considered as conforming to the requirements of this specification for warpage, resistance to acid and alkali and the abrasion test, if the number of appliances out of those examined under **6.6**, found failing to conform the requirements of any one or more of these tests does not exceed the corresponding permissible number of defectives as given in col 5 of Table 1.

7. INSPECTION AND MANUFACTURER'S CERTIFICATE

7.1 The appliance shall be subjected to visual inspection in good light and shall not show any flaws or other defects affecting the quality of the material and finish and serviceability of the appliance.

7.2 The purchaser or his representative shall be given all facilities for inspection of the goods at all stages of manufacture and finally prior to despatch from the manufacturer's works.

7.3 When no inspection of the goods is made by the purchaser's representative at the manufacturer's works, the manufacturer, when requested to do so, shall supply a certificate stating that the goods conform to this standard in all respects.

8. REJECTION

8.1 The purchaser shall have the option of rejecting any appliance purported to be supplied to this standard if it fails to meet any of the requirements laid down in this standard.

9. MARKING

9.1 Each appliance shall be marked with the manufacturer's name or trade-mark at a prominent place such that it is visible even after the appliance is fixed in position.

APPENDIX A

(Clause 5.3)

TEST FOR RESISTANCE TO ALKALI

A-1. OUTLINE OF THE METHOD

A-1.1 The enamelled test specimens are placed inside a stainless steel drum containing sufficient sodium pyrophosphate solution to immerse them completely.

A-2. APPARATUS

A-2.1 The apparatus shall consist of a stainless steel cylindrical drum, with both sides open, placed on a stand as shown in Fig. 1. The lids for the open ends shall be tightened with clamps. The portion at the top of the drum shall be fitted with rubber stopper through which a reflux condenser shall be connected.

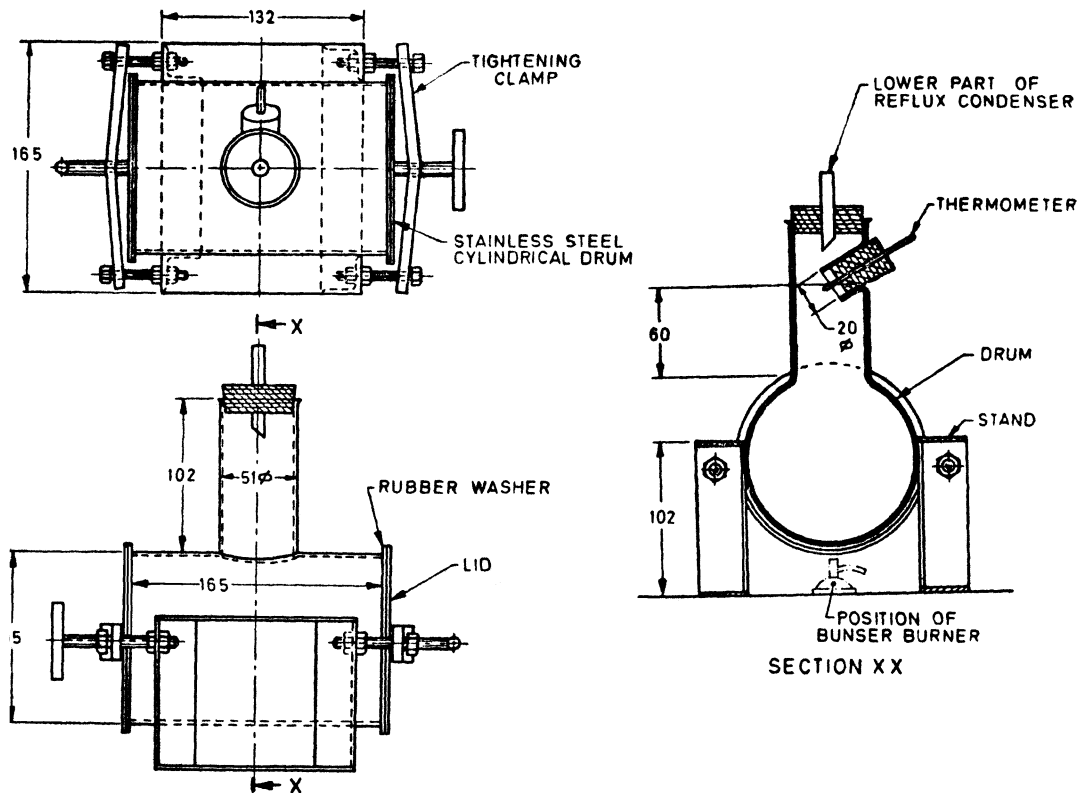
A-3. REAGENT

A-3.1 Sodium Pyrophosphate Solution — Dissolve 10.0 g of sodium pyrophosphate decahydrate ($\text{Na}_4\text{P}_2\text{O}_7 \cdot 10\text{H}_2\text{O}$) in sufficient quantity of water and make up the volume to 1 000 ml. Prepare the solution freshly before the test.

A-4. TEST SPECIMENS

A-4.1 Take at least 4 rectangular plates each measuring 40×75 mm either cut from the ware or coated on both sides with the same enamel and fired under identical conditions.

A-4.1.1 Specimen Preparation — Clean any adhering dirt and grease from the enamelled surfaces of the test specimens with acetone and dry.



All dimensions in millimetres.

FIG. 1 APPARATUS FOR ALKALI TEST

A-5. PROCEDURE

A-5.1 Place the test specimens inside the test apparatus side by side in a suitable rack of stainless steel. Tighten the lid by means of clamp. Pour 1 000 ml of boiling pyrophosphate solution into the drum through the top opening and connect it to the reflux condenser, through which water shall circulate. Keep the solution boiling for 2½ hours. At the end of the heating, remove the specimens from the apparatus, wash by rinsing with distilled water and dry in an air-oven at $105 \pm 2^{\circ}\text{C}$ for one hour. Cool in a desiccator.

A-6. ASSESSMENT OF RESULTS

A-6.1 The specimens tested as above shall meet the requirements specified in **5.3**.

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