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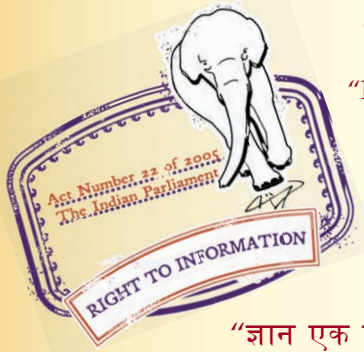
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IS 4860 (1968): acid-resistant bricks [CED 5: Flooring, Wall Finishing and Roofing]



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IS : 4860 - 1968

Indian Standard

**SPECIFICATION FOR
ACID-RESISTANT BRICKS**

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

Indian Standard

SPECIFICATION FOR ACID-RESISTANT BRICKS

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Indian Standard

SPECIFICATION FOR ACID-RESISTANT BRICKS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 17 November 1968, after the draft finalized by the Flooring and Plastering Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Acid-resistant bricks are used for masonry constructions, floorings subject to acid attack, lining of chambers and towers in chemical plants, lining of sewers carrying industrial effluents, etc, to prevent deterioration of the surface by acids except hydrofluoric acid and perchloric acid, and other chemicals. These bricks are made of raw materials, such as clay or shale of suitable composition with low lime and iron content, feldspar, flint or sand, and vitrified at high temperatures in ceramic kilns. These bricks are designed primarily for use in chemical and allied industries and are normally used with chemical resistant mortars. This standard covers the requirements for bricks intended for use where minimum absorption is required and thermal shock and alkali resistance are not important service factors.

0.3 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by referring to the ISO Recommendation R 475-1966 'Dimensions of rectangular refractory bricks'.

0.4 Assistance has also been rendered by the investigations carried out by Central Building Research Institute, Roorkee.

0.5 This standard contains a Note in Table 1 which permits the purchaser to use his option regarding requirement for resistance to wear of acid-resistant bricks.

0.6 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.

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

1. SCOPE

1.1 This standard lays down requirements for acid-resistant bricks.

2. DIMENSIONS AND TOLERANCES

2.1 **Dimensions** — The actual dimensions for acid-resistant bricks shall be as given below:

$$230 \times 114 \times 64 \text{ mm}$$

2.2 **Tolerances** — The permissible tolerances on the dimensions specified in 2.1 shall be as follows:

<i>Dimensions</i>	<i>Tolerances</i>
mm	mm
230	± 3.5
114	± 2.0
64	± 1.0

2.3 **Shape and Size** — The shape and size of brick other than the standard shall be as agreed to between the purchaser and the manufacturer.

2.4 **Warp** — When measured by the method described in 2.4.1, no surface shall depart from a plane surface by more than 2.5 mm at any point.

2.4.1 *Measurement of Warp* — Place a straight edge flat over the brick resting on a plane surface so as to leave maximum gap between the straight edge and the surface of the brick, as judged by the naked eye. Insert the measuring metallic wedge (see Fig. 1) in this gap and measure the maximum value.

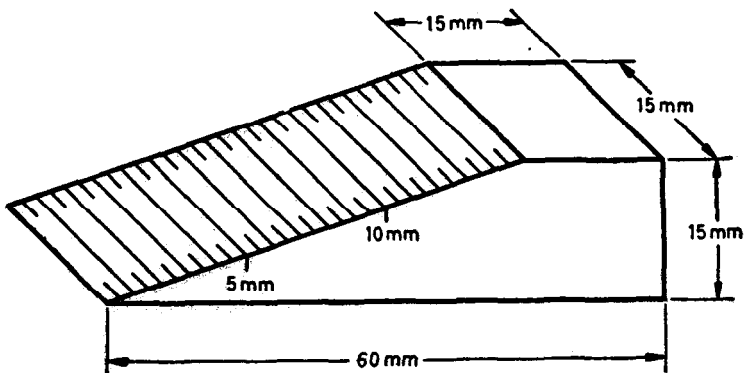


FIG. 1 MEASURING METALLIC WEDGE

3. FINISH

3.1 The finished brick when fractured shall appear fine grained in texture, dense and homogenous. The brick shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility.

4. CLASSIFICATION

4.1 The acid-resistant bricks shall be manufactured in two classes satisfying the requirements given in Table 1.

TABLE 1 PERFORMANCE REQUIREMENTS OF ACID-RESISTANT BRICKS

Sl. No.	CHARACTERISTIC	REQUIREMENT FOR		METHOD OF TEST (REF TO APPENDIX)
		Class I Bricks	Class II Bricks	
i)	Water absorption, percent, <i>Max</i>	2	4	Appendix A
ii)	Flexural strength, kg/cm ² , <i>Min</i>	100	70	Appendix B
iii)	Compressive strength, kg/cm ² , <i>Min</i>	700	500	Appendix C
iv)	Resistance to acid	Loss in weight shall not exceed 1.5 percent	Loss in weight shall not exceed 4.0 percent	Appendix D
v)	Resistance to wear	Average wear shall not exceed 2 mm	—	Appendix A of IS : 1237-1959*

NOTE — The requirement for resistance to wear is only optional and shall be carried out if required by the purchaser.

*Specification for cement concrete flooring tiles.

4.1.1 Class I Bricks — These are recommended for severe types of corrosive environments as obtained in storage tanks, pickling tanks, etc, and also in heavy duty floors subject to frequent contact with corrosives.

4.1.2 Class II Bricks — These are recommended for floors and working areas which are subject to occasional spillage of acids, fumes and contact with dry chemicals as in fertilizer silos. These may also be used for skirting and lining of silos.

5. PERFORMANCE REQUIREMENTS

5.1 The bricks when tested in accordance with the methods given in the appendices shall conform to the requirements specified in Table 1.

6. SAMPLING

6.1 The method of drawing representative samples of the acid-resistant bricks and the criteria for conformity shall be as given in Appendix E.

7. MARKING

7.1 Each brick shall be legibly marked on the largest face (230 × 114 mm) with the name of the manufacturer or his trade-mark, manufacturer's batch number and year of manufacture.

7.1.1 Each brick may also be marked with the Standard Mark.

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

APPENDIX A

[Table 1, Item (i)]

TEST FOR WATER ABSORPTION

A-1. PREPARATION OF TEST SPECIMEN

A-1.1 A minimum of five whole bricks shall be dried for at least 6 hours in an oven maintained at $110 \pm 5^\circ\text{C}$ and then transferred for cooling to an oven maintained at about 30°C . The specimens shall then be weighed (W_d) in a balance to an accuracy of 5 g.

A-2. PROCEDURE

A-2.1 The weighed specimens shall then be immersed in distilled water in a suitable vessel and boiled for two hours. During boiling, the test specimens shall be supported so as not to come in contact with the heated bottom of the container. After boiling the specimens shall be

allowed to remain immersed in water for 20 h. They shall be lifted and the excess water on the surface shall be removed by wiping the surface with a damp cloth and the specimens re-weighed (W_w) to an accuracy of 5 g.

A-3. CALCULATION

A-3.1 The water absorption of the specimen shall be calculated as follows:

$$\text{Percentage water absorption} = \frac{W_w - W_d}{W_d} \times 100$$

where

W_w = weight in g of the surface wiped specimen after 2 h boiling in distilled water and 20 h immersion in cold water, and

W_d = weight in g of the oven-dry specimen.

A-3.1.1 The individual test results shall be reported.

APPENDIX B

[Table 1, Item (ii)]

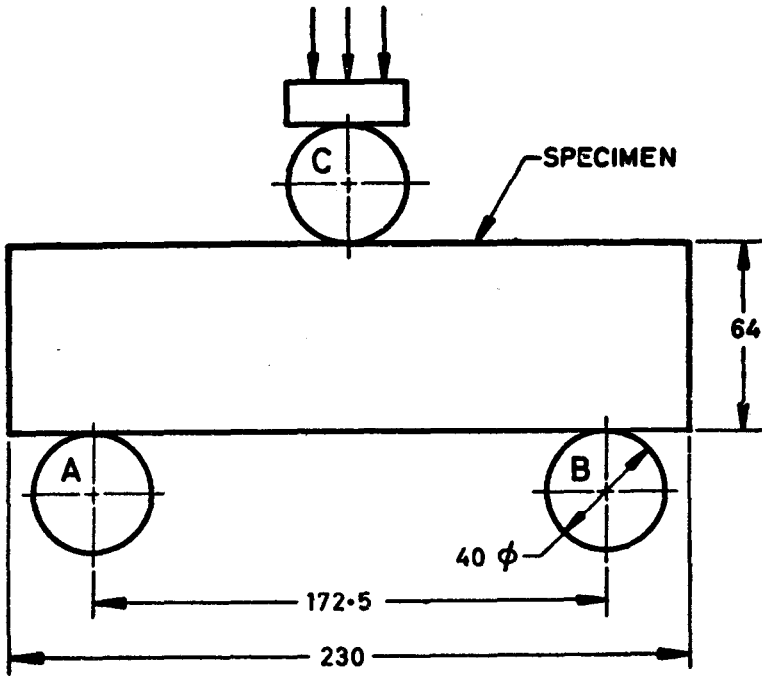
TEST FOR FLEXURAL STRENGTH

B-1. PREPARATION OF TEST SPECIMEN

B-1.1 The test specimens shall be whole bricks the dimensions of which shall be measured to the nearest 1 mm. A minimum of five bricks shall be separately tested. The test specimens shall be immersed in water at $27 \pm 2^\circ\text{C}$ for 24 hours.

B-2. PROCEDURE

B-2.1 The test specimen shall be placed centrally on self-aligning bearers *A*, *B* and *C* as shown in Fig. 2. The bearers shall be of mild steel 40 mm in diameter and shall be in the same horizontal plane and parallel to each other. The distance between the bearers *A* and *B* at the lines of contact with the specimen shall be three-fourths of the length dimension of the brick. Bearer *C* shall be midway between bearers *A* and *B* measured horizontally and rests upon the surface of the specimen. The load shall be applied at a uniform rate not greater than 30 kg/min through bearer *C*.



All dimensions in millimetres.

FIG. 2 ARRANGEMENT OF LOADING

B-3. CALCULATION AND REPORT

B-3.1 The individual breaking load shall be recorded and the flexural strength calculated by the following formula:

$$F = \frac{3 PL}{2 BD^2}$$

where

F = flexural strength of the brick in kg/cm²,

P = load in kg,

L = span in cm,

B = width of the brick in cm, and

D = depth of the brick in cm.

APPENDIX C

[Table 1, Item (iii)]

TEST FOR COMPRESSIVE STRENGTH

C-1. PREPARATION OF TEST SPECIMEN

C-1.1 The test specimens shall be whole bricks the dimensions of which shall be measured to the nearest 1 mm. A minimum of five bricks shall be immersed in water at $27 \pm 2^\circ\text{C}$ for 24 h.

C-2. PROCEDURE

C-2.1 The bricks shall be taken out from water one at a time for testing. The brick shall be wiped dry and placed between two 3-plywood sheets or 2 asbestos sheets each approximately 3 mm thick and carefully centered between the plates of the compression testing machine. The compression plate of the testing machine shall have a ball seating in the form of a portion of a sphere, the centre of which coincides with the centre of the face of the plate. The load shall be applied axially at a uniform rate of approximately $140 \text{ kg/cm}^2/\text{min}$ until failure occurs.

C-3. CALCULATION AND REPORT

C-3.1 The maximum load at failure divided by the area of brick shall be taken as the compressive strength.

C-3.2 The compressive strength of the brick shall be expressed in kg/cm^2 . The individual test results shall be reported.

APPENDIX D

[Table 1, Item (iv)]

TEST FOR ACID RESISTANCE

D-1. PREPARATION OF TEST SPECIMEN

D-1.1 The test specimen shall be prepared from individual bricks. A minimum of five bricks shall be tested.

D-1.1.1 Crush the bricks to powder individually in a stoneware mortar. Take 30 g of powder of each brick which passes 850-micron

IS Sieve and is retained on 600-micron IS Sieve (*see* IS : 460-1962*) 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 sandbath 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 one hour. Decant the water and rinse the particles with cold distilled water. Dry the material to constant weight keeping it in an oven maintained at a temperature of 110°C.

D-2. REAGENTS

D-2.1 The reagents used for the test shall be as follows:

- a) *Concentrated Nitric Acid* — conforming to IS : 264-1950†.
- b) *Concentrated Sulphuric Acid* — conforming to IS : 266-1961‡.

D-3. PROCEDURE

D-3.1 Weigh 25 g accurately to 0.01 g of the prepared specimen 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 sand bath and heat carefully, avoiding spurting, till all nitric acid has evaporated and sulphuric acid starts fuming profusely. Cool the basin and its contents to $27 \pm 2^\circ\text{C}$. 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 the 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 the final decantation, dry the sample in an oven maintained at 110°C to constant weight.

D-4. CALCULATION AND REPORT

D-4.1 Loss in weight (percent) shall be calculated as follows:

$$\frac{\text{Initial weight in g} - \text{final weight in g}}{\text{Initial weight in g}} \times 100$$

D-4.1.1 The individual test results shall be reported.

*Specification for test sieves (*revised*).

†Specification for nitric acid. (*Since revised*).

‡Specification for sulphuric acid (*revised*).

APPENDIX E

(Clause 6.1)

SAMPLING OF ACID-RESISTANT BRICKS

E-1. SCALE OF SAMPLING

E-1.1 Lot — In any consignment all the bricks of the same shape and size and from the same batch of manufacture shall be grouped together to constitute a lot.

E-1.1.1 Each lot so formed shall be tested separately for ascertaining its conformity or otherwise to the requirements of the specification.

E-1.2 The number of bricks to be selected at random from the lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table 2.

TABLE 2 SCALE OF SAMPLING

LOT SIZE	SAMPLE SIZE	PERMISSIBLE NO. OF DEFECTIVE BRICKS	SUB-SAMPLE SIZE
(1)	(2)	(3)	(4)
Up to 1 000	50	2	24
1 001 to 3 000	80	3	28
3 001 to 10 000	125	5	32
Over 10 000	200	7	40

E-1.2.1 In order to ensure the randomness in the selection of bricks in the sample, random number tables shall be used. In case such tables are not available the following procedure for selection may be adopted.

Starting from any brick 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 brick thus counted shall be withdrawn to give sample for inspection and testing.

E-2. NUMBER OF TESTS AND CRITERION FOR CONFORMITY

E-2.1 All the bricks selected as in E-1.2.1 (col 2 of Table 2) shall be inspected for shape, dimensions and tolerances (see 2) and finish (see 3).

E-2.1.1 The lot shall be considered as conforming to the requirements of these characteristics if the number of defective bricks does not exceed the permissible number as given in col 3 of Table 2. A brick is considered as defective if it fails in respect of any one or more of these characteristics.

E-2.2 The lot having been found conforming to the characteristics mentioned in E-2.1 shall then be tested for performance requirements (see 5 and Table 1). The number of bricks to be tested for these requirements shall be chosen at random from those already selected in accordance with col 4 of Table 2. These bricks shall then be divided at random into four groups, each having the same number of bricks. One group shall be put to water absorption test, the second group to flexural strength test, and third group to compressive strength test and the fourth group to resistance to acid test.

E-2.2.1 The lot shall be considered as conforming to the performance requirements if the criteria given in Table 3 are all satisfied.

E-3. RE-TEST

E-3.1 If the samples, when tested, do not comply with the requirements specified in the standard, a further similar set of samples shall be taken at random from the same batch and subjected to the tests. If any of the samples of the second test fails to comply with the requirements specified in the standard then all the bricks in the batch represented by the samples shall be rejected.

E-4. CERTIFICATE

E-4.1 The manufacturer shall, if required, supply the purchaser with a certificate from a recognized laboratory stating that the acid-resistant bricks supplied by him conform to the requirements laid down in the standard.

TABLE 3 CRITERIA FOR CONFORMITY FOR PERFORMANCE REQUIREMENTS

(Clause E-2.2.1)

Sr. No.	REQUIREMENT	TEST RESULTS	AVERAGE	RANGE	CRITERIA FOR CONFORMITY	CLASS I BRICKS	CLASS II BRICKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Water absorption	$x_{11}, x_{12} \dots x_{1n}$	\bar{x}_1	R_1	$\bar{x}_1 + 0.6R_1$	< 2 percent	4 percent
ii)	Flexural strength	$x_{21}, x_{22} \dots x_{2n}$	\bar{x}_2	R_2	$\bar{x}_2 - 0.6R_2$	$\geq 100 \text{ kg/cm}^2$	70 kg/cm^2
iii)	Compressive strength	$x_{31}, x_{32} \dots x_{3n}$	\bar{x}_3	R_3	$\bar{x}_3 - 0.6R_3$	$\geq 700 \text{ kg/cm}^2$	500 kg/cm^2
iv)	Resistance to acid	$x_{41}, x_{42} \dots x_{4n}$	\bar{x}_4	R_4	$\bar{x}_4 + 0.6R_4$	< 1.5 percent	4 percent

NOTE 1 — Average (\bar{x}) is obtained by dividing the sum of the observations by the number of observations.

NOTE 2 — Range (R) is the difference between the largest and the smallest observations or test results.

NOTE 3 — If a single test result deviates from the average value by more than 15 percent, this result shall be discarded, and the average of the remaining specimens, whose deviation does not exceed this limit, shall be taken.

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