(Reaffirmed 0)

भारतीय मानक
Indian Standard

IS 16720 : 2018

चूर्णित ईंधन राख-सीमेंट ईंट — विशिष्टि

Pulverized Fuel Ash-Cement Bricks — Specification

ICS 91.100.10; 91.100.25

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली-110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.org.in www.standardsbis.in

April 2018

Price Group 4

Cement Matrix Products Sectional Committee, CED 53

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement Matrix Products Sectional Committee had been approved by the Civil Engineering Division Council.

Pulverized fuel ash is a byproduct from thermal power stations using pulverized coal as fuel. This national resource can be gainfully utilized for manufacture of pulverized fuel ash-cement bricks as a supplement to common burnt clay building bricks leading to conservation of natural resources and improvement in environment quality.

Pulverized fuel ash-cement bricks are made from materials consisting of pulverized fuel ash in major quantity, cement and other ingredients. These bricks are manufactured by mixing of various raw materials which are then moulded into bricks and are demoulded when sufficiently hardened and then subjected to curing. While cement is used as binder, in the process, the calcium hydroxide liberated during the hydration of cement reacts with pozzolanic portion of pulverized fuel ash in the presence of moisture results in secondary hydrated mineralogy akin to those of cement hydration which gives additional strength to bricks.

Pulverized fuel ash-cement bricks are suitable for use in masonry construction just like common burnt clay bricks. Production of these bricks has already started in the country. It is expected that this standard would help in quality control and encourage their production and use on mass scale. This standard lays down the essential requirements of pulverized fuel ash-cement bricks so as to achieve quality and uniformity in the manufacture of such bricks.

The composition of the Committee responsible for formulation of this standard is given in Annex B.

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

Indian Standard

PULVERIZED FUEL ASH-CEMENT BRICKS — SPECIFICATION

1 SCOPE

This standard covers classification, dimensions, manufacture, physical requirements, sampling and criteria of conformity of pulverized fuel ash-cement bricks used in construction.

2 REFERENCES

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

3 TERMINOLOGY

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

3.1 Bricks — A masonry unit not exceeding 300 mm in length, 150 mm in width or 100 mm in height.

3.2 Density — The quantity calculated by dividing the mass of a pulverized fuel ash-cement brick by the overall volume, ignoring the volume of frog, if any.

3.3 Frog — The depression made in one or both of larger sides of bricks in order to form a key for the mortar at the joints.

4 DIMENSIONS AND TOLERANCES

4.1 Dimensions

4.1.1 The standard modular sizes of pulverized fuel ash-cement bricks shall be as follows (*see* Fig. 1A and Fig.1B):

Length (L) mm	*Width (B)* mm	*Height (H)* mm
190	90	90
190	90	40

4.1.2 The following non-modular sizes of the pulverized fuel ash-cement bricks may also be used (*see* Fig. 1A and Fig. 1B):

Length (L) mm	*Width (B)* mm	*Height (H)* mm
230	110	70
230	110	30

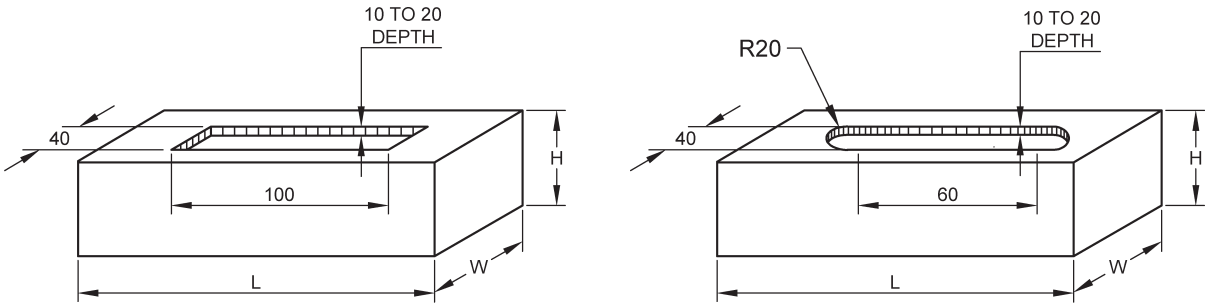
4.1.3 For obtaining proper bond arrangement in modular and non-modular bricks, bricks of suitable smaller size may also be manufactured for the purpose.

NOTE — By an agreement between the purchaser and the manufacturer, the pulverized fuel ash-cement bricks may be manufactured in other sizes also. The tolerance requirements of length, width and height shall remain the same as given in **4.2**.

4.2 Tolerance

4.2.1 The dimensions of pulverized fuel ash-cement bricks when tested in accordance with **4.2.2** shall be within the following limits per 10 pulverized fuel ash-cement bricks:

a) Length: ± 20 mm
b) Width: ± 20 mm
c) Height for individual bricks: ± 3 mm



1A 1B

All dimensions in millimetres.

FIG. 1 SHAPE AND SIZE OF FROGS IN PULVERIZED FUEL ASH-CEMENT BRICKS

4.2.2 Ten whole pulverized fuel ash-cement bricks shall be selected at random from the sample selected under **9**. All loose particles and small projections shall be removed from the pulverized fuel ash-cement bricks. They shall then be arranged on a level surface successively as indicated in Fig. 2A and Fig. 2B for measurement of length and width, respectively. The pulverized fuel ash-cement bricks are place in contact with each other and in a straight line for the measurement of length and width. The overall length of the assembled pulverized fuel ash-cement bricks shall be measured with a steel tape or other suitable inextensible measure sufficiently long to measure the whole row at one stretch. Measurement by repeated application of short rule or measure shall not be permitted. All these dimensions shall be added together. However, height of pulverized fuel ash-cement bricks shall be measured for individual bricks.

4.3 The pulverized fuel ash-cement bricks shall be solid and may be without or with frog which, where provided, shall be 10 mm to 20 mm deep on one of its larger sides of bricks. Typical shape and size of the frog is given in Fig. 1A or Fig. 1B.

5 CLASSIFICATION

Pulverized fuel ash-cement bricks shall be classified on the basis of average wet compressive strength as given in Table 1.

Table 1 Classes of Pulverized Fuel Ash — Cement Bricks
(*Clauses* 5 *and* 8.4)

Sl No.	Class Designation	Average 28-Day Wet Compressive Strength, *Min* N/mm^2
(1)	(2)	(3)
i)	15	15
ii)	12.5	12.5
iii)	10	10
iv)	7.5	7.5
v)	5	5

6 MATERIALS

The materials used shall conform to **6.1** to **6.5**.

6.1 Pulverized Fuel Ash

Pulverized fuel ash shall conform to IS 3812 (Part 1) or IS 3812 (Part 2).

6.2 Aggregates

6.2.1 Fine aggregates used shall conform to IS 383.

6.2.2 Coarse aggregates used shall conform to IS 383. The nominal maximum size of coarse aggregates used shall be passing 6.3 mm IS sieve.

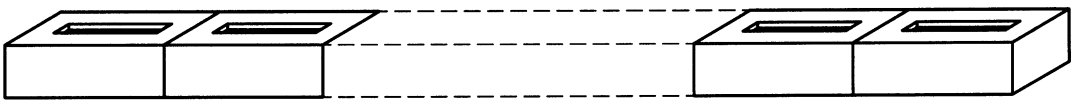
6.3 Cement

Cement complying with any of the following Indian Standards may be used:

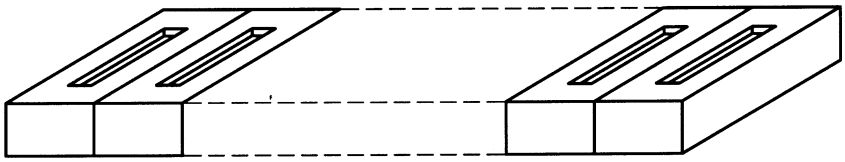
a) Ordinary Portland cement, conforming to IS 269;
b) Portland slag cement, conforming to IS 455;
c) Portland pozzalana cement: fly ash based, conforming to IS 1489 (Part 1);
d) Portland pozzolana cement: calcined clay based, conforming to IS 1489 (Part 2);
e) Sulphate resisting Portland cement, conforming to IS 12330;
f) Supersulphated cement, conforming to IS 6909;
g) Rapid hardening Portland cement, conforming to IS 8041;
h) White Portland cement, conforming to IS 8042;
j) Hydrophobic Portland cement, conforming to IS 8043; and
k) Composite cement, conforming to IS 16415.

6.4 Chemical Admixtures

Chemical admixtures, when used shall conform to IS 9103. Previous experience with and data on such



2A Measurement of Length



2B Measurement of Width

FIG. 2 MEASUREMENT OF TOLERANCES OF PULVERIZED FUEL ASH-CEMENT BRICKS

materials should be considered in relation to the specified standards of mechanization, supervision and workmanship in production of pulverized fuel ash-cement bricks. They may be added for specific requirements without affecting of specified quality parameters.

6.5 Water

The water used in production of pulverized fuel ash-cement bricks shall conform to the requirements specified in IS 456.

6.6 Additives

Any suitable additive considered not detrimental to the durability of the pulverized fuel ash-cement bricks, such as gypsum and lime may be used.

7 MANUFACTURE

7.1 The pulverized fuel ash cement-bricks should be manufactured by mixing of cement, pulverized fuel ash, aggregate and water. Chemical admixtures may be added, if required. The brick shall have total pulverized fuel ash content not less than 35 percent of the mass of bricks. Certificate shall be provided by the manufacturer, wherever required indicating the percentage of pulverized fuel ash in the brick.

7.2 Mixing

Batching of the ingredients should be done accurately and mixing shall be done in a mechanical mixer to achieve homogeneous mix. Mixing shall be continued until there is a uniform distribution of the materials, and the mass is uniform in colour and consistency.

7.3 Placing and Compaction

7.3.1 The pulverized fuel ash-cement bricks may be compacted in moulds by hydraulic or vibratory press or hydraulic-cum-vibratory press, and finished to proper size without broken edges.

7.3.2 After demounding, the pulverized fuel ash-cement bricks shall be handled carefully to avoid damage. The pulverized fuel ash-cement bricks shall be protected until they are sufficiently hardened before starting curing.

7.4 Curing

7.4.1 The pulverized fuel ash-cement bricks hardened in accordance with **7.3.2** shall then be cured as per **13.5** of IS 456 or by mist curing so as to achieve the specified strength of pulverized fuel ash-cement bricks.

7.4.2 The pulverized fuel ash-cement bricks hardened in accordance with **7.3.2** may alternatively be cured by steam curing.

8 PHYSICAL CHARACTERISTICS

8.1 GENERAL

Visually, the pulverized fuel ash-cement bricks shall be sound, free from visible cracks, and uniform in shape and colour. They shall have smooth rectangular faces with sharp corners. Minor chipping remitting from customary method of handling during delivery shall not be deemed ground for rejection.

8.2 Dimensions

The overall dimensions of the units when measured shall be in accordance with **4** subject to the tolerances mentioned therein.

8.3 Density

The pulverized fuel ash-cement bricks density when determined as per Annex C of IS 2185 (Part 1) shall have density between 1 100 kg/m^3 and 2 000 kg/m^3.

8.4 Compressive Strength

The minimum average 28 day wet compressive strength of pulverized fuel ash-cement bricks shall not be less than the one specified for each class as per Table 1, when tested as described in IS 3495 (Part 1). The 28 day wet compressive strength of any individual pulverized fuel ash-cement bricks shall not fall below the minimum average wet compressive strength specified for the corresponding class of pulverized fuel ash-cement bricks by more than 20 percent.

NOTE — In case any of the test results of wet compressive strength exceed the minimum specified strength for the class, by more than 25 percent, the same shall be limited to a value equal to 1.25 times the specified strength the class, for the purpose of averaging.

8.5 Drying Shrinkage

The average drying shrinkage of the pulverized fuel ash-cement bricks when tested by the method described in IS 4139, being the average of three units, shall not exceed 0.05 percent.

8.6 Water Absorption

The pulverized fuel ash-cement bricks, when tested in accordance with the procedure laid down in IS 3495 (Part 2), after immersion in cold water for 24 h, shall have average water absorption not more than 20 percent by mass up to class 10, and 15 percent by mass for higher classes.

9 SAMPLING

9.1 Lot

A collection of pulverized fuel ash-cement bricks of the same class and size, manufactured under relatively

similar conditions of production shall constitute a lot. For the purpose of sampling, a lot shall contain a maximum of 50 000 pulverized fuel ash-cement bricks. In case a consignment has pulverized fuel ash-cement bricks more than 50 000 of the same classification and size, and manufactured under relatively similar conditions of production, it shall be divided into lots of 50 000 pulverized fuel ash-cement bricks or part thereof. In case a consignment has pulverized fuel ash-cement bricks less than 50 000 of the same classification and size and manufactured under relatively similar conditions of production per day, the total production of each day shall be taken as a lot.

9.2 The pulverized fuel ash-cement bricks required for carrying out the tests laid down in this standard shall be taken by one of the methods given in **9.3** and **9.4**. In either case, a sample of 10 pulverized fuel ash-cement bricks shall be taken from every lot/consignment of 50 000 pulverized fuel ash-cement bricks or part thereof or per day production as given in **9.1** from the same class, size and same batch of manufacture.

9.3 The required number of pulverized fuel ash-cement bricks shall be taken at regular intervals during the loading of the vehicle or the unloading of the vehicle depending on whether sample is to be taken before delivery or after delivery. When this is not practicable, the sample shall be taken from the stack in which case the required number of pulverized fuel ash-cement bricks shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the.stacks by opening trenches from the top.

9.4 The sample of pulverized fuel ash-cement bricks shall be marked for future identification of the consignment it represents. The pulverized fuel ash-cement bricks shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind until they are required for test. The tests shall be undertaken as soon as practicable after the sample has been taken.

9.5 Number of Tests

9.5.1 All the 10 pulverized fuel ash-cement bricks shall be checked for dimensions and inspected for visual defects.

9.5.2 Out of the 10 pulverized fuel ash-cement bricks, 3 pulverized fuel ash-cement bricks shall be subjected to the test for compressive strength, 3 pulverized fuel ash-cement bricks to the test for density and 3 pulverized fuel ash-cement bricks to the test for water absorption and later to the test for drying shrinkage. The remaining 1 pulverized fuel ash-cement bricks shall be reserved.

10 CRITERIA FOR CONFORMITY

10.1 The lot shall be considered as conforming to the requirements of the specification, if the conditions mentioned in **10.2** to **10.4** are satisfied.

10.2 A lot shall be considered having found meeting the requirements of dimensions and tolerances, if none of the groups of bricks inspected fails to meet the specified requirements.

The number of pulverized fuel ash-cement bricks with visual defects, among those inspected shall be not more than two.

10.3 For pulverized fuel ash-cement brick density, the mean value determined shall be greater than or equal to the minimum specified. For compressive strength, the average value and minimum individual value determined shall be greater than or equal to the value specified.

10.4 For water absorption, the mean value determined shall be equal or less than maximum limit specified.

11 MANUFACTURER'S CERTIFICATE

The manufacturer shall satisfy himself that the pulverized fuel ash-cement bricks conform to the requirements of this standard and, if requested, shall supply a certificate to this effect to the purchaser or his representative.

12 MARKING

12.1 Each pulverized fuel ash-cement brick shall be marked (in the frog where provided) with an indication of source of manufacture. In pulverized fuel ash-cement bricks where frog is not provided, each pulverized fuel ash-cement bricks shall be marked on any of the faces.

12.2 BIS Certification Marking

The manufacturer may also use the Standard Mark.

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

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
269 : 2015	Specification for ordinary portland cement (*sixth revision*)	3812	Specification for pulverized fuel ash
383: 2016	Specification for coarse and fine aggregates for concrete (*third revision*)	(Part 1) : 2013	For use as pozzolana in cement, cement mortar and concrete (*third revision*)
455: 2015	Specification for portland slag cement (*fifth revision*)	(Part 2) : 2013	For use as admixture in cement mortar and concrete (*third revision*)
456 : 2000	Code of practice for plain and reinforced concrete (*fourth revision*)	4139 : 1989	Specification for calcium silicate bricks *(second revision*)
1489	Specification for portland pozzolana cement	6909 : 1990	Specification for supersulphated cement (*first revision*)
(Part 1) : 2015	Fly ash based (*fourth revision*)	8041: 1990	Specification for rapid hardening portland cement (*second revision*)
(Part 2) : 2015	Calcined clay based (*fourth revision*)	8042 : 2015	Specification white portland cement (*third revision*)
1727 : 1967	Methods of test for pozzolanic materials (*first revision*)	8043 : 1991	Specification for hydrophobic portland cement (*second revision*)
2185 (Part 1) : 2005	Specification for concrete masonry Units: Part 1 Hollow and solid concrete blocks (*third revision*)	9103 : 1999	Specification for concrete admixtures (*first revision*)
3495	Methods of tests of burnt clay building bricks	12330 : 1998	Specification for sulphate resisting Portland cement
(Part 1) : 1992	Determination of compressive strength (*third revision*)	16415 : 2015	Specification for composite cement
(Part 2) : 1992	Determination of water absorption (*third revision*)		

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Cement Matrix Products Sectional Committee, CED 53

Organization	*Representative(s)*
National Council for Cement and Building Materials, Ballabgarh	Shri V. V. Arora (***Chairman***)
All India A.C. Pipe Manufacturers' Association, Secunderabad	Shri N. Kishan Reddy Shri P. S. Kalani (*Alternate*)
Ambuja Cements Ltd, Ahmedabad	Shri J. P. Desai Shri B. K. Jagetiaya (*Alternate*)
Asbestos Information Centre, New Delhi	Shri Aaroon K. Sethi Shri John Nicodemus (*Alternate*)
Central Pollution Control Board, Delhi	Dr J. S. Kamyotra Shri P. K. Gupta (*Alternate*)
Central Public Health and Environmental Engineering Organization, New Delhi	Representative
Central Public Works Department, New Delhi	Shri B. B. Dhar Shri Mathura Prasad (*Alternate*)
CSIR-Central Building Research Institute, Roorkee	Shri S. K. Agarwal
CSIR-Structural Engineering Research Center, Chennai	Shri P. Srinivasan Dr B. H. Bharat Kumar (*Alternate*)
Delhi Development Authority, New Delhi	Representative
Director General of Factory Advise Services and Labour Institute, Mumbai	Dr Champak Bhattacharya
Engineers India Limited, New Delhi	Shri Rajanji Srivastava Shri Anurag Sinha (*Alternate*)
Everest Industries Limited, New Delhi	Shri Y. Srinivasa Rao Shri S. P. Bolar (*Alternate*)
Gammon India Ltd, Mumbai	Shri Manish Mokal Shri Sudeesh Rajendran (*Alternate*)
HIL Limited, Hyderabad	Shri R Pradeep Kumar Shri D. Satyanarayan (*Alternate*)
Housing & Urban Development Corporation Ltd, New Delhi	Chairman And Managing Director Shri Deepak Bansal (*Alternate*)
Military Engineer Service, Engineer-in-Chief's Branch, Army HQ, New Delhi	Shri V. K. Manglik Shri P. K. Gupta (*Alternate*)
Ministry of Science & Technology, New Delhi	Shri Chander Mohan
Ministry of Environment, Forest and Climate Change, New Delhi	Representative
Municipal Corporation of Delhi, New Delhi	Superintendent Engineer (Planning) Executive Engineer (Planning) (*Alternate*)
National Test House, Ghaziabad	Shri B. R. Meena Shri Aloke De (*Alternate*)
Rural Electrification Corporation, New Delhi	Shri Dinesh Kumar Shri P. K. Singhal(*Alternate*)
Spun Pipes Manufacturer's Association Maharashtra, Nanded	Shri C. Y. Gavhane Shri D. N. Joshi (*Alternate*)
Tamil Nadu Water Supply & Drainage, Chennai	Shri S. Hariramasamy

Organization	*Representative(s)*
The Indian Hume Pipe Company, Mumbai	Shri P. R. Bhat Shri S. J. Shah (*Alternate*)
BIS Directorate General	Shri Sanjay Pant, Scientist 'E' and Head (Civil Engg) [Representating Director General (*Ex-officio*)]

Member Secretary
Shri Manoj Kumar Rajak
Scientist 'C' (Civil Engg), BIS

Precast Concrete Products, Subcommittee, CED 53:3

Organization	*Representative(s)*
In Personal Capacity (*C-2/2220, Vasant Kunj, New Delhi*)	Shri Suddhodan Roy (***Convener***)
B. G. Shirke Construction Technology Pvt Ltd, Pune	Shri V. G. Jana Shri Y. P. Kajale (*Alternate)*
Central Electricity Authority, New Delhi	Director (RE) Deputy Director (RE) (*Alternate*)
Central Public Works Department, New Delhi	Shri B. B Dhar Shri Prasad (*Alternate*)
Central Soil and Materials Research Station, New Delhi	Shri N. Chander Shekharan Shri N. Shiv Kumar (*Alternate*)
CSIR-Central Building Research Institute, Roorkee	Representative
CSIR-Structural Engineering Research Centre,Chennai	Dr J. Prabhakar Dr S. Bhaskar (*Alternate*)
Delhi Development Authority, New Delhi	Suptdg Engineer (Design-1) Executive Engineer (Design-1) (*Alternate*)
Gammon India Ltd, Delhi	Shri Ratnaji T. N. V. S Shri Prakash Ramachandran (*Alternate*)
HIL Ltd, Hyderabad	Shri Sharad Dalmia Dr D. Satyanaryana (Alternate)
Hindustan Prefab Ltd, New Delhi	Shri Rajesh Goel Shri Satish Kumar Jain (*Alternate*)
Housing & Urban Development Corporation Ltd, New Delhi	Chairman And Managing Director Shri Deepak Bansal (*Alternate*)
K. K. Manhole & Grating Co (P) Ltd, New Delhi	Shri P. S. Gupta Shri C. G. Gupta (*Alternate)*
Larsen & Toubro Ltd, Chennai	Shri S. R. Kumar Shri Sthaladipti Saha (*Alternate)*
Maharashtra State Electricity Board, Mumbai	Shri C. B. Runwal
Medhavi Cement Products, Nanded	Shri Chandrakant Y. Gavhane Shri Abhijit C. Gavhane (*Alternate*)
Military Engineer Service, Engineer-in-Chief's Branch Army HQ, New Delhi	Shri Yashwant Kumar Shri K.G. Dua (*Alternate)*
Ministry of Science and Technology, New Delhi	Shri Chandra Mohan
National Council for Cement & Building Material, Ballabgarh	Shri V. V. Arora Shri Satish Sharma (*Alternate)*
Siporex India Pvt Ltd, Pune	Shri D. N. Dhongde Shri D. V. Kulkarni (*Alternate*)
System Building Technologists, New Delhi	Shri G. B. Singh
The Indian Hume Pipe Company Ltd, Mumbai	Shri P. R. Bhat Shri S. J. Shah (*Alternate)*
The Institution of Engineers (India), Kolkata	Representative
U. P. Electricity Board, Lucknow	Chief Engineer

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc No.: CED 53 (8074).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices: *Telephones*

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002 — 2323 7617, 2323 3841

Eastern : 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi, KOLKATA 700054 — 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, CHANDIGARH 160019 — 26 50206, 265 0290

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 — 2254 1216, 2254 1442, 2254 2519, 2254 2315

Western : Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400093 — 2832 9295, 2832 7858, 2832 7891, 2832 7892

Branches: AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. DURGAPUR. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. JAMMU. JAMSHEDPUR. KOCHI. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAIPUR. RAJKOT. VISAKHAPATNAM.

Published by BIS, New Delhi