

अतिसूक्ष्म फ्लाई ऐश — विशिष्टि

Ultrafine Fly Ash — Specification

ICS 91.100.10

© BIS 2024



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

FOREWORD

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

Ultrafine fly ash (UFFA) is a very fine pozzolanic material (pulverized fuel ash) consisting of ultrafine, glassy, spherical particles (of average size 3 micron to 5 micron) produced through multistage classification of selected fly ash conforming to IS 3812 (Part 1) : 2013 ‘Pulverized fuel ash — Specification: Part 1 For use as pozzolana in cement, cement mortar and concrete (*third revision*)’. Due to the fine size of ultrafine fly ash particles, it has more reactive surface area, which helps to achieve higher early strength and lower permeability to the concrete mix due to mechanical packing effect of well graded fine particles.

The use of finer pozzolanic materials in production of concrete especially of higher grades (M 60 and above) is progressively increasing in India. Keeping this trend in view and to meet the requirement of the construction industry, the standard on silica fume, IS 15388 : 2003 ‘Silica fume — Specification’ was formulated earlier. The standard for another ultrafine material, metakaolin was also formulated as IS 16354 : 2015 ‘Metakaolin for use in cement, cement mortar and concrete — Specification’. The advancements made during the last decade in grinding and classification technologies aided in yet another standard on ultrafine slag namely IS 16715 : 2018 ‘Ultrafine ground granulated blast furnace slag — Specification’. This standard is also in line with the above.

The ultrafine slag as well as ultrafine fly ash, both are indigenously produced in India while majority of silica fume is imported. The performance of these ultrafine materials when used as part replacement of cement in concrete or mortar in the range of 5 percent to 10 percent is comparable and found to enhance the properties and durability of concrete especially its permeability.

This standard contains [10.2](#), [10.2.1](#), [10.2.2](#), [12](#) and [13](#) which call for agreement between the purchaser and the supplier.

This standard contributes to the following Sustainable Development Goal: Goal 9 ‘Industry, innovation and infrastructure’ towards building resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation’, Goal 11 ‘Sustainable cities and communities’ and Goal 13 ‘Climate action’.

The composition of the Committee responsible for the formulation of this standard is given in [Annex D](#).

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 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. 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

ULTRAFINE FLY ASH — SPECIFICATION

1 SCOPE

This standard covers the chemical and physical requirements of ultrafine fly ash for use in concrete, mortar and other systems containing hydraulic cement.

2 REFERENCES

The standards listed in [Annex A](#) contain provisions, which through references in this text, constitute provisions 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 edition of these standards.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 4305 for pozzolanic materials and fly ash, and the following shall apply.

3.1 Raw Material — Fly ash used in the manufacture of ultrafine fly ash shall conform to IS 3812 (Part 1).

3.2 Ultrafine Fly Ash — A very fine pozzolanic material mainly consisting of pulverized fuel ash (fly ash) extracted from flue gases resulting from combustion of ground or pulverized coal and collected by cyclone separator or electrostatic

precipitator [*see* IS 3812 (Part 1)] and further processed and air classified to required fineness as per this standard.

4 MANUFACTURE

4.1 The ultrafine fly ash shall be produced by multi-stage classification of fly ash conforming to IS 3812 (Part 1), either by cyclone separators or other suitable methods so that the resulting product conforms to the specifications laid down in this standard. The residue (coarser part of fly ash) shall be suitably disposed of by the producer either for the manufacture of fly ash bricks or any other fly ash based (cement matrix) products based on relevant Indian Standards or in any other standard form to avoid environmental pollution.

4.2 Ultrafine fly ash shall not be prepared/manufactured by grinding pulverized fuel ash, but only through classification of fly ash obtained from the cyclone separator.

5 CHEMICAL REQUIREMENTS

Ultrafine fly ash shall conform to the chemical requirements given in [Table 1](#).

6 PHYSICAL REQUIREMENTS

Ultrafine fly ash shall conform to the physical requirements given in [Table 2](#).

Table 1 Chemical Requirements

([Clauses 5](#) and [8.2.2](#))

Sl No.	Characteristic	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Silicon dioxide (SiO ₂) + aluminium oxide (Al ₂ O ₃) + iron oxide (Fe ₂ O ₃), in percent by mass, <i>Min</i>	70	IS 1727
ii)	SiO ₂ , in percent by mass, <i>Min</i>	35	IS 1727
iii)	Magnesium oxide, in percent by mass, <i>Max</i>	5	IS 1727
iv)	Total sulphur as sulphur anhydride (SO ₃), <i>Max</i>	3	IS 1727

Table 1 (Concluded)

SI No.	Characteristic	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
v)	Total chlorides, in percent by mass, <i>Max</i>	0.05	IS 4032
vi)	Loss on ignition, in percent by mass, <i>Max</i>	4	IS 1727
vii)	Moisture content, in percent by mass, <i>Max</i>	2	Annex B
viii)	Total alkalis equivalent to sodium oxide (Na ₂ O), in percent by mass, <i>Max</i>	1.5	Annex C

Table 2 Physical Requirements

(Clauses 6 and 8.2.2)

SI No.	Characteristic	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Specific surface in m ² /kg (by BET method), <i>Min</i>	1 500	IS 11578
ii)	Oversize percent retained on 45 micron IS sieve, <i>Max</i> (see Note 1)	5	IS 1727
iii)	Oversize percent retained on 45 micron IS sieve, variation from average percent, <i>Max</i> (see Note 1)	5	IS 1727
iv)	Compressive strength at 7 days as percent of control sample, <i>Min</i> (see Note 2)	95	IS 1727
v)	Compressive strength at 28 days as percent of control sample, <i>Min</i> (see Note 2)	110	IS 1727
vi)	Lime reactivity measured in MPa, <i>Min</i> (see Note 3)	7	IS 1727
vii)	Soundness, by autoclave test method in percent, <i>Max</i>	0.8	IS 4031 (Part 3)

NOTES

1 The average shall consist of the ten preceding tests or all of the preceding tests if the number is less than ten.

2 The determination of compressive strength of Ultrafine fly ash cement mortar shall be done as per 10 of IS 1727 with the following modifications:

- a) The dry materials for the standard test mortar shall be UFFA : cement : standard sand in proportion 0.1 : 0.9 : 3.0 by weight, blended intimately.
- b) The following quantities of materials are suggested for preparation of the mortar:
 - 50 g : UFFA
 - 450 g : cement
 - 1 500 g : standard sand

3 Optional method of determination of reactive silica using X-ray diffraction (XRD) may also be employed. For more details, National Council for Cement and Building Materials Ballabgarh's established method as in their monograph (MS-14-2010) may be referred.

7 PARTICLE SIZE

Ultrafine fly ash shall have the following particle size distribution (PSD) as determined by using laser diffraction PSD analyser.

$$d_{50} < 7 \mu\text{m}$$

$$d_{90} < 15 \mu\text{m}$$

where

d_n = indicates that n percent of the particles on mass basis are below a given size (diameter).

8 SAMPLING AND CRITERIA FOR CONFORMITY

8.1 Sampling

8.1.1 The method and procedure of sampling of ultrafine fly ash shall be the same as the method given for fly ash in IS 6491. All samples whether grab or composite shall have a mass of at least 1 kg. Two grab/composite samples shall be taken from the first 100 t of ultrafine fly ash. For each subsequent 100 t from a lot of ultrafine fly ash, one sample shall be taken. However, not less than two samples shall be taken in any sampling process.

8.1.2 The sample or samples for testing may be taken by the purchaser or his representative or by any person appointed to supervise the work for which the ultrafine fly ash is required or by the latter's representative.

8.2 Criteria for Conformity

8.2.1 The samples of ultrafine fly ash drawn as per [8.1](#) and prepared as per [9](#) shall be tested for chemical and physical properties as per [5](#) and [6](#) respectively.

8.2.2 Samples representing each 100 t of ultrafine fly ash shall be tested for moisture content, loss on ignition, and over size of material in accordance with [Annex B](#), [Table 1](#) and [Table 2](#) respectively.

8.2.3 Testing for all other physical and chemical characteristics (except those mentioned in [8.2.2](#)) shall be carried out on complete samples representing not more than 400 t material each. The composite sample shall be prepared by combining portions equally from each of the 100 t samples.

8.2.4 The lot shall be considered passing if the sample meets all the requirements. The ultrafine fly ash may be rejected if it fails to meet any of the requirements of this standard. In case of dissatisfaction with the result of tests, the producer or supplier may request re-testing of the

failed consignment on terms and conditions as mutually agreed between the supplier and the purchaser.

9 SAMPLE PREPARATION

9.1 The grab or composite sample drawn in accordance with [8.1](#) shall be mixed thoroughly. The mixing may be done in a clean and dry laboratory mixer. The amount of ultrafine fly ash shall be 40 percent to 50 percent of the volume capacity of the mixer. The mixing time shall be 5 min ± 1 min. It shall be ensured that no material is thrown out from the mixer during mixing. A polyethene sheet or any other suitable arrangements shall be made to keep the material in the mixer during mixing.

9.2 A sampling device of appropriate size shall be used to take material from the thoroughly mixed sample for purpose of making the test specimen. At least six random sub-samples shall be taken to prepare the test specimen.

10 PACKING

10.1 The ultrafine fly ash shall be packed in any of the following bags:

- a) PP woven laminated block bottom valve sacks conforming to IS 16709;
- b) Multi-wall paper sacks conforming to IS 11761;
- c) HDPE/PP woven sacks with liner conforming to IS 11652; and
- e) Any other approved composite bag.

Bags shall be in good condition at the time of packing and inspection.

10.2 The net quantity of ultrafine fly ash per bag shall be 50 kg subject to tolerance as agreed to between the supplier and the purchaser.

10.2.1 The net quantity of ultrafine fly ash per bag may also be 25 kg, 10 kg, 5 kg, 2 kg or 1 kg and packed in suitable bags as agreed to between the purchaser and the manufacturer.

10.2.2 Supplies of ultrafine fly ash may be made in drums or bulk by arrangement between the purchaser and the manufacturer/supplier.

11 STORAGE AND INSPECTION

11.1 The ultrafine fly ash shall be stored in such a manner so as to permit easy access for proper inspection and identification of each consignment.

IS 19058 : 2024

11.2 Adequate facilities shall be provided to the purchaser for careful sampling and inspection, either at the source or at the site of the work, as may be specified by the purchaser. IS 4082 may be referred for guidance in general. Ultrafine fly ash shall be stored similar to cement/fly ash/silica-fume/metakaolin, depending upon the storage requirement in bags/bulk form.

12 DELIVERY

The supply of ultrafine fly ash shall be made in suitable quantities mutually agreed between the purchaser and the supplier. Where so required by the purchaser, the material shall be supplied in bags. The ultrafine fly ash may also be delivered in drum/bulk as agreed upon between the supplier and the purchaser.

13 MANUFACTURER'S CERTIFICATE

The supplier/manufacturer shall satisfy himself that the ultrafine fly ash conforms to the requirements of this standard and, if requested by the purchaser, shall furnish a certificate to this effect, indicating the results of the tests carried out on the samples of the ultrafine fly ash.

14 MARKING

14.1 Each bag/consignment of ultrafine fly ash shall be clearly and permanently marked with the following information.

- a) Manufacturer's name and his registered trade-mark;
- b) The words 'ULTRAFINE FLY ASH';
- c) Net quantity, in kg;

- d) The words 'USE NO HOOKS' on the bags;
- e) Batch/control unit number in terms of week, month and year of packing; and
- f) Address of the manufacturer.

14.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

15 HEALTH AND SAFETY

15.1 Ultrafine fly ash is very fine powdery material, and when handled, some dust may become suspended in the air in the working area. It is therefore advisable to take all necessary precautions while handling and using the material.

15.2 Every attempt should be made to keep airborne ultrafine fly ash particles to a minimum to avoid irritation of eyes, nose and throat. Should this not be practicable, then the use of goggles, dust masks and suitable respiratory protective devices shall be made (*see IS 14352 and IS 9473*).

15.3 Similar information shall be provided in the shipping invoices accompanying the shipment of bulk ultrafine fly ash.

15.4 The ultrafine fly ash consignment shall be in good condition at the time of inspection.

ANNEX A

(Clause 2)

LIST OF REFERRED STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
IS 1727 : 1967	Methods of test for pozzolanic materials (<i>first revision</i>)	IS 11578 : 1986	Method for determination of specific surface area of powders and porous particles using low temperature gas adsorption techniques
IS 3812 (Part 1) : 2013	Pulverized fuel ash — Specification: Part 1 For use as pozzolana in cement, cement mortar and concrete (<i>third revision</i>)	IS 11652 : 2017	Textiles — High density polyethylene (HDPE)/ polypropylene (PP) woven sacks for packaging of 50 kg cement — Specification (<i>third revision</i>)
IS 4031 (Part 3) : 1988	Methods of physical tests for hydraulic cement: Part 3 Determination of soundness (<i>first revision</i>)	IS 11761 : 2024	Multi-wall paper sacks for cement — Specification (<i>second revision</i>)
IS 4032 : 1985	Methods of chemical analysis of hydraulic cement (<i>first revision</i>)	IS 14352 : 1996	Miner's safety goggles — Specification
IS 4082 : 1996	Stacking and storage of construction materials and components at site — Recommendations (<i>second revision</i>)	IS 16709 : 2017	Textiles — Polypropylene (PP) woven, laminated, block bottom valve sacks for packaging of 50 kg cement — Specification
IS 4305 : 1967	Glossary of terms relating to pozzolana		
IS 6491 : 1972	Methods of sampling fly ash		
IS 9473 : 2002	Respiratory protective devices — Filtering half masks to protect against particles — Specification (<i>first revision</i>)		

To access Indian Standards click on the link below:

https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/knownyourstandards/Indian_standards/isdetails/

ANNEX B

(Table 1 and clause 8.2.2)

METHOD OF TEST FOR DETERMINATION OF MOISTURE CONTENT

B-1 PROCEDURE

Dry the clean empty petri dish (approximately 100 mm diameter) at a temperature of 105 °C to 110 °C and weigh it, after cooling in a desiccator. Spread uniformly, not less than 2.5 g ± 0.5 g, ultrafine fly ash sample as received basis, in this petri dish and weigh. Heat this uncovered petri dish with ultrafine fly ash in a drying oven at a temperature of 105 °C to 110 °C for 1 h. Cool the petri dish with heated ultrafine fly ash in a desiccator and weigh. Repeat the process until there is no further loss in mass.

B-2 CALCULATION AND REPORTING OF RESULTS

Calculate the percentage of moisture to the nearest

0.1 percent as follows:

$$\text{Moisture content (in percent)} = \frac{x}{y} \times 100$$

where

x = loss in mass of the ultrafine fly ash during drying in gram; and

y = mass of ultrafine fly ash, as received basis in gram.

ANNEX C

(Table 1)

METHOD FOR DETERMINATION OF AVAILABLE ALKALIES

C-1 PROCEDURE

C-1.1 Weigh 5.0 g of the sample and 2.0 g of hydrated lime on a piece of weighing paper, carefully mix using a metal spatula and transfer to a small plastic vial of approximately 25 ml capacity. Add 10.0 ml of water to this mixture, seal the vial by securing the cap or lid to the vial with tape (*see Note*), blend by shaking until the mixture is uniform, and store at 38 °C ± 2 °C.

NOTE — To ensure that moisture loss from the paste does not occur, place the sealed vial in a sealable container (such as a small sample or mason jar), add sufficient water to cover the bottom of the container, and seal.

C-2.2 Open the vial at the age of 28 days and transfer the contents to a 250 ml casserole. Break up and grind the cake with a pestle, adding a small amount of water, if necessary, so that a uniform slurry containing no lumps is obtained (*see Note*). Add sufficient water to make the total volume to 200 ml. Let it stand for 1 h at room temperature with frequent stirring. Filter through a medium-textured filter paper onto a 500 ml volumetric flask. Wash thoroughly with hot water (8 to 10 times).

NOTE — At times it may be necessary to break the vial and peel off the plastic from the solid cake. In such cases, care should be exercised to avoid the loss of material and to remove all solid material from the fragments of the vial. If the cake is too hard to break up and grind in the casserole, a mortar should be used.

C-1.3 Neutralize the filtrate with dilute HCl (1 + 3), using 1 to 2 drops of phenolphthalein solution as an indicator. Add exactly 5 ml of dilute HCl (1 + 3) in excess. Cool the solution to room temperature and fill the flask to the mark with distilled water. Determine the amount of sodium and potassium oxides in the solution using the flame photometric procedure, described in IS 4032, except that the standard solutions shall be made up, to contain 8 ml of calcium chloride (CaCl₂) stock solution per litre of standard solution, and the solution as prepared shall be used in place of the solution of cement.

NOTE — The standard solutions made up with 8 ml of calcium chloride (CaCl₂) stock solution containing the equivalent of 504 ppm of CaO. Tests have shown that this amount closely approximates the amount of calcium dissolved in the test solution.

C-2 CALCULATION AND REPORTING OF RESULTS

Calculate the results as percent by mass of the original sample material. Report as equivalent percentage of sodium oxide (Na₂O), calculated as follows:

$$\text{Equivalent Na}_2\text{O, percent} = \text{Na}_2\text{O, percent} + 0.658 \times \text{K}_2\text{O, percent}$$

ANNEX D

(Foreword)

COMMITTEE COMPOSITION

Cement and Concrete Sectional Committee, CED 02

<i>Organization</i>	<i>Representative(s)</i>
In Personal Capacity (<i>Grace Villa, Kadamankulam PO, Thiruvalla</i>)	SHRI JOSE KURIAN (Chairperson)
ACC Ltd, Mumbai	SHRI MANOJ JINDAL DR MANISH V. KARANDIKAR (<i>Alternate</i>)
Ambuja Cements Limited, Ahmedabad	SHRI UMESH P. SONI SHRI SUKURU RAMARAO (<i>Alternate</i>)
Cement Manufacturers Association, Noida	DR V. RAMACHANDRA SHRI PRAKHAR SRIVASTAVA (<i>Alternate I</i>) SHRI SHUBHO CHAKRAVARTY (<i>Alternate II</i>)
Central Public Works Department, New Delhi	SHRI DINESH KUMAR UJJAINIA
Central Soil and Materials Research Station, New Delhi	SHRI U. S. VIDYARTHI SHRI B. K. MUNZNI (<i>Alternate</i>)
CSIR - Central Building Research Institute, Roorkee	DR S. K. SINGH SHRI SUBHASH CHAND BOSE GURRAM (<i>Alternate</i>)
CSIR - Structural Engineering Research Centre, Chennai	DR S. BHASKAR DR J. PRABHAKAR (<i>Alternate I</i>) SHRI PRABHAT RANJAN PREM (<i>Alternate II</i>)
Engineers India Limited, New Delhi	DR SUDIP PAUL SHRI VIKRAM K. GUPTA (<i>Alternate I</i>) SHRI RAKESH KUMAR (<i>Alternate II</i>) SHRI RAVI GERA (<i>Alternate III</i>)
Hindustan Construction Company Ltd, Mumbai	SHRI KHATAR BATCHA SHRI PRAVEEN H. SHETTIGAR (<i>Alternate</i>)
Hindustan Consulting Associates Pvt Ltd, New Delhi	SHRI SATISH KUMAR SHARMA
Housing and Urban Development Corporation Limited, New Delhi	SHRI DEEPAK BANSAL
Indian Association of Structural Engineers, New Delhi	PROF MAHESH TANDON SHRI MANOJ K. MITTAL (<i>Alternate</i>)
Indian Concrete Institute, Chennai	DR M. R. KALGAL PROF S. SARASWATI (<i>Alternate</i>)
Indian Institute of Technology Delhi, New Delhi	DR SHASHANK BISHNOI DR DIPTI RANJAN SAHOO (<i>Alternate</i>)
Indian Institute of Technology Madras, Chennai	PROF MANU SANTHANAM

<i>Organization</i>	<i>Representative(s)</i>
Indian Institute of Technology Roorkee, Roorkee	DR UMESH KUMAR SHARMA DR PRAMOD KUMAR GUPTA (<i>Alternate I</i>) PROF ANJANEYA DIXIT (<i>Alternate II</i>)
L&T Construction, Chennai	DR K. SIVAKUMAR
Military Engineering Services, New Delhi	MAJ GEN RAJESH SINGH SHRI SUNEEL KUMAR ARORA (<i>Alternate</i>)
National Council for Cement and Building Materials, Ballabgarh	SHRI P. N. OJHA DR S. K. CHATURVEDI (<i>Alternate I</i>) SHRI BRIJESH SINGH (<i>Alternate II</i>)
National Test House, Kolkata	SHRI D. V. S. PRASAD DR SOMIT NEOGI (<i>Alternate</i>)
Nuvoco Vistas Corporation Ltd, Mumbai	SHRI PRANAV DESAI SHRI JAI SINGH (<i>Alternate</i>)
The India Cements Limited, Chennai	SHRI S. DAKSHINAMOORTHY SHRI P. MUNI REDDY (<i>Alternate</i>)
The Indian Hume Pipe Company Limited, Mumbai	SHRI S. J. SHAH SHRI U.S. MAHAJAN (<i>Alternate</i>)
The Institution of Engineers (India), Kolkata	DR H. C. VISVESVARAYA SHRI S. H. JAIN (<i>Alternate</i>)
The Ramco Cements Limited, Chennai	SHRI BALAJI K. MOORTHY SHRI ANIL KUMAR PILLAI (<i>Alternate</i>)
Ultra Tech Cement Ltd, Mumbai	SHRI RAJU GOYAL SHRI K. JAYASANKAR (<i>Alternate</i>)
Voluntary Organization in Interest of Consumer Education, New Delhi	SHRI M. A. U. KHAN DR RAJIV JHA (<i>Alternate</i>)
In Personal Capacity (<i>House No. 131 Sector 11D Faridabad</i>)	SHRI V. V. ARORA
In Personal Capacity [<i>B-806, Oberoi Exquisite, Oberoi Garden City, Goregaon (East), Mumbai</i>]	SHRI A. K. JAIN
In Personal Capacity (<i>36, Old Sneh Nagar, Wardha Road, Nagpur</i>)	SHRI L. K. JAIN
BIS Directorate General	SHRI DWAIPAYAN BHADRA, SCIENTIST 'E'/DIRECTOR AND HEAD (CIVIL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)]

Member Secretary
SHRI JITENDRA KUMAR CHAUDHARY
SCIENTIST 'B'/ASSISTANT DIRECTOR
(CIVIL ENGINEERING), BIS

Cement, Pozzolana and Cement Additives Sub-committee, CED 2 : 1


<i>Organization</i>	<i>Representative(s)</i>
In Personal Capacity (<i>Type IV/17, President's Estate, New Delhi</i>)	SHRI K. H. BABU (<i>Convener</i>)
20 Microns Limited, Mumbai	SHRI ATIL PARIKH SHRI SUNIL MISTRY (<i>Alternate</i>)
ACC Limited, Mumbai	SHRI PRALHAD MUJUMDAR SHRI ANIL KULKARNI (<i>Alternate</i>)
AIMIL Limited, New Delhi	SHRI YOGIN CHANDORKAR SHRI MADAN KUMAR SHARMA (<i>Alternate</i>)
Ambuja Cement, Mumbai	SHRI SUKURU RAMARAO SHRI UMESH P. SONI (<i>Alternate</i>)
Building Material and Technology Promotion Council, New Delhi	SHRI C. N. JHA SHRI SHARAD GUPTA (<i>Alternate</i>)
Cement Corporation of India Limited, New Delhi	SHRIMATI SARASWATHI DEVI MS BIBHA KUMARI (<i>Alternate</i>)
Cement Manufacturers Association, New Delhi	SHRI ASHWANI PAHUJA DR S. K. SAXENA (<i>Alternate I</i>) SHRI SHUBHO CHAKRAVARTY (<i>Alternate II</i>)
Central Electricity Authority, New Delhi	SHRI BALESHWAR THAKUR SHRI MOHAN KUMAR (<i>Alternate</i>)
Central Pollution Control Board, New Delhi	SHRI DIVYA SINHA SHRI P. K. GUPTA (<i>Alternate</i>)
Central Public Works Department, New Delhi	SHRI DINESH KUMAR UJJAINIA
Central Soil and Materials Research Station, New Delhi	SHRI U. S. VIDYARTHI SHRI RAJ KUMAR (<i>Alternate</i>)
CSIR - Central Building Research Institute, Roorkee	DR S. K. SINGH SHRI MICKY M. DELBEHRA (<i>Alternate I</i>) SHRIMATI HUMAIRA ATHAR (<i>Alternate II</i>)
CSIR - Central Road Research Institute, New Delhi	SHRI J. B. SENGUPTA SHRI SATISH PANDEY (<i>Alternate</i>)
CSIR - Structural Engineering Research Centre, Chennai	DR S. MAHESWARAN SHRI G. RAMESH (<i>Alternate I</i>) MS NASIMA G. (<i>Alternate II</i>)
Dalmia Cement (Bharat) Limited, New Delhi	SHRI JAI PRAKASH VRATI SHRI ASHOK BOSE (<i>Alternate</i>)
Elkem South Asia Private Limited, Navi Mumbai	SHRI BRAJESH MALVIYA SHRI SURENDRA SHARMA (<i>Alternate</i>)
Gujarat Engineering Research Institute, Narmada, Water Resources, Water Supply and Kalpsar Department, Vadodara	SHRI R. M. PATEL SHRI K. R. PATEL (<i>Alternate</i>)
Hindustan Construction Company Limited, Mumbai	SHRI KHATAR BATCHA SHRI MANOHAR CHERALA (<i>Alternate</i>)

<i>Organization</i>	<i>Representative(s)</i>
Hindustan Consulting Associates Pvt Ltd, New Delhi	SHRI SATISH KUMAR SHARMA
Indian Concrete Institute, Chennai	DR SAPNA DEVENDRA
Indian Institute of Technology Delhi, New Delhi	DR SHASHANK BISHNOI DR SUPRATIC GUPTA (<i>Alternate</i>)
Institute for Solid Waste Research and Ecological Balance Insward, Visakhapatnam	DR N. BHANUMATHIDAS SHRI N. KALIDAS (<i>Alternate</i>)
JSW Cement Limited, Mumbai	MS LOPAMUDRA SENGUPTA DR JAGABANDHU KOLE (<i>Alternate</i>)
Maharashtra Engineering Research Institute, Nashik	ASSISTANT RESEARCH OFFICER
Military Engineer Services, New Delhi	SHRI MANOJ BAPNA SHRI M. K. DEEPAK (<i>Alternate</i>)
Ministry of Commerce and Industry, Department of Commerce, New Delhi	SHRI MOHD ZAKARIA KHAN YUSUFZAI SHRI SUNIL AGARWAL (<i>Alternate</i>)
Ministry of Science and Technology, Department of Science & Technology, New Delhi	SHRI S. S. KOHLI
National Council for Cement and Building Materials, Faridabad	DR S. K. CHATURVEDI SHRI P. N. OJHA (<i>Alternate I</i>) SHRI BRIJESH SINGH (<i>Alternate II</i>) SHRI SURESH VANGURI (<i>Alternate III</i>)
National Hydroelectric Power Corporation, Faridabad	SHRI R. M. A. KHAN
National Test House, Kolkata	SHRI D. V. S. PRASAD DR MOITRAYEE DEVI (<i>Alternate</i>)
Netra NTPC Limited, Noida	DEPUTY GENERAL MANAGER SHRI MASSOM ALI (<i>Alternate</i>)
Nuvoco Vistas Company Limited, Mumbai	SHRI PRANAV DESAI SHRI RAVINDRA KHAMPARIA (<i>Alternate</i>)
Raw Materials and Coke Making, Tata Steel Limited, Jamshedpur	SHRI VIPUL MOHAN KORANNE
Ready Mixed Concrete Manufactures Association, Mumbai	SHRI A. K. JAIN
Tamil Nadu Minerals Limited, Chennai	SHRI V. SANTHANAM SHRI E. GANESAN (<i>Alternate</i>)
The India Cements Limited, Chennai	SHRI S. DAKSHINAMOORTHY SHRI P. MUNI REDDY (<i>Alternate</i>)
The Ramco Cements Limited, Chennai	SHRI BALAJI K. MOORTHY SHRI ANIL KUMAR PILLAI (<i>Alternate</i>)
UltraTech Cement Limited, Mumbai	DR K. SURESH SHRI SHUBHO CHAKRAVARTY (<i>Alternate</i>)
In Personal Capacity (<i>P9-3D, SRS Residency, Sector - 88, Faridabad</i>)	SHRI S. HARSH

Panel for Revision of Cement Standards, CED 2 : 1/P1

<i>Organization</i>	<i>Representative(s)</i>
In Personal Capacity (<i>Type IV/17, President's Estate, New Delhi</i>)	SHRI K. H. BABU (<i>Convener</i>)
AIMIL Limited, New Delhi	SHRI HEMAN MANCHANDA SHRI AMAN KHULLAR (<i>Alternate</i>)
Cement Manufacturers Association, New Delhi	DR AWADESH K. SINGH SHRI SATYENDRA KUMAR (<i>Alternate I</i>) SHRI SHUBHO CHAKRAVARTY (<i>Alternate II</i>)
Central Public Works Department, New Delhi	SHRI DINESH KUMAR UJJAINIA
CSIR - Central Building Research Institute, Roorkee	DR S. K. SINGH DR NEERAJ JAIN (<i>Alternate I</i>) SHRI RAJESH KUMAR (<i>Alternate II</i>)
CSIR - Structural Engineering Research Centre, Chennai	DR P. S. AMBILY DR K. SENTHIL (<i>Alternate I</i>) SHRI NARTHU MANOJ (<i>Alternate II</i>)
Hindustan Construction Company Limited, Mumbai	SHRI PRAVEEN H. SHETTIGAR SHRI VIVEK KALE (<i>Alternate</i>)
Indian Institute of Technology Delhi, New Delhi	DR SHASHANK BISHNOI
Military Engineer Services, New Delhi	SHRI MANOJ BAPNA SHRI M. K. DEEPAK (<i>Alternate</i>)
National Council for Cement and Building Materials, Faridabad	DR S. K. CHATURVEDI SHRI P. N. OJHA (<i>Alternate I</i>) DR PINKY PANDEY (<i>Alternate II</i>)
Ready Mixed Concrete Manufactures Association, Mumbai	SHRI A. K. JAIN SHRI DEVENDRA KUMAR PANDEY (<i>Alternate</i>)
In Personal Capacity (<i>House No. 131 Sector 11D Faridabad</i>)	SHRI V. V. ARORA
In Personal Capacity (<i>P9-3D, SRS Residency, Sector - 88, Faridabad</i>)	SHRI S. HARSH

Composition of the Working Group

<i>Organization</i>	<i>Representative(s)</i>
In Personal Capacity [<i>B-806, Oberoi Exquisite, Oberoi Garden City, Goregaon (East), Mumbai</i>]	SHRI A. K. JAIN (<i>Convener</i>)
Indian Institute of Technology Delhi, New Delhi	DR SHASHANK BISHNOI
National Council for Cement and Building Materials, Faridabad	SHRI P. N. OJHA  SHRI PUNEET KAURA
In Personal Capacity (<i>House No. 131 Sector 11D Faridabad</i>)	SHRI V. V. ARORA

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 2016* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Head (Publication & Sales), BIS.

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 website-www.bis.gov.in or www.standardsbis.in.

This Indian Standard has been developed from Doc No.: CED 02 (26639).

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.gov.in

Regional Offices:

	Telephones
Central : 601/A, Konnectus Tower -1, 6 th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	{ 2323 7617
Eastern : 8 th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	{ 2367 0012 2320 9474
Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	{ 265 9930
Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	{ 2254 1442 2254 1216
Western : 5 th Floor/MTNL CETTM Technology Street, Hiranandani Gardens, Powai, Mumbai - 400076	{ 25700030 25702715

Branches : AHMEDABAD, BENGALURU, BHOPAL, BHUBANESHWAR, CHANDIGARH, CHENNAI, COIMBATORE, DEHRADUN, DELHI, FARIDABAD, GHAZIABAD, GUWAHATI, HARYANA (CHANDIGARH), HUBLI, HYDERABAD, JAIPUR, JAMMU, JAMSHEDPUR, KOCHI, KOLKATA, LUCKNOW, MADURAI, MUMBAI, NAGPUR, NOIDA, PARWANOO, PATNA, PUNE, RAIPUR, RAJKOT, SURAT, VIJAYAWADA.