Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

IS 15388 : 2003
(Reaffirmed - 2012)
(Reaffirmed 2017)
(Reaffirmed 2022)

भारतीय मानक

सिलिका फ्यूम — विशिष्टि

Indian Standard

SILICA FUME — SPECIFICATION

ICS 91.100.15

© BIS 2003

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

August 2003

Price Group 4

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

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.

Silica fume is very fine pozzolanic material composed of ultra fine, amorphous glassy sphere (average diameter, 0.10-0.15μm) of silicon dioxide (SiO_2) produced during the manufacture of silicon or ferro-silicon by electric arc furnaces at temperature of over 2 000°C. The micro silica is formed when SiO gas produced in the furnace mixes with oxygen, oxidizes to SiO_2, condensing into the pure spherical particles of micro silica that form the major part of the smoke or fume from the furnace. These fumes are collected and bagged called silica fume. It is also known as condensed silica fume and micro silica. The Committee also felt that chloride content in silica fume shall be declared by the manufacturer so that different samples of silica fume can be compared and Engineer-in-Charge is in knowledge of the amount of chloride entering into concrete through silica fume.

This standard has been formulated to fulfil the need for a specification for this material, in view of its increasing use in the country.

In the preparation of this standard, due weightage has been given to the international coordination among the standards and practices in different countries in addition to relating it to the practices in the field in this country. For this, assistance has been derived from the following:

a) ASTM C 1240-2000 'Standard specification for use of silica fume as a mineral admixture in hydraulic cement concrete, mortar and grout'; issued by the American Society for Testing and Material

b) EN 197-1 : 2001 'Cement — Part 1 : Composition, specifications and conformity criteria for common cements'

The composition of the Committee responsible for formulation of the standard is given at 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, 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.

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

Indian Standard

SILICA FUME — SPECIFICATION

1 SCOPE

This standard covers the chemical and physical requirements of silica fume for use in concrete and other systems containing hydraulic cement.

2 REFERENCES

The following standards contain provisions which through reference 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 editions of the standards indicated below.

IS No.	*Title*
1727 : 1967	Methods of test for pozzolanic materials (*first revision*)
4082 : 1996	Recommendations on stacking and storage of construction materials and components at site (*second revision*)
4305 : 1967	Glossary of terms relating to pozzolana
6491 : 1972	Methods of sampling fly ash

3 TERMINOLOGY

3.0 For the purpose of this standard, the definitions given in IS 4305 and the following shall apply.

3.1 Silica Fume — Very fine pozzolanic material, composed mostly of amorphous silica produced by electric arc furnaces as a byproduct of the production of elemental silicon or ferro-silicon alloys.

3.2 Silica Fume in Natural State — Silica fume taken directly from the collection filter. The bulk density typically being in the range of 150-350 kg/m^3.

3.3 Densified Silica Fume — Silica fume that has been treated to increase the bulk density by particle agglomeration. The bulk density typically being above 500 kg/m^3.

3.4 Silica Fume Slurry — A homogenous, liquid suspension of silica fume particles in water, typically with a dry content of 50 percent by mass, corresponding to about 700 kg/m^3 of silica fume.

4 CHEMICAL REQUIREMENTS

Silica fume shall conform to the chemical requirements given in Table 1.

Table 1 Chemical Requirements

(*Clause* 4)

Sl No. (1)	Characteristic (2)	Requirements (3)	Test Method (4)
i)	SiO_2, percent by mass, *Min*	85.0	IS 1727
ii)	Moisture content, percent by mass, *Max*	3.0	*see* Note1
iii)	Loss on ignition, percent by mass, *Max*	4.0	IS 1727
iv)	Alkalies as Na_2O, percent, *Max*	1.5	*See* Notes 2 and 3

NOTES

1 For determination of moisture content, dry a weighed sample as received to constant mass in an oven at 105°C to 110°C. Express in percentage, the loss in mass and record as moisture content.

2 Requirement of limiting alkali shall be applicable in case silica fume is to be used in concrete containing reactive aggregate.

3 For determination of alkalies, method of test used for determination of this in cement may be adopted.

5 PHYSICAL REQUIREMENTS

Silica fume shall conform to the physical requirements given in Table 2.

6 SAMPLING AND CRITERIA FOR CONFERMITY

6.1 Sampling

6.1.1 The methods and procedure of sampling of silica fume shall be 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 lot for the first 100 t of silica fume. For each subsequent 100 t from the lot of silica fume, one sample shall be taken. However, not less than two samples shall be taken in any sampling programme.

6.1.2 The sample or samples for the purpose of testing may be taken by the purchaser or his representative or by any person appointed to supervise the work for the purpose of which the silica fume is required or by the latter's representative.

6.2 Criteria for Conformity

6.2.1 The samples of silica fume drawn in accordance with **6.1** and then prepared as per **7** and shall be tested as per **4** and **5**.

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

Table 2 Physical Requirements
(*Clause* 5)

Sl No.	Characteristic	Requirement	Method of Test, Ref to	
			Annex	IS No.
(1)	(2)	(3)	(4)	(5)
i)	Specific surface m^2/g, *Min* (*see* Note 1)	15	A	—
ii)	Oversize percent retained on 45 micron IS Sieve, *Max* (*see* Note 1)	10	—	1727
iii)	Oversize percent retained on 45 micron IS Sieve, variation from average percent, *Max* (*see* Notes 1 and 2)	5	—	1727
iv)	Compressive strength at 7 days as percent of control sample, *Min* (*see* Note 3)	85.0	—	1727

NOTES

1 Any one of the tests specified in (i) or (ii) and (iii) indicated may be adopted.

2 For (iii) the average shall consist of the ten preceding tests or all of the preceding tests if the number is less than ten.

3 In the test method for determination of compressive strength of silica fume cement mortar in accordance with IS 1727, the value of factor N may be taken as one.

6.2.1.1 Samples representing each 100 t of silica fume shall be tested for moisture content, loss on ignition and oversize.

6.2.1.2 Testing for all other physical and chemical requirements shall be carried out on composite samples representing not more than 400 t material each. The composite samples shall be prepared by combining portions equally from each of 100 t sample.

6.2.2 The lot shall be considered passing if samples meet in all the requirements. The silica fume may be rejected if it fails to meet any of the requirements of this standard. In case of dissatisfaction with the results of tests, the producer or supplier may request re-testing of the failed consignment.

7 SAMPLE PREPARATION

7.1 The grab or composite samples drawn in accordance with **6.1** shall be mixed thoroughly. A clean and dry laboratory concrete drum mixer provides adequate mixing for the purpose. The amount of silica fume shall be 10 to 50 percent of the volume capacity of the mixer. The mixing time shall be 5 ± 1 min. A polyethylene film shall be secured on the drum to keep the material in the drum during mixing of the sample lot.

7.2 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.

8 STORAGE AND INSPECTION

8.1 The silica fume shall be stored in such a manner so as to permit easy access for proper inspection and identification of each consignment.

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

9 DELIVERY

The supply of silica fume shall be made in suitable quantities mutually agreed upon between the purchaser and the supplier. Where so required by the purchaser, the material shall be supplied in bags (jute laminated, multiply paper or polyethylene lines).

10 MANUFACTURER'S CERTIFICATE

The supplier/manufacturer shall satisfy himself that the silica fume 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 silica fume.

11 MARKING

11.1 Each bag/consignment of silica fume shall be clearly and permanently marked with the following informations :

a) Identifications of the source of silica fume,
b) Net mass of silica fume,
c) Batch/Control unit number,
d) Month and year of packing, and
e) Any other identification mark as required by the purchaser.

11.2 BIS Certification Marking

The silica fume may also be marked with the Standard Mark.

11.2.1 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 details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

12 HEALTH AND SAFETY

12.1 Owing to its fineness and its high silicon dioxide content, fears have been expressed over the use of the powder forms of micro silica. A large number of X-ray diffraction analysis suggest that it is amorphous material and should therefore be less dangerous than a crystalline material. However, it is advisable to take all necessary precautions while handling and using the material. In many applications silica fume is handled as a aqueous slurry, reducing the dust problem virtually to zero in such cases.

12.2 Similar information shall be provided in the shipping invoices accompanying the shipment of bulk silica fume.

12.3 The silica fume consignment shall be in good condition at the time of inspection.

ANNEX A

(*Table* 2)

DETERMINATION OF SPECIFIC SURFACE AREA BY GAS ADSORPTION USING THE BET METHOD

A-1 SCOPE

This method of test specifies the determination of the total specific external and internal surface area of disperse or porous solids by measuring the amount of physically adsorbed gas according to the method of Brunauer, Emmett and Teller (BET method).

The BET method cannot reliably be applied to solids which absorb the measuring gas.

A-2 PRINCIPLE

The method specified involves the determination of the amount of adsorbate or adsorptive gas required to cover the external and the accessible internal pore surfaces of a solid with a complete monolayer of adsorbate. This monolayer capacity can be calculated from the adsorption isotherm using the BET equation. Nitrogen at its boiling point (about 77 K) is usually the most suitable adsorptive.

A-3 PROCEDURE

A-3.1 Sample Preparation

Prior to the determination of an adsorption isotherm, remove physically adsorbed material from the sample surface by degassing, while avoiding irreversible changes to the surface. As certain the maximum temperature at which the sample is not affected by thermogravimetric analysis or by trial experiments using different degassing conditions of time and temperature. When vaccumed conditions are used, degassing to a residual pressure of approximately 1 Pa or better is usually sufficient. Degassing of a sample can also be performed at elevated temperature by flushing with helium or with adsorptive. Degassing is complete when a steady value of the residual gas pressure p, of its composition or the sample mass m is reached.

A-3.2 Methods of Measurements

Adsorption isotherms may be obtained by volumetric, gravimetric, calorimetric or spectroscopic measurements or by the carrier gas method using continuous or discontinuous operation. The procedure recommended by the manufacturer shall be followed.

The adsorptive gas is admitted to the sample container which is held at a constant temperature. The amounts adsorbed are measured in equilibrium with the adsorptive gas pressure p and plotted against relative pressure, p/p_0, to give an adsorption isotherm.

A-4 EVALUATION OF ADSORPTION DATA

The amount of gas adsorbed n_a, preferably expressed in moles per gram, is plotted as ordinate against the respective pressure, p/p_0 as abscissa to give the adsorption isotherm. The monolayer capacity n_m is calculated using the BET equation.

$$\frac{p/p_0}{n_a\left[1-(p/p_0)\right]} = \frac{1}{n_m C} + \frac{C-1}{n_m C}\cdot\frac{p}{p_0}$$

where

p = pressure of the adsorptive in equilibrium with the adsorbate, Pa;

p_0 = saturation vapour pressure of the adsorptive, Pa;

n_a = specific amount adsorbed, mol g^{-1};

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

n_m = specific monolayer capacity of adsorbate; amount of adsorbate needed to cover the surface with a complete monolayer of molecules; and

C = BET parameter.

A-5 TEST REPORT

The report of the determination shall include the following information :

a) Laboratory, type of equipment, date of determination;

b) Characterization of the sample, for example source, chemical composition, purity, method of sampling, sample division;

c) Pre-treatment and degassing conditions, for example temperature, residual pressure, partial pressures, duration of degassing, flushing with adsorptive or helium, mass reduction;

d) Mass of degassed sample, in g;

e) Experimental procedure for adsorption isotherm determination, for example volumetric, gravimetric, chromatographic, static or continuous gas admission, single-point determination, calibration of dead volume or buoyancy;

f) Adsorptive (chemical nature, purity, moisture content);

g) Adsorption isotherm (n_a, expressed, in mol g^{-1}, plotted against relative pressure, p/p_0), sample temperature in kelvin, saturation vapour pressure, expressed in Pa);

h) Evaluation parameters: multipoint or single-point determination, BET plot or range of linearity, monolayer capacity n_m expressed in mol g^{-1}, C value, molecular cross-sectional area a_m expressed in square nanometers;

j) Specific surface area, a_s, expressed in m^2/g; and

k) Reference material(s) used for validation of results.

A-6 USE OF REFERENCE MATERIAL

To ensure proper working conditions and correct data evaluation, the apparatus performance should be monitored periodically using a certified surface area reference material.

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Cement and Concrete Sectional Committee, CED 2

Organization	*Representative(s)*
In personal capacity (*'Chandrika' at 15th Cross, 63-64, East Park Road, Malleswaram, Bangalore-560003*)	DR H. C. VISVESVARAYA (**Chairman**)
B.G. Shirke Construction Technology Limited, Pune	SHRI G. R. BHARITKAR
Builders Association of India, Mumbai	SECRETARY
Building Materials & Technology Promotion Council, New Delhi	SHRI T. N. GUPTA SHRI J. K. PRASAD (*Alternate*)
Cement Corporation of India Limited, New Delhi	SHRI MAHESH KUMAR SHRI I. K. WATTAL (*Alternate*)
Central Board of Irrigation and Power, New Delhi	MEMBER SECRETARY DIRECTOR (CIVIL) (*Alternate*)
Central Building Research Institute, Roorkee	DR C. L. VERMA DR B. K. RAO (*Alternate*)
Central Public Works Department, New Delhi	CHIEF ENGINEER (DESIGN) SUPERINTENDING ENGINEER (S&S) (*Alternate*)
Central Road Research Institute, New Delhi	HEAD DIRECTOR (*Alternate*)
Central Soil and Materials Research Station, New Delhi	DIRECTOR SHRI P. L. KASHYAP (*Alternate*)
Central Water Commission, New Delhi	DIRECTOR (CMDD) (N&W) DEPUTY DIRECTOR (CMDD) (NW&S) (*Alternate*)
Directorate General of Supplies & Disposals, Bangalore	SHRI V. BALSUBRAMANIAN SHRI R. P. SINGH (*Alternate*)
Engineer-in-Chief's Branch, Army Headquarters, New Delhi	MAJ GEN YASH MALHOTRA SHRI MAHENDRA PRASAD (*Alternate*)
Fly Ash Mission, Department of Science & Technology, New Delhi	DR VIMAL KUMAR SHRI MUKESH MATHUR (*Alternate*)
Gammon India Limited, Mumbai	SHRI S. A. REDDI SHRI M. U. SHAH (*Alternate*)
Geological Survey of India, Jaipur	DR S. S. AMETA DR D. K. RAI (*Alternate*)
Grasim Industries Limited, Mumbai	SHRI A. K. JAIN COL SUDHIR TAMHANEY (RETD) (*Alternate*)
Gujarat Ambuja Cements Limited, Ahmedabad	SHRI J. P. DESAI SHRI B. K. JAGETIA (*Alternate*)
Hospital Services Consultancy Corporation (India) Ltd, Noida	SHRI J. SARUP SHRI P. K. JAIPURIAR (*Alternate*)
Housing and Urban Development Corporation Limited, New Delhi	SHRI V. SURESH SHRI V. ARUL KUMAR (*Alternate*)
Indian Concrete Institute, Mumbai	SHRI L. N. APTE SHRI D. SRINIVASAN (*Alternate*)
Indian Institute of Science, Bangalore	PROF T. S. NAGARAJ
Indian Institute of Technology, Roorkee	PROF A. K. JAIN
Indian Institute of Technology, Kharagpur	DR ASHOK KUMAR GHOSH
Indian Roads Congress, New Delhi	DR S. S. SEHRA SHRI ARUN KUMAR SHARMA (*Alternate*)
Institute for Solid Waste Research & Ecological Balance, Vishakhapatnam	DR N. BHANUMATHIDAS SHRI N. KALIDAS (*Alternate*)

(*Continued on page* 6)

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

(*Continued from page* 5)

Organization	*Representative(s)*
Larsen & Toubro Limited, Mumbai	SHRI C. R. V. SUBRAMANIUM SHRI S. CHOWDHURY (*Alternate*)
Madras Cements Ltd, Chennai	DR N. BHANUMATHIDAS
Ministry of Road Transport & Highways, New Delhi	SHRI C. C. BHATTACHARYA SHRI I. K. PANDEY (*Alternate*)
National Council for Cement and Building Materials, Ballabgarh	DR S. C. MAITI DR (SHRIMATI) S. LAXMI (*Alternate*)
National Test House, Kolkata	SHRI D. K. KANUNGO SHRI B. R. MEENA (*Alternate*)
OCL India Limited, New Delhi	DR S. C. AHLUWALIA
Public Works Department, Chennai	SUPERINTENDING ENGINEER (DESIGN) EXECUTIVE ENGINEER (*Alternate*)
Research, Design & Standards Organization, Lucknow	JOINT DIRECTOR (STD) (B&S)/CB-II JOINT DIRECTOR (STD) (B&S)/CB-I (*Alternate*)
Sardar Sarovar Narmada Nigam Limited, District Narmada	CHIEF ENGINEER (NAVGAM DAM) SUPERINTENDING ENGINEER (*Alternate*)
Structural Engineering Research Centre, Chennai	SHRI S. GOPALAKRISHNAN SHRI N. P. RAJAMANE (*Alternate*)
The Associated Cement Companies Limited, Mumbai	SHRI T. N. TIWARI DR D. GHOSH (*Alternate*)
The India Cements Limited, Chennai	SHRI S. GOPINATH SHRI R. ARUNACHALAM (*Alternate*)
The Indian Hume Pipe Company Limited, Mumbai	SHRI P. R. C. NAIR SHRI P. D. KELKAR (*Alternate*)
The Institution of Engineers (India), Bangalore	DR H. C. VISVESVARAYA SHRI D. C. CHATURVEDI (*Alternate*)
In personal capacity (*F-12, Naraina Vihar, New Delhi*)	SHRI Y. R. TANEJA
BIS Directorate General	SHRI S. K. JAIN, Director and Head (CED) [Representing Director General (*Ex-officio*)]

Member Secretaries
SHRI SANJAY PANT
Joint Director (CED), BIS
SHRI ALOK KESARI
Deputy Director (CED), BIS

Cement, Pozzolana and Cement Additives Subcommittee, CED 2:1

In personal capacity (*'Chandrika' at 15th Cross, 63-64, East Park Road, Malleswaram, Bangalore-560003*)	DR H. C. VISVESVARAYA (***Convener***)
All India Mini Cement Manufacturers' Association, Hyderabad	SHRI K. GOPI PRASAD
Building Materials & Technology Promotion Council, New Delhi	SHRI J. K. PRASAD
Cement Corporation of India Ltd, New Delhi	SHRI I. K. WATTAL SHRIMATI SARASWATHI DEVI (*Alternate*)
Cement Manufactuters Association, Kolkata	SHRI SOMNATH BANERJEE
Central Building Research Institute, Roorkee	DR B. K. RAO DR MANJIT SINGH (*Alternate*)
Central Electricity Authority, New Delhi	SHRI Y. K. SHARMA SHRI MOHAN KUMAR (*Alternate*)
Central Public Works Department, New Delhi	CHIEF ENGINEER (CDO) SUPERINTENDING ENGINEER (S&S) (*Alternate*)

(*Continued on page* 7)

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

(*Continued from page* 6)

Organization	*Representative(s)*
Central Road Research Institute, New Delhi	SHRI S. S. SEEHRA SHRI SATANDER KUMAR (*Alternate*)
Central Soil and Materials Research Station, New Delhi	DIRECTOR SHRI N. CHANDRASEKARAN (*Alternate*)
Central Water Commission, New Delhi	DIRECTOR (C&MDD-II) DEPUTY DIRECTOR (CMDD-II) (*Alternate*)
Dalmia Cement (Bharat) Limited, New Delhi	DR K. C. NARANG SHRI C. S. SHARMA (*Alternate*)
Engineer-in-Chief's Branch, Chandigarh	SHRI HIRA LAL LT-COL DEVENDRA KUMAR (*Alternate*)
Fly Ash Mission, Department of Science & Technology, New Delhi	DR VIMAL KUMAR SHRI MUKESH MATHUR (*Alternate*)
Gammon India Limited, Mumbai	SHRI S. A. REDDI
Grasim Industries Limited, Mumbai	SHRI A. K. JAIN COL SUDHIR TAMHANEY (RETD) (*Alternate*)
Gujarat Ambuja Cements Ltd, Ahmedabad	SHRI J. P. DESAI SHRI B. K. JAGETIA (*Alternate*)
Gujarat Engineering Research Institute, Vadodara	DIRECTOR SHRI J. K. PATEL (*Alternate*)
Indian Concrete Institute, Chennai	DR C. S. VISWANATHA PROF M. S. SHETTY (*Alternate*)
Indian Institute of Science, Bangalore	PROF T. S. NAGARAJ
Indian Institute of Technology, Kharagpur	DR ASHOK KUMAR GHOSH
Indorama Cement Limited, Mumbai	SHRI K. K. TAPARIA SHRI A. K. PRASHAR (*Alternate*)
Larsen & Toubro Limited, Mumbai	SHRI S. CHOWDHURY
Madras Cements Ltd, Chennai	DR N. BHANUMATHIDAS
Maharashtra Engineering Research Institute, Nasik	DIRECTOR RESEARCH OFFICER (*Alternate*)
Ministry of Commerce & Industry, New Delhi	SHRI P. K. JAIN SHRI SHAISH KUMAR (*Alternate*)
Ministry of Road Transport & Highways, New Delhi	SHRI V. VELAYUTHAM SHRI I. K. PANDEY (*Alternate*)
National Council of Cement and Building Materials, Ballabgarh	DR K. MOHAN DR (SHRIMATI) S. LAXMI (*Alternate*)
National Test House (WR), Mumbai	SHRI B. R. MEENA SHRI B. K. MANDAL (*Alternate*)
Orissa Cement Limited, New Delhi	DR S. C. AHLUWALIA
Public Works Department, Chennai	SUPERINTENDING ENGINEER (DESIGN) SENIOR DEPUTY CHIEF ENGINEER (*Alternate*)
Research, Design and Standards Organization, Lucknow	DEPUTY DIRECTOR (B&F) ASSISTANT DESIGN ENGINEER (B&F) (*Alternate*)
Tamil Nadu Minerals Limited, Chennai	SHRI K. SUMANTH BABU
The Associated Cement Company Ltd, Mumbai	SHRI T. N. TIWARI DR D. GHOSH (*Alternate*)
The Hindustan Construction Company Limited, Mumbai	SHRI A. P. PHADKE SHRI D. M. SAVUR (*Alternate*)

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

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.

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 Director (Publications), 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 latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc : No. CED 2 (4956).

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 110 002
Telephones : 2323 0131, 2323 33 75, 2323 9402

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices :		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110 002	2323 7617, 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi, KOLKATA 700 054	2337 8499, 2337 8561, 2337 8626, 2337 9120
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160 022	60 3843, 60 9285
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600 113	2254 1216, 2254 1442, 2254 2519, 2254 2315
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400 093	2832 9295, 2832 7858, 2832 7891, 2832 7892

Branches : AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. NALAGARH. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

Printed at Prabhat Offset Press, New Delhi-2

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

AMENDMENT 1 APRIL 2017
TO
IS 15388 : 2003 SILICA FUME — SPECIFICATION

(*Second cover page*, *para* 5) — Substitute 'Annex C' *for* 'Annex A'.

(*Page* 1, *clause* 2) — Insert the following entry at an appropriate place:

IS No.	*Title*
4032 : 1985	Method of chemical analysis of hydraulic cement

(*Page* 1, *Table* 1, *Note* 3) — Substitute the following for the existing note:

'3 The alkalies shall be determined as per the procedure given in Annex A.'

(*Page* 2, *Table* 2, *row* 1, *col* 4) — Substitute 'B' *for* 'A'.

(*Page* 3, *Annex* A) —— Insert the following new annex and renumber the subsequent annexes:

ANNEX A
METHOD FOR DETERMINATION OF AVAILABLE ALKALIS
(*Table* 1)

A-1 PROCEDURE

A-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 ±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 container, and seal.

A-1.2 Open the vial at the age of 28 days and transfer the contents to a 250 ml casserole. Break up and grind the paste with a pestle, adding a small amount of water, if necessary, so that uniform slurry containing no lumps is obtained (*see* Note). Add sufficient water to make the total volume to 200 ml. Let it stand 1 h at room temperature and stir frequently. Filter through a medium-

Free Standard provided by BIS via BSB Edge Private Limited to Cheki Zangmo - Thimphu(chekiz@bsb.gov.bt) 119.2.119.26 [for non-commercial use only].

textured filter paper onto a 500 ml volumetric flask. Wash thoroughly with hot water (eight to ten 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.

A-1.3 Neutralize the filtrate with dilute HCL (1+3), using 1 to 2 drops of phenolphthalein solution as the 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 oxide in the solution using the flame photometric procedure, described in IS 4032, except that the standard solution shall be made up to contain 8 ml of calcium chloride ($CaCl_2$) stock solution per litre of standard solution, and the solution as prepared shall be used in place of solution of cement.

NOTE — The standard solutions made up with 8 ml of calcium chloride ($CaCl_2$) stock solution contain the equivalent of 504 ppm of CaO. Tests have shown that this amount closely approximates the amount of calcium dissolved in the test solution.

A-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 (Na_2O), calculated as follows:

$$\text{Equivalent } Na_2O, \text{ percent} = Na_2O, \text{ percent} + 0.658 \times K_2O, \text{ percent}$$

(CED 02)

Publication Unit, BIS, New Delhi, India