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(Reaffirmed 2000)
Edition 2.3
(2000-05)

Indian Standard

**HIGH ALUMINA CEMENT FOR
STRUCTURAL USE — SPECIFICATION**

(First Revision)

भारतीय मानक

संरचना उपयोग के लिये उच्च ऐलुमिना सीमेंट — विशिष्टि

(पहला पुनरीक्षण)

(Incorporating Amendment Nos. 1, 2 & 3)

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on 24 November 1989, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

High alumina cement (HAC) is a special cement containing essentially hydraulic calcium aluminates as the major ingredient. The presence of the mono calcium aluminate ($\text{CaO Al}_2\text{O}_3$) constituent in HAC imparts certain unique properties, such as high early strength and refractoriness.

High alumina cement is mainly a refractory cement but in some cold regions this cement may find use as a structural material taking advantage of high heat of hydration and high early strength development. The hydration of mono calcium aluminates imparts high early strength and hence this cement will have special utility in work involving emergency repair or construction. However, conversion of the hydration product of the calcium aluminates from dicalcium aluminate hydrate to aluminate hydroxide and tricalcium aluminate hydrate and water will result in increased porosity and gradual reduction in strength. This conversion is more rapid in presence of moisture and at atmosphere temperatures over 18 to 20 C. In tropical climates the loss in strength can be as much as 50 to 80 percent.

There has been considerable controversy on the long term effect of storage of high alumina cement concrete in water at temperatures around 18°C, also the data on retrogression is conflicting. In view of this, the use of this cement should be restricted to areas of continuously low temperature where highest summer temperatures do not exceed 18°C.

In view of the above and other properties of high alumina cement, there are certain restrictions given below about the use of this cement in concrete which should be strictly followed:

- a) In view of the restrogression in strength and reduced durability, high alumina cement shall not be used in locations where the ambient temperatures are likely to exceed 18°C even for short periods. It shall not be used in mass concrete in view of the high heat of hydration inducing conversion of the hydrated compounds;
- b) Accelerators like calcium chloride shall not be used with this cement;
- c) Steam curing or elevated temperature of curing shall be avoided; and
- d) High alumina cement shall not be mixed with any other type of cement.

This standard was first published in 1972. Since publication of this standard large number of amendments have been issued from time to time in order to modify various requirements and also other standards referred to in the specification have been revised. The important amendments include incorporating a clause allowing different types of bags for packing 50 kg cement, permitting packaging of cement in 25 kg bags and incorporating a note regarding supply of cement in bulk and intermediate containers. As a result of these modifications, the Sectional Committee decided to bring out the first revision of this standard incorporating all the amendments for the convenience of the users.

Mass of cement packed in bags and the tolerance requirements for the mass of cement packed in bags shall be in accordance with the relevant provisions of the Standards of Weights and Measures (Packaged Commodities) Rules, 1977 and **B-1.2** (*see* Annex B for information). Any modification in these rules in respect of tolerance on mass of cement would apply automatically to this standard.

The composition of the committee responsible for the formulation of this standard is given in Annex C.

This edition 2.3 incorporates Amendment No.1 (November 1991), Amendment No. 2 (November 1993) and Amendment No. 3 (May 2000). Side bar indicates modification of the text as the result of incorporation of the amendments.

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***HIGH ALUMINA CEMENT FOR
STRUCTURAL USE — SPECIFICATION***(First Revision)***1 SCOPE**

1.1 This standard covers the manufacture of high alumina cement (HAC) and the specific requirements for its use as a structural building material in the colder regions of our country (continuously 18°C and below). Its use as a refractory cement is not covered.

2 REFERENCES

2.1 The Indian standards listed in Annex A are necessary adjuncts to this standard.

3 MANUFACTURE

3.1 The cement shall be manufactured from aluminous and calcareous materials either by fusion or by sintering, and grinding the resulting clinker so as to produce a cement complying with this specification. No materials, other than water, shall be added during grinding of the cement.

4 PROPERTIES

4.1 The total alumina content (Al_2O_3) determined in accordance with the method specified in IS 4032 : 1985 shall not be less than 32 percent by mass.

4.2 Fineness

Fineness of cement expressed in terms of specific surface determined by Blaine's air permeability method described in IS 4031 (Part 2) : 1988 shall be not less than 225 m²/kg.

4.3 Soundness

When tested by the 'Le-Chatelier' method described in IS 4031 (Part 3) : 1988, (except that the quantity of mixing water shall be 22 percent of cement by mass) the cement shall not have an expansion of more than 5 mm.

4.4 Setting Time

The setting time of cement, when tested by the Vicat apparatus method described in IS 4031 (Part 5) : 1988 (except that the quantity of mixing water shall be 22 percent of cement by mass) shall conform to the following requirements:

- a) Initial setting time not less than 30 min, and
- b) Final setting time not more than 10 h.

4.5 Compressive Strength

The average compressive strength of at least three mortar cubes (area of face 50 cm²) composed of one part of cement, three parts of standard sand (conforming to IS 650 : 1966) by mass and 10.5 to 11 percent (of combined mass of cement plus sand) water, and prepared, stored and tested at temperature 18 ± 2°C in the manner described in IS 4031 (Part 6) : 1988 shall be as follows:

- a) At 24 h ± 30 min not less than 30 MPa, and
- b) At 72 ± 1 h shall show an increase on the compressive strength at 24 h and shall be not less than 35 MPa.

5 SAMPLING**5.1 Samples for Testing**

A sample or samples for testing may be taken by the purchaser or his representative, or by any person appointed to superintend the work for the purpose of which the cement is required or by the latter's representative. The samples shall be taken within three weeks of delivery and the tests shall be made within four weeks of delivery.

5.2 Notwithstanding the requirements of **5.1**, the methods and procedures of sampling shall be in accordance with IS 3535 : 1986.

5.3 Facilities for Sampling and Identifying

The manufacturer or supplier shall afford every facility and shall provide all labour and materials for taking and packing the samples for testing the cement and for subsequent identification of the cement sampled.

6 TESTS

6.1 The sample or samples of cement for test shall be taken as described in **5.1** and shall be tested in the manner described in **4**.

6.2 Temperature for Testing

The temperature at which physical tests may be carried out shall be 18 ± 2°C.

6.3 Non-Compliance with Tests

Any cement which does not comply with any of the tests and analysis specified above, or which has not been stored in the manner provided in **7.1** may be rejected as not complying with this standard.

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6.4 Independent Testing

6.4.1 If the purchaser or his representative requires independent tests, the samples shall be taken before or immediately after delivery at the option of the purchaser or his representative and the tests shall be carried out in accordance with this standard on the written instructions of the purchaser or his representative.

6.4.2 Cost of Testing

The manufacturer shall supply, free of charge, the cement required for testing. Unless otherwise specified in the enquiry and order, the cost of the tests shall be borne as follows:

- a) By the manufacturer in the event of the results showing that the cement does not comply with this standard, and
- b) By the purchaser in the event of the results showing that the cement complies with this standard.

6.4.3 After a representative sample has been drawn, tests on the samples shall be carried out as expeditiously as possible.

7 STORAGE

7.1 The cement shall be stored in such a manner as to permit of easy access for proper inspection and in a suitable weather-tight building to protect the cement from dampness and to minimize warehouse deterioration.

8 MANUFACTURER'S CERTIFICATE

8.1 The manufacturer shall satisfy himself that the cement conforms to the requirements of this standard and, if requested, shall furnish a certificate to this effect to the purchaser or his representative.

9 DELIVERY

9.1 The cement shall be packed only in new bags [jute sacking bag conforming to IS 2580 : 1982, double hessian bituminized (CRI type), multi-wall paper conforming to IS 11761 : 1986, polyethylene lined (CRI type) jute, light weight jute conforming to IS 12154 : 1987, woven HDPE conforming to IS 11652 : 1986, woven polypropylene conforming to IS 11653 : 1986, jute synthetic union conforming to IS 12174 : 1987 or any other approved composite bags] bearing the

indication of the source of manufacture, if any. Second hand bags shall not be used.

9.1.1 In order to distinguish aluminous cement from ordinary Portland cement, a distinctive mark along with the words 'High Alumina Cement' shall be permanently marked on the bag or container.

9.2 The net mass of cement per bag shall be 50 kg (*see* Annex B).

9.2.1 The net mass of cement per bag may also be 25 kg subject to tolerances as given in **9.2.1.1** and packed in suitable bags as agreed to between the purchaser and the manufacturer.

9.2.1.1 The number of bags in a sample taken for weighment showing a minus error greater than 2 percent of the specified net mass shall be not more than 5 percent of the bags in the sample. Also the minus error in none of such bags in the sample shall exceed 4 percent of the specified net mass of cement in the bag. However, the net mass of cement in a sample shall be equal to or more than 25 kg.

9.2.2 When cement is intended for export and if the purchaser so requires, packing of cement may be done in bags or in drums with a net mass of cement per bag or drum as agreed to between the purchaser and the manufacturer.

9.2.2.1 For this purpose the permission of the certifying authority shall be obtained in advance for each export order.

9.2.2.2 The words 'FOR EXPORT' and the net mass of cement per bag/drum shall be clearly marked in indelible ink on each bag/drum.

9.2.2.3 The packing material shall be as agreed to between the manufacturer and the purchaser.

9.2.2.4 The tolerance requirements for the mass of cement packed in bags/drum shall be as given in **9.2.1.1** except the net mass which shall be equal to or more than the quantity in **9.2.2**.

9.3 Supplies of cement in bulk may be made by arrangement between the purchaser and the supplier (manufacturer or stockist).

NOTE — A single bag or container containing 1 000 kg or more net mass of cement shall be considered as bulk supply of cement. Supply of cement may also be made in intermediate containers, for example, drums of 200 kg, by agreement between the purchaser and the manufacturer.

ANNEX A

(Clause 2.1)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
IS 650 : 1966	Specification for Standard sand for testing of cement (<i>first revision</i>)	IS 4905 : 1968	Methods for random sampling
IS 2580 : 1982	Specification for jute sacking bags for packing cement (<i>second revision</i>)	IS 11652 : 1986	Specification for high density polyethylene (HDPE) woven sacks for packing cement
IS 3535 : 1986	Methods of sampling hydraulic cements (<i>first revision</i>)	IS 11653 : 1986	Specification for polypropylene (PP) woven sacks for packing cement
IS 4031 (Parts 1 to 13) : 1988	Methods of physical test for hydraulic cement (<i>first revision</i>)	IS 11761 : 1986	Specification for multi-wall paper sacks for cement valved-sewn-gusseted type
IS 4032 : 1985	Method of chemical analysis of hydraulic cement (<i>first revision</i>)	IS 12154 : 1987	Specification for light weight jute bags for packing cement
		IS 12174 : 1987	Specification for jute synthetic union bag for packing cement

ANNEX B

(Clause 9.2)

TOLERANCE REQUIREMENTS FOR THE MASS OF CEMENT PACKED IN BAGS

B-1 The net mass of cement packed in bags at the plant in a sample shall be equal to or more than 50 kg. The number of bags in a sample shall be as given below:

<i>Batch Size</i>	<i>Sample Size</i>
100 to 150	20
151 to 280	32
281 to 500	50
501 to 1 200	80
1 201 to 3 200	125
3 201 and over	200

The bags in a sample shall be selected at random (*see* IS 4905 : 1968).

B-1.1 The number of bags in a sample showing a minus error greater than 2 percent of the specified net mass (50 kg) shall be not more than 5 percent of the bags in the sample. Also

the minus error in none of such bags in the sample shall exceed 4 percent of the specified net mass of cement in the bag.

NOTE — The matter given in **B-1** and **B-1.1** are extracts based on the Standards of Weights and Measures (Packaged Commodities) Rules, 1977 to which reference shall be made for full details. Any modification made in these Rules and other related Acts and Rules would apply automatically.

B-1.2 In case of wagon/truck load up to 25 tonnes, the overall tolerance on net mass of cement shall be 0 to + 0.5 percent.

NOTE — The mass of a jute sacking bag conforming to IS 2580 : 1982 to hold 50 kg of cement is 531 g, the mass of a double hessian bituminized (CRI type) bag to hold 50 kg of cement is 630 g, the mass of a 6-ply paper bag to hold 50 kg of cement is approximately 400 g and the mass of a polyethylene lined (CRI type) jute bag to hold 50 kg of cement is approximately 480 g.

ANNEX C**COMPOSITION OF THE TECHNICAL COMMITTEE**

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