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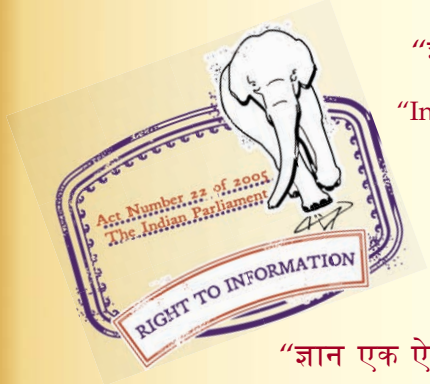
IS 4031-7 (1988): Methods of physical tests for hydraulic cement, Part 7: Determination of compressive strength of masonry cement [CED 2: Cement and Concrete]



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"Knowledge is such a treasure which cannot be stolen"

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Indian Standard

METHODS OF PHYSICAL TESTS FOR HYDRAULIC CEMENT

PART 7 DETERMINATION OF COMPRESSIVE STRENGTH OF MASONRY CEMENT

(First Revision)

Second Reprint MARCH 1998

UDC 666·946·5 : 539·411

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

Indian Standard

HYDRAULIC CEMENT

PART 7 DETERMINATION OF COMPRESSIVE STRENGTH OF MASONRY CEMENT

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part 7) (First Revision) was adopted by the Bureau of Indian Standards on 10 March 1988, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Standard methods of testing cement are essential adjunct to the cement specifications. This standard in different parts lays down the procedure for the tests to evaluate the physical properties of different types of hydraulic cements. The procedure for conducting chemical tests of hydraulic cement is covered in IS : 4032-1985*.

0.3 Originally all the tests to evaluate the physical properties of hydraulic cements were covered in one standard but for facilitating the use of this standard and future revisions, it has been decided to print the different tests as different parts of the standard and accordingly, this revised standard has been brought out in thirteen parts. This will also facilitate updating of individual tests. Further, since publication of the original standard in 1968, a number of standards covering the requirements of different equipment used for testing of cement, a brief description of which was also covered in the standard, had been published. In this revision, therefore, reference is given to different instrument specifications deleting the description of the instruments, as it has been recognized that reproducible and repeatable test results can be obtained only with standard testing equipment capable of giving desired level of accuracy. This part covers the method for determining the compressive strength of masonry cement. The criteria for accepting compressive strength values has also been incorporated in this revision.

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

*Method of chemical analysis of hydraulic cement (*first revision*).

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

1. SCOPE

1.1 This standard (Part 7) covers the procedure for determining the strength of masonry cement as represented by compressive strength tests on 50 mm mortar cubes.

2. SAMPLING AND SELECTION OF TEST SPECIMENS

2.1 The samples of the cement shall be taken in accordance with the requirements of IS : 3535-1986* and the relevant standard specification for the type of cement being tested. The representative sample of the cement selected as above shall be thoroughly mixed before testing.

*Methods of sampling hydraulic cements (*first revision*).

3. TEMPERATURE AND HUMIDITY

3.1 The temperature of moulding room, dry materials and water shall be maintained at 27 ± 2°C. The relative humidity of the laboratory shall be 65 ± 5 percent.

3.2 The moist closet or moist room shall be maintained at 27 ± 2°C and at a relative humidity of not less than 90 percent.

4. GENERAL

4.1 The standard sand to be used in the preparation of mortar cubes shall conform to IS : 650-1966*.

*Specification for standard sand for testing of cement (*first revision*).

5. APPARATUS

5.1 Balance — The balance shall conform to the following requirements:

On balance in use, the permissible variation at a load of 1 000 g shall be plus or minus 1·0 g. The permissible variation on new balance shall be one-half of this value. The sensibility reciprocal shall be not greater than twice the permissible variation.

NOTE 1 — The sensibility reciprocal is generally defined as the change in load required to change the position of rest of the indicating element or elements of a non-automatic indicating scale a definite amount at any load.

NOTE 2 — Self-indicating balance with equivalent accuracy may also be used.

5.2 Standard Weights — The permissible variations on weights in use in weighing the cement shall be as prescribed in Table 1.

TABLE 1 PERMISSIBLE VARIATIONS ON WEIGHTS

WEIGHTS	PERMISSIBLE VARIATION ON WEIGHTS IN USE, PLUS OR MINUS
g	g
(1)	(2)
500	0·35
300	0·30
250	0·25
200	0·20
100	0·15
50	0·10
20	0·05
10	0·04
5	0·03
2	0·02
1	0·01

5.3 Cube Moulds — Cube mould of 50 mm size and accessories conforming to IS : 10086-1982*.

5.4 Planetary Mixer — Planetary mixer conforming to IS : 10890-1984†.

5.5 Flow Table and Accessories — Flow table and accessories conforming to IS : 5512-1983‡.

5.6 Tamping Rod — Tamping rod conforming to **6.1** (c) of IS : 10086-1982*.

6. PREPARATION OF MOULDS

6.1 The interior faces of the specimen moulds shall be thinly covered with mineral oil or light cup grease. After assembling the moulds, excessive oil or grease shall be removed from the interior faces and the top and bottom surfaces of each mould. Moulds shall then be set on plane, non-absorbent base plates that have been thinly coated with the mineral oil, petrolatum, or light cup grease.

7. PREPARATION OF MORTAR

7.1 Clean appliances shall be used for mixing. Temperature of water and that of the test room at the time when these operations are being performed shall be 27 ± 2°C. Potable/distilled water shall be used in preparing the cubes.

7.2 The material for each set of three specimens shall be mixed separately and shall be as follows:

Masonry cement	420 g
Standard sand	1 440 g

7.2.1 The amount of water used for gauging shall be such as to produce a flow of 110 ± 5 percent with 25 drops in 15 s as determined in **7.3**.

7.3 Determination of Flow

7.3.1 *Trial Mixing* — With dry material as specified in **7.2**, make trial mortars with different percentages of water until specified flow is obtained Make each trial flow test with fresh mortar. The mixing shall be done mechanically by means of mixing apparatus as specified in **5.4**. Place the dry paddle and the dry bowl in the mixing position in the mixer, then introduce the materials for batch into the bowl and mix in the following manner:

a) Place all the mixing water in the bowl;

b) Add the masonry cement to the water, then start the mixer and mix at the slow speed (140 ± 5 rev/min) for 30 s;

c) Add the entire quantity of sand slowly over a period of 30 s, while mixing at slow speed (140 ± 5 rev/min);

d) Stop the mixer, change to medium speed (285 ± 10 rev/min), and mix for 30 s;

e) Stop the mixer, and let the mortar stand for one and a half minutes. During the first 15 s of this interval, quickly scrap down into the batch any mortar that may have collected on the side of the bowl, then for the remainder of this interval, cover the bowl with the lid;

f) Finish by mixing for one minute at medium speed (285 ± 10 rev/min); and

g) In cases requiring further remixing, any mortar adhering to the side of the bowl shall be quickly scraped down into the batch with the scraper prior to remixing which is to be continued till a uniform mortar is obtained.

*Specification for moulds for use in tests of cement and concrete.

†Specification for planetary mixer used in tests of cement and pozzolana.

‡Specification for flow table for use in tests of hydraulic cements and pozzolanic materials (*first revision*).

Upon the completion of mixing, the mixing paddle shall be shaken to remove excess mortar into the mixing bowl.

7.3.2 Carefully wipe the flow-table top clean, and dry and place the mould at the centre. Place about 25 mm thick layer of mortar mixed in accordance with 7.3.1 in the mould and tamp 20 times with the tamping rod. The tamping pressure shall be just sufficient to ensure uniform filling of the mould. Then fill the mould with mortar and tamp as specified for the first layer. Cut off the excess mortar to a plane surface flush with the top of the mould by drawing the straight edge of a trowel (held nearly perpendicular to the mould) with a sawing motion across the top of the mould. Wipe the table top clean and dry, particularly taking care to remove any water from around the edge of the flow mould. Lift the mould away from the mortar one minute after completion of the mixing operation. Immediately drop the table through a height of 12·5 mm, 25 times in 15 s. The flow is the resulting increase in average base diameter of the mortar mass, measured on at least four diameters at approximately equi-spaced intervals expressed as a percentage of the original base diameter.

7.4 The material for moulding each batch of test specimens shall be mixed separately using the quantities of dry materials, conforming to the proportions specified in 7.2 and the quantity of water as determined in 7.3. Mixing of mortar shall be done mechnically as described in 7.3.1.

8. MOULDING OF SPECIMENS

8.1 Immediately following completion of the flow test, return the mortar from the flow mould to the mixing bowl. Quickly scrape down into the batch the mortar that may have collected on the side of the bowl and give the entire batch a 15 s mixing at medium speed (285 ± 10 rev/ min). Start moulding the specimens within a total elapsed time of not more than 2 min and 15 s after completion of the original mixing of the mortar batch. Place a layer of mortar about 25 mm in thickness in all the cube compartments. Tamp the mortar in each cube compartment 32 times in about 10 s in four rounds, each round to be at right angles to the other and consisting of eight adjoining strokes over the surface of the specimen as illustrated in Fig. 1. The tamping pressure shall be just sufficient to ensure uniform filling of the moulds. The four rounds of tamping (32 strokes) of the mortar shall be completed in one cube before going to the next. When the tamping of the first layer in all of the cube compartments is completed, fill the compartments with the remaining mortar and then tamp as specified for the first layer. During tamping of the second layer, bring in the mortar forced out on to the tops of the moulds after each round of tamping by means of the gloved fingers and the tamper upon completion of each round and before starting the next round of tamping. On completion of the tamping, the tops of all cubes should extend slightly above the tops of the moulds. Bring in the mortar that has been forced out on to the tops of the moulds with a trowel and smooth off the cubes by drawing the flat side of the trowel (with the leading edge slightly raised) once across the top of each cube at right angles to the length of the mould. Then for the purpose of levelling the mortar and making the mortar that protrudes above the top of the mould of more uniform thickness, draw the flat side of the trowel with the leading edge slightly raised) lightly once along the length of the mould. Cut off the mortar to a plane surface flush with the top of the mould by drawing the straight edge of the trowel (held nearly prependicular to the mould) with a sawing motion over the length of the mould.

NOTE — When a duplicate batch is to be made immediately for additional specimens, the repetition of flow test may be omitted and the mortar allowed to stand in the mixing bowl for 90 s and then remixed for 15 s at medium speed before starting the moulding of the specimens.

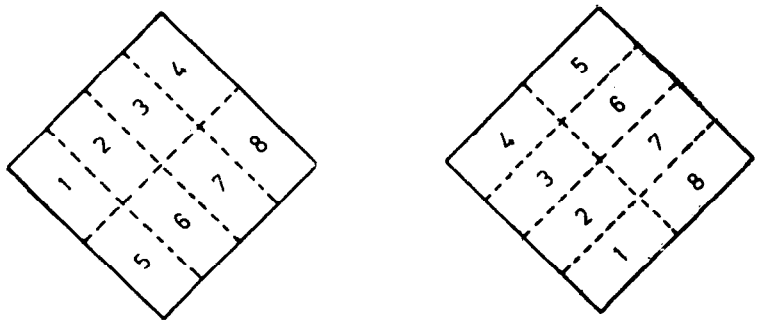

FIG. 1 ORDER OF TAMPING FOR MOULDING TEST SPECIMENS

9. STORAGE AND CURING OF SPECIMENS

9.1 All test specimens, immediately after moulding and compaction, shall be kept in the moulds on plane plates in a moist cabinet, maintained at a temperature of 27 ± 2°C and a relative humidity of 90 percent or more, from 48 to 52 h

in such a manner that the upper surfaces shall be exposed to the moist air. The cubes shall then be removed from the moulds and placed in the moist cabinet for five days in such a manner as to allow free circulation of air around at least five faces of the specimens After five days curing in moist cabinet, the cubes for 7-day compressive strength shall be removed for testing whereas the cubes for 28-day compressive strength test shall be immersed in clean water for another twenty-one days in storage tanks of non-corrosive materials.

10. TESTING

10.1 Test not less than three cubes for compressive strength for each of the curing periods of 7 and 28 days as indicated in **9.1**, the periods being reckoned from the completion of moulding and compaction.

10.2 Testing of the cube specimens shall be carried out immediately after their removal from the moist cabinet for 7-day specimens, and from storage water for all other specimens If more than one specimen at a time is removed from the moist cabinet for 7-day tests, these cubes shall be covered with a damp cloth until the time of testing. If more than one specimen at a time is removed from storage water for testing, these cubes shall be placed in a pan of water at a temperature of 27 $\pm$ 2°C and of sufficient depth to completely immerse each cube until the time of testing.

10.2.1 The cubes shall be tested on their sides without any packing between the cube and the steel plattens of the electrically operated testing machine. One of the plattens shall be carried on a base and shall be self-adjusting. An initial loading up to one-half of the expected maximum load for specimens having expected maximum loads of more than 13 500 N may be applied at any convenient rate. Apply no initial loading to specimens having expected maximum loads of less than 13 500 N. Adjust the rate of load without interruption so that the breaking strength of the cube is reached in not less than 20 s and not more than 80 s. Make no adjustment in the control of the testing machine while a specimen is yielding rapidly immediately before failure.

11. CALCULATION

11.1 The measured compressive strength of the cubes shall be calculated by dividing the maximum load applied to the cubes during the test by the cross-sectional area, calculated from the mean dimensions of the section and shall be expressed to the nearest 0·5 N/mm^2. In determining the compressive strength, do not consider specimens that are manifestly faulty, or that give strengths differing by more than 10 percent from the average value of all test specimens. After discarding specimens or strength values, if less than two strength values are left for determining the compressive strength at any given period, a retest shall be made.

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Amendments Issued Since Publication

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Printed by Reprography Unit, BIS, New Delhi

AMENDMENT NO. 1 MAY 2013
TO
IS 4031 (Part 7) : 1988 METHODS OF PHYSICAL TESTS FOR HYDRAULIC CEMENT

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(First Revision)

(*Page* 1, *clause* **3.1**, *line* 4) — Substitute 'not less than 65 percent' *for* '65 ± 5 percent'.

(CED 2)

Reprography Unit, BIS, New Delhi, India