

**IS : 4031 (Part 6) - 1988**  
**(Reaffirmed 2000)**  
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**(2003-02)**

*Indian Standard*

**METHODS OF PHYSICAL TESTS FOR  
HYDRAULIC CEMENT**

**PART 6 DETERMINATION OF COMPRESSIVE STRENGTH OF HYDRAULIC  
CEMENT OTHER THAN MASONRY CEMENT**

*( First Revision )*

(Incorporating Amendment Nos. 1, 2 & 3)

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**BUREAU OF INDIAN STANDARDS**  
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**Price Group 2**

*Indian Standard***METHODS OF PHYSICAL TESTS FOR  
HYDRAULIC CEMENT****PART 6 DETERMINATION OF COMPRESSIVE STRENGTH OF HYDRAULIC  
CEMENT OTHER THAN MASONRY CEMENT***( First Revision )***0. FOREWORD**

**0.1** This Indian Standard (Part 6) (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 hydraulic cement other than masonry cement which is covered in Part 7 of this standard. The criteria for accepting compressive strength values has been incorporated and the use of single graded sand has been deleted in this revision.

**0.4** This edition 2.3 incorporates Amendment No. 1 (March 1993), Amendment No. 2 (March 2002) and Amendment No. 3 (February 2003). Side bar indicates modification of the text as the result of incorporation of the amendments.

**0.5** 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 6) covers the procedure for determining the strength of cement as represented by compressive strength tests on mortar cubes compacted by means of standard vibration machine.

**2. SAMPLING AND SELECTION OF TEST SPECIMEN**

**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 cement (*first revision*).

**3. TEMPERATURE AND HUMIDITY**

**3.1** The temperature of moulding room, dry materials and water shall be maintained at  $27 \pm 2^\circ\text{C}$ . The relative humidity of the laboratory shall be  $65 \pm 5$  percent.

**3.2** The moist closet or moist room shall be maintained at  $27 \pm 2^\circ\text{C}$  and at a relative humidity of not less than 90 percent.

**4. GENERAL**

**4.1 Standard Sand** — The standard sand to be used in the test shall conform to IS : 650-1966\*.

**5. APPARATUS**

**5.1 Vibration Machine** — Vibration machine

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

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conforming to IS : 10080-1982\*.

**5.2 Poking Rod** — Poking rod conforming to IS : 10080-1982\*.

**5.3 Cube Mould** — The mould shall be of 70.6 mm size conforming to IS : 10080-1982\*.

**5.4 Gauging Trowel** — Gauging trowel conforming to IS : 10086-1982†.

**5.5 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  $\pm 1.0$  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 at a non-automatic indicating scale a definite amount of any load.

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

**5.6 Standard Weights** — The permissible variation on weights in use in weighing the cement shall be as prescribed in Table 1.

TABLE 1 PERMISSIBLE VARIATIONS ON WEIGHTS

WEIGHT	PERMISSIBLE VARIATION ON WEIGHTS IN USE
(1)	(2)
(g)	(g)
500	$\pm 0.35$
300	$\pm 0.30$
250	$\pm 0.25$
200	$\pm 0.20$
100	$\pm 0.15$
50	$\pm 0.10$
20	$\pm 0.05$
10	$\pm 0.04$
5	$\pm 0.03$
2	$\pm 0.02$
1	$\pm 0.01$

**5.7 Graduated Glass Cylinders** — Graduated glass cylinders of 150 to 200 ml capacity. The permissible variation on these cylinders shall be  $\pm 1$  ml. The main graduation lines of the cylinders shall be in circles and shall be numbered. The least graduations shall extend at least one-seventh of the way around, and intermediate graduations shall extend at least one-fifth of the way around the cylinder. The graduation lines may be omitted for the lowest 5 ml.

## 6. PREPARATION OF TEST SPECIMENS

### 6.1 Mix Proportions and Mixing

**6.1.1** Clean appliances shall be used for mixing

\*Specification for vibration machine for casting standard cement mortar cubes.

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

and the temperature of water and that of the test room at the time when the above operations are being performed shall be  $27 \pm 2^\circ\text{C}$ . Potable/distilled water shall be used in preparing the cubes.

**6.1.2** The material for each cube shall be mixed separately and the quantity of cement, standard sand and water shall be as follows:

Cement 200 g  
Standard Sand 600 g

Water  $\left(\frac{P}{4} + 3.0\right)$  percent of combined

mass of cement and sand, where  $P$  is the percentage of water required to produce a paste of standard consistency determined as described in IS : 4031 (Part 4)-1988\*.

**6.1.3** Place on a nonporous plate, a mixture of cement and standard sand. Mix it dry with a trowel for one minute and then with water until the mixture is of uniform colour. The quantity of water to be used shall be as specified in 6.1.2. The time of mixing shall in any event be not less than 3 min and should the time taken to obtain a uniform colour exceed 4 min, the mixture shall be rejected and the operation repeated with a fresh quantity of cement, sand and water.

### 6.2 Moulding Specimens

**6.2.1** In assembling the moulds ready for use, cover the joints between the halves of the mould with a thin film of petroleum jelly and apply a similar coating of petroleum jelly between the contact surfaces of the bottom of the mould and its base plate in order to ensure that no water escapes during vibration. Treat the interior faces of the mould with a thin coating of mould oil.

**6.2.2** Place the assembled mould on the table of the vibration machine and hold it firmly in position by means of a suitable clamp. Attach a hopper of suitable size and shape securely at the top of the mould to facilitate filling and this hopper shall not be removed until the completion of the vibration period.

**6.2.3** Immediately after mixing the mortar in accordance with 6.1, place the mortar in the cube mould and prod with the rod specified in 5.2. The mortar shall be prodded 20 times in about 8 s to ensure elimination of entrained air and honey-combing. Place the remaining quantity of mortar in the hopper of the cube mould and prod again as specified for the first layer and then compact the mortar by vibration.

\*Methods of physical tests for hydraulic cement: Part 4 Determination of consistency of standard cement paste (first revision).

**6.2.4** The period of vibration shall be two minutes at the specified speed of  $12\,000 \pm 400$  vibration per minute.

**6.2.5** At the end of vibration, remove the mould together with the base plate from the machine and finish the top surface of the cube in the mould by smoothing the surface with the blade of a trowel.

**6.3 Curing Specimens** — Keep the filled moulds in moist closet or moist room for  $24 \pm 1$  hours after completion of vibration. At the end of that period, remove them from the moulds and immediately submerge in clean fresh water and keep there until taken out just prior to breaking. The water in which the cubes are submerged shall be renewed every 7 days and shall be maintained at a temperature of  $27 \pm 2^\circ\text{C}$ . After they have been taken out and until they are broken, the cubes shall not be allowed to become dry.

## **7. TESTING**

**7.1** Test three cubes for compressive strength for each period of curing mentioned under the relevant specifications for different hydraulic

cements, the periods being reckoned from the completion of vibration.

**7.1.1** The cubes shall be tested on their sides without any packing between the cube and the steel plattens of the testing machine. One of the plattens shall be carried on a base and shall be self-adjusting, and the load shall be steadily and uniformly applied, starting from zero at a rate of  $35\text{ N/mm}^2/\text{min}$ .

## **8. CALCULATION**

**8.1** 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  $0.5\text{ N/mm}^2$ . 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 the 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.

