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(Reaffirmed 1995)

Indian Standard

METHODS OF PHYSICAL TESTS FOR HYDRAULIC CEMENT

PART 10 DETERMINATION OF DRYING SHRINKAGE

(First Revision)

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Indian Standard

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0. FOREWORD

0.1 This Indian Standard (Part 10) (First Revision) was adopted by the Bureau of Indian Standards on 22 April 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 the 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 recognised that reproducible and repeatable test results can be obtained only with standard testing equipment capable of giving desired level of accuracy This part (Part 10) covers determination of drying shrinkage of cement.

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 10) covers the procedure for determining the drying shrinkage of hydraulic cement as obtained on rectangular specimens, prepared and tested under specified conditions.

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

4. APPARATUS

4.1 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 ± 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 the elements of a non-automatic indicating scale a definite mount at any load.

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

4.2 Weights — The permissibie variations 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, PLUS OR MINUS
g	g
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

4.3 Trowel — This shall have a steel blade 100 to 150 mm in length with straight edges and of mass 210 ± 10 g.

4.4 Length Comparator — Length comparator conforming to IS : 9459-1980*.

4.5 Flow Table and Accessories — Flow table and accessories conforming to IS : 5512-1969†.

4.6 Mould — Beam mould shall be 25 × 25 mm size and 282 mm internal length conforming to IS : 10086-1982‡.

4.7 Control Cabinet — A drying cabinet with suitable racks shall be provided for storing specimens in air. Conditioned air shall be circulated inside the cabinet in a uniform manner so that the specified rate of evaporation is attained to all adjacent specimens. The temperature and relative humidity of the cabinet shall be measured at least twice in each working day. The temperature of the cabinet shall be 27 ± 2°C. Relative humidity shall be maintained at 50 ± 5 percent.

5. PREPARATION OF MOULDS

5.1 The moulds shall be thinly covered with mineral oil. After this operation, the stainless steel or non-corroding metal reference inserts with knurl heads shall be set to obtain an effective gauge length of 250 mm, care being taken to keep them clean and free of oil.

6. PREPARATION OF MORTAR

6.1 Clean appliances shall be used for mixing and the temperature of the water and that of the test room at the time when the mixing operation is being performed shall be 27 ± 2°C. Potable/ distilled water shall be used in preparing the mortar.

6.2 The materials for the standard test mortar shall be cement and standard sand in the proportion of 1 : 3 by mass blended intimately.

6.2.1 The amount of water for gauging shall be equal to that required to give a flow between 100 and 115 percent with 25 drops in 15 s, as determined in **7.3** of IS : 4031 (Part 7) - 1988*.

6.3 The materials for moulding each batch of test specimens shall be mixed separately using the quantities of dry materials, conforming to the proportions given in **6.2** and the quantity of water as determined in accordance with the procedure given in **7.2.1** and **7.3** of IS : 4031 (Part 7)-1988* to give a flow of 100 to 115 percent with 25 drops in 15 seconds. Mixing shall be done mechanically as described in **7.3.1** of IS : 4031 (Part 7) - 1988*.

7. MOULDING SPECIMENS

7.1 Immediately following the completion of mixing, the test specimen shall be moulded in two layers, each layer being compacted with the thumbs and forefingers by pressing the mortar into the corners, around the reference inserts and along the surfaces of the moulds until a homogeneous specimen is obtained. After the top layer has been compacted, the mortar shall be levelled off flush with the top of the mould and the surface smoothed with a few strokes of the trowel. During the operations of mixing and moulding, the hands shall be protected by rubber gloves.

8. PROCEDURE OF TESTING

8.1 After filling the moulds, place them immediately in a moist room or moist closet for 24 ± 2 h. Then remove the specimens from the moulds and immediately immerse in water at 27 ± 2°C and allow them to remain there for six days.

8.2 Remove the specimens from the water and measure its length using a length comparator. Protect specimens against loss of moisture prior to reading for initial length. The temperature of the test specimens at the time of initial

*Specification for apparatus for use in measurement of length change of hardened cement paste, mortar and concrete.

†Specification for flow table for use in tests of hydraulic cements and pozzolanic materials.

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

*Methods of physical tests for hydraulic cement: Part 7 Determination of compressive strength of masonry cement (*first revision*).

measurement shall be 27 ± 2°C Store the specimens in a control cabinet maintained at 27 ± 2°C and 50 ± 5 percent relative humidity Measure the length of the specimens again 28 days after the initial measurement. Place the specimens in the comparator with the same end uppermost with respect to the position of the specimens as when the initial measurement was made. When making the measurements, the specimens, the comparator, and the reference bar shall be at a temperature of 27 ± 2°C.

9. CALCULATION

9.1 After the specimens are measured as in **8.2** at the age of 7 and 35 days, calculate the average difference in length of three specimens to the nearest 0·01 percent of the effective gauge length and report this difference as the drying shrinkage.

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