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मानक

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IS 9103 (1999): Specification for Concrete Admixtures -
[CED 2: Cement and Concrete]



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“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक
कंक्रीट एडमिक्स्चर — विशिष्टि
(पहला पुनरीक्षण)

Indian Standard
CONCRETE ADMIXTURES — SPECIFICATION
(*First Revision*)

ICS 91.100.30

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FOREWORD

This Indian Standard (First Revision) 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.

Admixtures are materials added to the concrete before or during its mixing, with a view to modifying one or more of the properties of concrete in the plastic or hardened state. An important feature of the majority of admixtures for concrete is that it is difficult to quantitatively evaluate the behaviour of the concrete under various possible circumstances. Therefore, performance of an admixture is evaluated by comparing the properties of concrete with the admixture under test with those of concrete without any admixture or with a reference admixture. This standard lays down the procedure for such a relative evaluation of admixtures for concrete.

In recent time there has been a lot of development in the field of admixtures. Superplasticizers, both normal and retarding type, constitute a major group of admixtures used by site engineers now. Superplasticizers help in lowering the water/cement ratio so as to contribute to the enhancement of durability. In this first revision of the standard, first published in 1979, requirements of superplasticizers in detail and methods of determination of flow of concrete of high workability have been added.

This standard also gives uniformity tests which demonstrate that a particular consignment is similar to material that has previously been submitted to the acceptance test.

The admixtures covered in this standard are intended mainly for modifying a single property in concrete, but some of the admixtures available in the market are often capable of modifying more than one property of the concrete. In addition, an admixture may be used to improve the desirable properties of concrete in more than one way. For example, water reducing admixtures (*see 3.4*) may be used to improve the workability of concrete with the same water and cement contents, to increase the compressive strength without changing the workability by reduction of the water content in the concrete mix or to effect saving in cement content by reduction in both the cement and water contents in the mix while maintaining the same workability and compressive strength as in the reference concrete. In such cases, the procedure of evaluation of the admixture may have to be appropriately chosen. This standard also provided for evaluation of admixtures for specific use with the materials and mix proportions to be used on the work.

The performance of concrete admixtures including superplasticizers depend upon both the admixtures and the cement and their compatibility, in addition to the concrete mix proportions and the environmental conditions in the field. Among the characteristics of the cement, which affect the performance of concrete admixtures including superplasticizers are the C_3A , SO_3 and alkali contents, nature of sulphates, and the fineness. The ambient temperature and humidity conditions influence the performance of set-controlling admixtures and affect the retention of enhanced workability (slump loss) when water-reducing admixtures and superplasticizers are used. While no generalisation of these effects is possible, it is nevertheless necessary to evaluate concrete admixtures for specific use with the concrete-making materials and mix proportions to be used on the work, under field conditions. This standard also provides for such specific evaluation of an admixture, in addition to the general evaluation for conformity to the requirements of this standard.

The requirements of integral waterproofing admixtures are covered in IS 2645 : 1975 'Specification for integral cement waterproofing compounds (*first revision*)'.

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***CONCRETE ADMIXTURES — SPECIFICATION***(First Revision)***1 SCOPE**

1.1 This standard covers the chemical and air-entraining admixtures including superplasticizers, solid or liquid or emulsion, to be added to cement concrete at the time of mixing so as to achieve the desired property in concrete, in the plastic or hardened state.

1.2 The different types of admixtures covered in this standard are as follows:

- a) Accelerating admixtures,
- b) Retarding admixtures,
- c) Water-reducing admixtures,
- d) Air-entraining admixtures, and
- e) Superplasticizing admixtures.

1.3 The chloride content in the admixture shall be declared by the manufacturer. Superplasticizers are expected to be chloride free.

1.3.1 Admixtures that contain relatively large amounts of chloride may accelerate corrosion of prestressing steel. Where corrosion of such steel is of major concern, compliance with the requirement of this specification does not constitute assurance of acceptability of the admixture for use in prestressed concrete. In case of reinforced concrete, to minimize the chances of deterioration of concrete, the total chloride content in the concrete should be limited as specified in IS 456.

2 NORMATIVE REFERENCES

The Indian Standards listed in Annex A contain provisions which through reference in this text, constitute provision of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated in Annex A.

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Admixtures

A material other than water, aggregates, and hydraulic cement and additives like pozzolana or slag and fibre reinforcement used as an ingredient of concrete or mortar and added to the batch immediately before or during its mixing to modify one or more of the

properties of concrete in the plastic or hardened state.

3.2 Accelerating Admixture or Accelerator

An admixture when added to concrete, mortar or grout, increases the rate of hydration of a hydraulic cement, shortens the time of set, or increases the rate of hardening or strength development.

3.3 Retarding Admixture or Retarder

An admixture which delays the setting of cement paste, and hence of mixtures, such as mortar or concrete containing cement.

3.4 Water Reducing Admixture or Workability Aid

An admixture which either increases workability of freshly mixed mortar or concrete without increasing water content or maintains workability with a reduced amount of water.

3.5 Air-Entraining Admixtures

An admixture for concrete or mortar which causes air to be incorporated in the form of minute bubbles in the concrete or mortar during mixing, usually to increase workability and resistance to freezing and thawing and disruptive action of de-icing salts.

3.6 Superplasticizing Admixtures

An admixture for mortar or concrete which imparts very high workability or allows a large decrease in water content for a given workability.

3.7 Retarding Superplasticizing Admixture

Superplasticizing admixture that imparts prolonged workability retention and retards setting.

4 REQUIREMENTS FOR ADMIXTURES

Concrete made with admixtures when compared with identical concrete made without the admixture in accordance with 7 and 8 shall conform to the requirements appropriate to the type of admixture given in Table 1A and Table 1B, except in the case of air-entraining admixture. In the case of air-entraining admixtures, a reference admixture of approved quality shall be used in the control concrete to entrain identical amount of air.

NOTE — If required by the purchaser, the concrete with air-entraining admixture may be tested for resistance to freezing and thawing in accordance with the procedure given in Annex B, in such case the relative durability factor of the concrete with admixture under test shall be not less than 80.

Table 1A Physical Requirements

(Clause 4)

Sl No.	Requirements	Accele- rating Admixture	Retarding Admixture	Water Reducing Admixture	Air-Entrain- ing Admixture	Superplasticizing Admixture (for Water- Reduced Concrete Mix)		Test Ref
						Normal	Retarding Type	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Water content, percent of control sample, <i>Max</i>	—	—	95	—	80	80	7.2.5
ii)	Slump	—	—	—	—	Not more than 15 mm below that of the control mix concrete		7.2.1
iii)	Time of setting, allowable deviation from control sample hours:							7.2.3
	Initial							
	<i>Max</i>	- 3	+ 3	± 1	—	—	+ 4	
	<i>Min</i>	- 1	+ 1	—	—	+ 1.5	+ 1	
	Final							
	<i>Max</i>	- 2	+ 3	± 1	—	± 1.5	± 3	
	<i>Min</i>	- 1	+ 1	—	—	—	—	
iv)	Compressive strength, percent of control sample, <i>Min</i>							8.2.1
	1 day	—	—	—	—	140	—	
	3 days	125	90	110	90	125	125	
	7 days	100	90	110	90	125	125	
	28 days	100	90	110	90	115	115	
	6 months	90	90	100	90	100	100	
	1 year	90	90	100	90	100	100	
v)	Flexural strength, percent of control sample, <i>Min</i>							8.2.2
	3 days	110	90	100	90	110	110	
	7 days	100	90	100	90	100	100	
	28 days	90	90	100	90	100	100	
vi)	Length change, percent increase over control sample, <i>Max</i>							8.2.3
	28 days	0.010	0.010	0.010	0.010	0.010	0.010	
	6 months	0.010	0.010	0.010	0.010	0.010	0.010	
	1 year	0.010	0.010	0.010	0.010	0.010	0.010	
vii)	Bleeding, percent increase over control sample, <i>Max</i>	5	5	5	5	5	5	7.2.4
viii)	Loss of workability	—	—	—	—	At 45 min the slump shall be not less than that of control mix concrete at 15 min	At 2 h, the slump shall be not less than that of control mix concrete at 15 min	7.2.1.2
ix)	Air content (%) <i>Max</i> , over control	—	—	—	—	1.5	1.5	

Table 1B Requirements for High Workability Test Mix

(Clause 4)

Sl No.	Requirements	Type of Superplasticizing Admixture		Test Reference
		Normal	Retarding Type	
(1)	(2)	(3)	(4)	(5)
i)	Flow	510 mm - 620 mm	510 mm - 620 mm	7.2.1.1
ii)	Loss of workability on standing	At 45 min the slump shall be not less than that of control mix concrete at 15 min	At 2 h the slump shall be not less than that of control mix concrete at 15 min	7.2.1.2
iii)	Minimum compressive strength, percent of control mix concrete			8.2.1
	7 days	90	90	
	28 days	90	90	
	6 months	90	90	
	1 year	90	90	

5 METHOD OF SAMPLING OF ADMIXTURE FOR TEST

5.1 Liquid Admixture

Liquid admixture shall be agitated thoroughly immediately prior to sampling. Grab (individual) samples taken for testing shall represent not more than 9 000 litres of admixture and shall have a volume of at least one litre. A minimum of four grab samples shall be taken. Composite samples shall be prepared by thoroughly mixing the grab samples selected and the resultant mixture sampled to provide at least 4 litres for quality tests.

5.1.1 Admixture from bulk storage tanks shall be sampled equally from the upper, intermediate, and lower levels by means of drain cocks in the sides of tanks or a weighed sampling bottle fitted with a stopper that can be removed after the bottle is lowered to the desired depth.

5.2 Non-liquid Admixture

Grab samples taken for tests shall represent not more than 2 tonnes of admixture and shall weigh at least 1 kg. A minimum of 4 grab samples shall be taken and composite sample shall be prepared by thoroughly mixing the four grab samples. The resultant mixture sampled shall provide at least 2.5 kg from the composite sample. Grab samples shall be taken from different locations well distributed throughout the quantity to be represented.

5.2.1 Samples of packed admixtures shall be obtained in the same manner as described in IS 3535.

5.2.2 Samples shall be packed in moisture-proof, airtight containers.

6 PREPARATION OF TEST SAMPLES

6.1 Materials

6.1.1 Materials for Tests for Specific Use

When an admixture is required to be tested for a specific work, test samples shall be prepared using materials proposed to be used on the work.

6.1.2 Materials for Tests for General Evaluation of Admixture

When an admixture is required to be tested for general evaluation, the requirements of materials shall be as follows:

- Cement* — The cement shall be ordinary Portland cement conforming to IS 269 or IS 8112 or IS 12269.
- Aggregate* — The coarse and fine aggregates shall conform to the requirements given in IS 383. While the fine aggregate shall conform to the grading of Zone II, the coarse aggregate shall be graded aggregate of 20 mm nominal maximum size, with the gradings conforming to IS 383 in both the cases.

6.2 Preparation of Concrete

6.2.1 Except in the case of air-entraining admixtures, the concrete mix shall be prepared both with and without admixture, the latter being treated as the reference or control concrete mixture. In the case of air-entraining admixtures, reference admixture shall be used in control concrete (see 4).

6.2.2 The admixture shall be used in accordance with the recommendations of the manufacturer. When an admixture is to be tested specifically for air-entrainment, it shall be used in such a quantity that it produces air content in the range of 3.5 to 7 percent.

NOTE — The manufacturer shall give detailed instructions on the correct use of the admixture for the purpose indicated.

6.2.3 Proportioning of Concrete

6.2.3.1 Proportioning concrete for tests for specific use

The concrete mix shall be proportioned to have the cement content specified for the work and to meet the stipulated workability and strength requirements. In case of air-entrained concrete, the air content specified for the work shall be used. If the maximum size of coarse aggregate is greater than 20 mm, the concrete mix shall be wet-screened over 20 mm IS Sieve before test.

6.2.3.2 Proportioning concrete for tests for general evaluation

The concrete mix may be designed according to any accepted method of mix design, to meet the following requirements:

- a) The cement content of the mix shall be $307 \pm 3 \text{ kg/m}^3$,
- b) The concrete mix shall have a slump of $50 \pm 10 \text{ mm}$ or a compaction factor of 0.85 to 0.90 to facilitate compaction by hand-rodding,
- c) The concrete mix shall be compacted according to the requirements given in IS 516, and
- d) In case of air-entrained concrete an air content of 6 percent shall be used.

6.2.3.3 Samples shall be thoroughly mixed as recommended by the manufacturer to ensure uniformity before testing.

6.2.4 The concrete shall be made in a mechanical power driven mixer in accordance with the procedure specified in IS 516.

7 SAMPLING AND TESTING OF FRESH CONCRETE

7.1 Sampling

Sampling of fresh concrete shall be done according to the requirements given in IS 1199.

7.2 Methods of Tests

Samples of freshly mixed concrete from at least three separate batches for each condition of concrete shall be analysed for the tests described in 7.2.1 to 7.2.5.

7.2.1 Test for Workability

The workability of freshly mixed concrete in terms of slump or compaction factor shall be determined according to method given in IS 1199.

NOTE — In some cases, it may also be worthwhile to determine the workability of fresh concrete not sooner than 15 min and not later than 20 min after completion

of mixing, as the relative advantage of some water-reducing admixtures may decrease with time after mixing.

7.2.1.1 The flow of freshly mixed superplasticized concrete of high workability shall be determined according to the method given in Annex C.

7.2.1.2 Loss of workability on standing

The slump of high workability concrete mixes shall be determined at 45 min and at 2 h, using normal type and retarding type superplasticizers, respectively after the following operations.

After mixing the concrete mixes shall be covered to prevent loss of water by evaporation and kept at a temperature of $27 \pm 2^\circ\text{C}$ and relative humidity of 65 ± 5 percent. At 45 min, the concrete shall be remixed by hand using a shovel just enough to counteract any bleeding or segregation and slump of concrete shall be determined. The tested concrete shall be discarded and the remaining concrete shall be covered and tested at 2 h, after mixing by hand using a shovel.

7.2.2 Test for Air-content

Air-content of freshly mixed concrete shall be determined by the pressure method given in IS 1199.

7.2.3 Test for Time of Setting

Time of setting, initial and final, shall be determined as given in IS 8142.

7.2.4 Test for Bleeding

Bleeding shall be computed at a percentage of the net amount of mixing water in the concrete. The net mixing water is the water in excess of that present as absorbed water in the aggregate. Absorbed water in the aggregate shall be determined as given in IS 2386 (Part 3). The test shall be carried out in accordance with the details given in Annex D.

7.2.5 Test for Water Content

7.2.5.1 The water-cement ratio of the concrete shall be determined to the nearest 0.001, as follows:

- a) Net water content of the batch shall be computed by determining the absorption water of aggregate as given in IS 2386 (Part 3).
- b) Mass of cement per unit volume of concrete shall be computed as given in IS 1199, and
- c) Water-cement ratio shall be determined by dividing the net mass of water by the mass of cement in batch.

7.2.5.2 The relative water content for the concrete containing admixture shall be expressed as a

percentage of the water content of the reference concrete mixture. This shall be computed by dividing the average water content of all batches of concrete by the average water content of the reference concrete and multiplying the quotient by 100.

8 TESTING OF HARDENED CONCRETE

8.1 Preparing Test Specimens

The test specimens shall be prepared as given in IS 516.

8.2 Method of Testing

Specimens for tests on hardened concrete shall be prepared from at least three separate batches for concrete with and without the admixture. The specimen shall be analysed for the requirements described in 8.2.1 to 8.2.3.

8.2.1 Test for Compressive Strength

At least three specimens shall be tested for each type of concrete and each age of testing. Compressive strength shall be determined as given in IS 516.

8.2.2 Test for Flexural Strength

At least three specimens shall be tested for each type of concrete and each age of testing. Flexural strength shall be computed as given in IS 516.

8.2.3 Test for Length Change (Drying Shrinkage)

Changes in length on drying and wetting shall be determined as given in IS 1199. The moist-curing period, including the period in moulds shall be 14 days.

9 UNIFORMITY TEST AND REQUIREMENTS

Any batch of admixture shall have the same physical

state and composition, as that of the admixture tested for acceptance. To check this uniformity of composition, a representative sample of the batch shall be tested and shall satisfy the requirements given in Table 2.

10 MARKING

10.1 Each container of admixture shall be legibly marked with the following information:

- Identification of the source of manufacture,
- Year and date of manufacture,
- Type of admixture, that is, whether accelerating, retarding, water reducing, air-entraining, normal superplasticizing or retarding superplasticizing,
- Batch Number, and
- Chloride ion content.

10.2 Additional Information

The following information shall be provided by the manufacturer in a printed form

- Physical State (that is, liquid or solid) and colour;
- Composition;
 - Generic type of main active constituent(s), for example, lignosulphonate, organic hydroxycarboxylic acid or carbohydrate;
 - Dry material content;
 - Ash content;
 - Relative density of liquid admixture;
 - Chloride ion content, expressed as a percentage by mass of total admixture;

Table 2 Uniformity Tests and Requirements

(Clause 9)

Sl No. (1)	Property (2)	Requirement Reference (3)	Test (4)
i)	Dry material content		Annex E
	a) For liquid admixture	Within 3 percent of the value stated by the manufacturer	
	b) For solid admixture		
ii)	Ash content	Within 1 percent of the value stated by the manufacturer	do
iii)	Relative density	Within 0.02 of the value stated by the manufacturer	do
iv)	Chloride ion content	Within 10 percent of the value or within 0.2 percent whichever is greater as stated by the manufacturer	do
v)	pH	7-8	do
NOTE — Uniformity requirements for ash content is not applicable to accelerating admixture which may contain more than 1 percent chloride content.			

- c) The chloride ion content relative to the cement mass contributed by the recommended dosage or dosages expressed as percentage by mass of chloride ion;
- d) Recommended storage conditions, maximum storage time before use and necessary safety precautions, for example, toxic or corrosive;
- e) Any known incompatibility with other admixture or with certain types of cement etc;
- f) The recommended dosage or dosages;
- g) The effect of underdosage and overdosages; and
- h) Expiry date.

10.3 Information Concerning the Admixture Acceptance Test

The following information shall be provided by the manufacturer in a printed form, if requested:

- a) The source of cement (works of manufacture)

and aggregates (quarry or pit or for material dredged from seas, estuaries or river the locality);

- b) The quantity of admixture used in the test mix concretes;
- c) The values of slump, w/c ratio and cement content for each batch of the control and test mix concretes; and
- d) The air content of each batch of the control and test mix concrete.

11 BIS Certification Marking

The product may also be marked with Standard Mark.

11.1 The use of Standard Mark is governed by the provisions of *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	Title	IS No.	Title
269 : 1989	Specification for 33 grade ordinary Portland cement (<i>fourth revision</i>)	3535 : 1966	Methods of sampling hydraulic cement (<i>first revision</i>)
383 : 1970	Specification for coarse and fine aggregates from natural sources for concrete (<i>second revision</i>)	6925 : 1973	Methods of test for determination of water soluble chlorides in concrete admixtures
456 : 1978	Code of practice for plain and reinforced concrete (<i>third revision</i>)	8112 : 1989	Specification for 43 grade ordinary Portland cement (<i>first revision</i>)
516 : 1959	Method of test for strength of concrete	8142 : 1976	Methods of test for determining setting time of concrete penetration resistance
1199 : 1959	Methods of sampling and analysis of concrete	12269 : 1987	Specification for 53 grade ordinary Portland cement
2386 (Part 3) : 1963	Methods of test for aggregates for concrete : Part 3 Specific gravity, density, voids, absorption and bulking		

ANNEX B(*Note under Clause 4*)**TEST FOR RESISTANCE OF CONCRETE AGAINST FREEZING AND THAWING****B-0 TEST FOR RESISTANCE OF CONCRETE AGAINST FREEZING AND THAWING**

B-1 The freezing and thawing cycle shall consist of alternately lowering the temperature of the specimens from $4 \pm 1^\circ\text{C}$ to $-18 \pm 2^\circ\text{C}$ and raising it from $-18 \pm 2^\circ\text{C}$ to $4 \pm 1^\circ\text{C}$ in not less than 2 h nor more than 5 h. The freezing and thawing can take place either in (i) water, or (ii) freezing in air and thawing in water.

B-2 The test for fundamental transverse frequency shall be conducted on concrete prism specimens (100 mm \times 100 mm \times 400 mm or 150 mm \times 150 mm \times 600 mm) or on concrete cylinder specimens (150 mm in dia \times 300 mm length). The test shall commence at the age of 14 days (water-curing till then) by electro-dynamic method in accordance with IS 516.

The relative dynamic modulus of elasticity shall be calculated as follows:

$$P_c = n_2^2/n_1^2 \times 100$$

where

P_c = relative dynamic modulus of elasticity (percent), after C cycles of freezing and thawing;

n_1 = fundamental transverse frequency at zero cycle of freezing and thawing; and

n_2 = fundamental transverse frequency after C cycle of freezing and thawing.

The relative durability factor shall be calculated as follows:

$$DF \text{ (or } DF_1 \text{)} = PN/300$$

$$RDF = DF/DF_1 \times 100$$

where

DF = durability factor of the concrete containing the admixture under test,

DF_1 = durability factor of the concrete containing the reference admixture,

P = relative dynamic modulus of elasticity in percentage of the dynamic modulus of elasticity at zero cycle (values of P will be 60 or greater), and

N = number of cycles at which P reaches 60 percent, or 300 if P does not reach 60 percent prior to the end of the test (300 cycles).

ANNEX C(*Clause 7.2.1.1*)**METHOD OF DETERMINATION OF FLOW OF CONCRETE OF HIGH WORKABILITY**

C-0 This method covers determination of the flow of fresh mixed superplasticized concrete of high workability.

C-1 APPARATUS**C-1.1 The Slump Cone**

The slump cone for receiving the freshly mixed concrete shall consist of a frustrum of cone of minimum thickness of 1.5 mm metal, with the following internal dimensions:

Diameter of the base : 200 \pm 2 mm

Diameter of top : 130 \pm 2 mm

Height : 200 \pm 2 mm

The slump cone shall be provided with two metal foot pieces at the bottom and two handles at the top.

C-1.2 Tamping Bar

The tamping bar shall be made of hardwood and having a 40 mm \times 40 mm section of length 200 mm, with a circular section to form a handle to the bar.

C-1.3 Flow Table Apparatus

The flow table apparatus shall be constructed in accordance with Fig. 1A and 1B. Flow table top shall be constructed from a flat metal plate of minimum thickness 1.5 mm. The top shall have a plan area of 700 mm × 700 mm and a flatness of within 1.5 mm. The centre of the table shall be scribed with a cross, the lines of which run parallel to and out to the edges of the plate, and with a central circle 200 mm in diameter. The under surface of the plate shall be reinforced in order to prevent distortion of the flat surface. The front of the flow table top shall be provided with a lifting handle as shown in Fig. 1. The total mass of the flow table top shall be 16 ± 1 kg.

The flow table top shall be hinged to a base frame using externally mounted hinges in such a way that no aggregate can become trapped easily between the hinges or hinged surfaces. The front of the base frame shall extend a minimum 120 mm beyond the flow table top in order to provide a top board. An upper stop

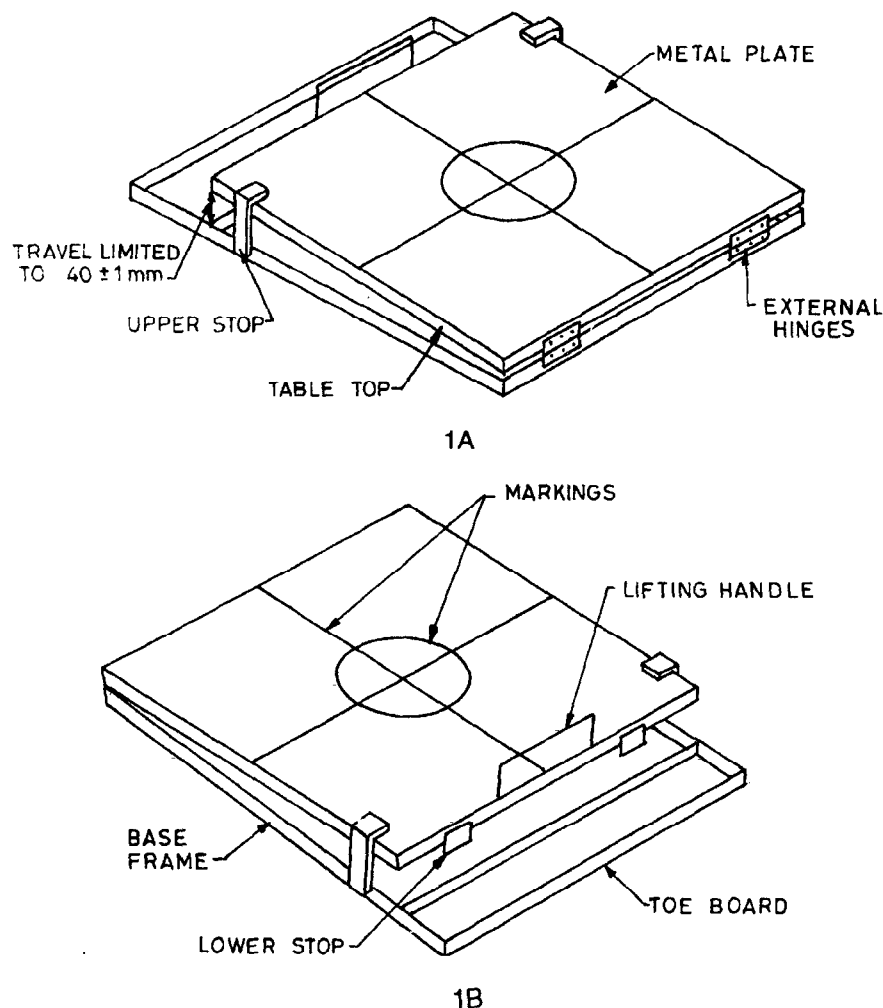
similar to that shown in Fig. 1A shall be provided on each side of the table so that the lower front edge of the table can only be lifted 40 ± 1 mm.

The lower front edge of the flow table top shall be provided with two hard rigid stops which transfer the load to the base frame. The base frame shall be so constructed that this load is then transferred directly to the surface on which the flow table is placed so that there is minimal tendency for the flow table top to bounce when allowed to fall.

C-1.4 Accessory Apparatus

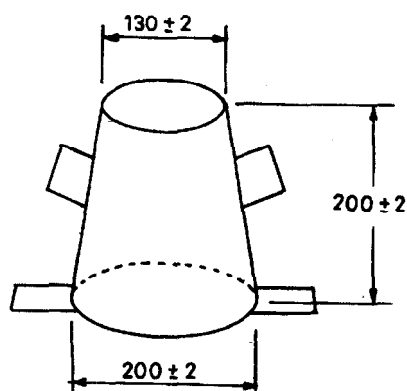
C-1.4.1 Mould

The mould shall be made of a metal readily not attacked by cement paste or liable to rust and of minimum thickness 1.5 mm. The interior of the mould shall be smooth and free from projections, such as protruding rivets, and shall be free from dents. The mould shall be in the form of a hollow frustrum of a cone having the internal dimensions as shown in Fig. 2. The base



All dimensions in millimetres.

FIG. 1 FLOW TABLE



All dimensions in millimetres.

FIG. 2 CONCRETE MOULD

and the top shall be open and parallel to each other and at right angles to the axis of the cone. The mould shall be provided with two metal foot pieces at the bottom and two handles above them.

C-1.4.2 Tamping Bar

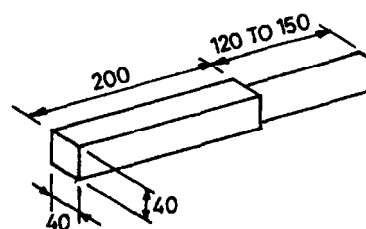
The tamping bar shall be made of a suitable hardwood and having dimensions as shown in Fig. 3.

C-2 SAMPLING

C-2.1 The sample of freshly mixed concrete shall be obtained in accordance with the provisions given in IS 1199.

C-3 PROCEDURE

The flow table shall be level and properly supported.



All dimensions in millimetres.

FIG. 3 TAMPING BAR

Before commencing the test, the table-top and inner surface of the mould shall be wiped with a damp cloth. The slump cone is placed centrally on the table and to be held in position by standing on the two foot pieces. The slump cone is to be filled with concrete in two equal layers, each layer tamped lightly 10 times with the wooden tamping bar. After filling the mould, the concrete is to be struck off flush with the upper edge of the slump cone and the free area of the table-top cleaned off.

Half a minute after striking off the concrete, the cone shall be slowly raised vertically by the handles. After this, the table-top raised by the handle and allowed to fall 15 times in 15 s. The concrete spreads itself out. The diameter of the concrete spread shall then be measured in two directions, parallel to the table edges. The arithmetic mean of the two diameters shall be the measurement of flow in millimetres.

ANNEX D

(Clause 7.2.4)

METHOD OF TEST FOR BLEEDING OF CONCRETE

D-0 This method covers determination of the relative quantity of mixing water that will bleed from a sample of freshly mixed concrete.

D-1 APPARATUS

D-1.1 Measure

A cylindrical container of approximately 0.01 m³ capacity, having an inside diameter of 250 mm and inside height of 280 mm. The container shall be made of metal of minimum thickness of 4 mm and shall be externally reinforced around the top with metal band 38 mm wide and 4 mm thick. The inside shall be smooth and free from corrosion, coating, or lubricants. Suitable handles should be provided, properly welded on the outer surface of the container, on the opposite sides in centre, so as to enable lifting/handling of the container with concrete.

D-1.2 Tamping Bar

The tamping bar shall be a round-ended steel bar of 16 mm diameter and 600 mm length.

D-1.3 Pipette

A pipette for drawing off free water from the surface of the test specimens.

D-1.4 Graduated Jar

A graduated jar of 100 cm³ capacity.

D-2 SAMPLING

The sample of freshly mixed concrete shall be obtained in accordance with the provisions given in IS 1199 except when small batches are made under laboratory conditions.

D-3 PROCEDURE**D-3.1 Compacting**

The container shall be filled with concrete as soon as practicable after mixing to a height of 250 ± 3 mm. The concrete shall be filled into the measure in layers approximately 50 mm deep and each layer shall be compacted by hand.

D-3.1.1 Compacting by Hand

When compacting by hand, tamping with the tamping bar shall be distributed in a uniform manner over the cross-section of the measure.

The number of strokes per layer required to produce the specified condition will vary according to the type of concrete, but in no case shall the concrete be subjected to less than 60 strokes per layer for the 0.01 m^3 measure. Then, the top surface of the concrete shall be levelled to a reasonably smooth surface by a minimum amount of trowelling.

D-3.2 The test specimen shall be kept at a temperature of $27 \pm 2^\circ\text{C}$. Immediately after trowelling the surface of test specimens the time as well as the mass, of the cylinder and its contents shall be recorded. The

container shall be kept on a level surface free from vibration and covered with a lid. Water accumulated at the top shall be drawn off by means of a pipette, at 10 min intervals during the first 40 min and at 30 min intervals subsequently till bleeding ceases. To facilitate collection of bleeding water, the specimen may be tilted by placing a 50-mm block under one side of the measure during collection of water. The water shall be transferred to graduated jar and accumulated quantity of water shall be recorded after each transfer.

D-4 CALCULATION

Accumulated bleeding water expressed as a percentage of the net mixing water shall be calculated as follows:

$$\text{Bleeding water percentage} = \frac{V_w}{w} \times 100$$

where

V_w = total mass of the bleeding water, kg;

w = net mass of water in the batch, kg;

W = total mass of the batch, kg; and

s = the mass of sample, kg.

ANNEX E

(Clause 10.1)

CHARACTERISTIC PROPERTIES OF ADMIXTURE**E-1 DRY MATERIAL CONTENT**

The dry material content in the liquid or non-liquid samples shall be determined according to the following procedures.

E-1.1 Liquid Admixture

Place 25 to 30 g of preheated, completely dry sand in a wide mouth glass weighing bottle (60 mm dia, 30 mm height) provided with ground glass stopper. Place the bottle with sand and stopper in the electric oven and dry for $17 \pm 1/4$ h at $105 \pm 2^\circ\text{C}$. (The period of drying may be shortened if sand is already dry.) Transfer the bottle with stopper to a desiccator and allow to cool to room temperature and weigh nearest to 0.001 g. Remove the stopper and with the help of a pipette evenly distribute 4 ml of the liquid over the sand. Insert the stopper and place the bottle and stopper in the oven. Dry for $17 \pm 1/4$ h at $105 \pm 2^\circ\text{C}$. At the end of the drying period transfer to a desiccator, cool to room

temperature. Stopper the weighing bottle and weigh to nearest 0.001 g. Again place the bottle and stopper in the oven for one hour and repeat the drying and the weighing etc. The weight should become constant.

Calculation:

Find the weight of sample and the dried residue.

Weight of bottle and sand = W_1

Weight of bottle, sand and sample = W_2

Weight of sample = $W_2 - W_1$

Weight of bottle, sand and dried residue = W_3

Weight of dried residue = $W_3 - W_1$

Percent residue on drying = $\frac{W_3 - W_1}{W_2 - W_1} \times 100$

E-1.2 Non-Liquid Admixture

Place about 3 g of the non-liquid sample into an already weighed dried tared glass stoppered weighing bottle to the nearest 0.001 g. Remove the stopper and immediately place both stopper and bottle in the drying oven. Dry for $17 + 1/4$ h at $105 \pm 2^\circ\text{C}$. At the end of the drying period transfer the bottle and stopper to a desiccator, cool to room temperature, stopper the bottle and weigh to nearest 0.001 g. Calculate as above in E-1.1.

E-2 ASH CONTENT

The ash content which gives an indication of inorganic constituents, is determined by igniting the admixture at 600°C to remove any organic material. Place, accurately weighed to the nearest 0.001 g, about 1 g of the sample to a clean pre-ignited and accurately weighed silica or porcelain crucible. Then place the crucible over a steam water bath or an air oven, at 90°C to remove the liquid portion by evaporation. Finally transfer the crucible with its solid contents to a muffle furnace at room temperature and heat gradually so that the temperature reaches 300°C in 1 h and 600°C in a further 2 to 3 h period. Maintain the temperature of the furnace at $600 \pm 25^\circ\text{C}$ for 16 to 24 h. Remove the crucible from the furnace, cool, covered with its lid in the desiccator. After cooling for 30 min, weigh the crucible plus lid and contents to the nearest 0.001 g.

Calculate the ash content in the original mass of the superplasticizer:

$$\text{Weight of crucible and lid} = W_1$$

$$\text{Weight of crucible, lid and sample} = W_2$$

$$\text{Weight of crucible, lid and ash} = W_3$$

$$\text{Ash content} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

E-3 RELATIVE DENSITY OF LIQUID ADMIXTURE**E-3.1 Apparatus**

Following apparatus shall be used:

- Constant temperature bath,
- Hydrometer, and
- Measuring cylinder.

Place about 400 ml of admixture in a 500-ml graduated cylinder avoiding the formation of air bubbles in the liquid. Allow the temperature of the liquid to be $20 \pm 5^\circ\text{C}$. Hold the temperature of the stem and insert it into the liquid in the cylinder. Insert the hydrometer into the cylinder in such a way that it floats free and does not touch the side of the cylinder. Release the hydrometer when approximately in the equilibrium position. When it has reached the equilibrium read the scale at the bottom of the meniscus for transparent liquids or where the meniscus merges with the stem of the hydrometer for opaque liquids to report the relative density.

E-4 CHLORIDE ION CONCENTRATION

The chloride ion content in an admixture shall be determined as given in IS 6925.

E-5 pH

The hydrogen ion concentration represented by pH value of the liquid superplasticizer shall be determined with the help of a suitable pH meter.

ANNEX F
(*Foreword*)
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(*Continued on page 13*)

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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AMENDMENT NO. 1 JANUARY 2003
TO
IS 9103 : 1999 CONCRETE ADMIXTURES —
SPECIFICATION

(First Revision)

[Page 2, Table 1A, Sl No. (iii), col 7 and 8] — Substitute the following for the existing:

		(7)	(8)
Initial	<i>Max</i>	± 1.5	+4
	<i>Min</i>	—	+1
Final	<i>Max</i>	± 1.5	+3
	<i>Min</i>	—	—

[Page 2, Table 1A, Sl No. (viii)] — Delete all the entries.

[Page 5, Table 2, Sl No. (v), col 3] — Substitute the following for the existing:

‘Within ± 1 of the value stated by the manufacturer’

(CED 2)

AMENDMENT NO. 2 AUGUST 2007
TO
IS 9103 : 1999 CONCRETE ADMIXTURES —
SPECIFICATION

(First Revision)

[Page 5, Table 2, Sl No. (i), col 3] — Substitute the following for the existing matter:

$$0.95T \leq DMC < 1.05T,$$

where

T – manufacturer's stated value, in percent by mass

DMC – test results, in percent by mass

[Page 5, Table 2, Sl No. (ii), col 3] — Substitute the following for the existing matter:

$$0.95T \leq AC < 1.05T,$$

where

T – manufacturer's stated value, in percent by mass

AC – test results in percent by mass

[Page 5, Table 2, Sl No. (v), col 3 (see also Amendment No. 1)] — Substitute the following for the existing:

‘6, Min’