ACTION RESEARCH REPORT

Study of the application of new material (ABS plastic) in making concrete testing apparatus — Slump cone

1. Objective of the Project

To study the suitability of using ABS plastic for producing slump cones for testing the workability of concrete, and to document quality parameters for the same.

2. Relevance of the Project to BIS

a) Increasing the scope of the BIS standard (IS 7320) with alternate material having vast potential for use in the laboratory and field.
b) So far, BIS certification is available only for metal slump cones. This study will result in revised provisions of the standard, which will pave way for production and certification of plastic slump cones.

3. Background of the Project

A slump cone is used to measure the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows. The simplicity of apparatus and the procedure makes it a very convenient tool in site to estimate the uniformity of concrete loads. The requirements of workability for different applications of concrete are given in the Concrete Code, IS 456: 2000 'Code of practise for plain and reinforced concrete'.

IS 7320:1974 'Specification for Concrete Slump Test Apparatus' covers the requirements for slump cones for testing the workability of concrete. But the standard only covers the specification for metal slump cones. (IS 7320:1974 attached as **Annex 1**)

The cement and concrete industry has advanced to a stage where more and more innovative techniques and raw materials are being discovered. One such advancement has been the popularization of ABS as a raw material for making concrete and cube and workability testing apparatuses.

ABS (acrylonitrile-butadiene-styrene copolymer) is a terpolymer of acrylonitrile, butadiene and styrene, and is widely used in machinery, construction, textile and other industrial areas. It has a density of 1.05 to 1.18 g/cc, poisons ratio of 0.394 and a melting temperature of 217 to 237 ℃. It has good impact strength, wear resistance and dimensional stability. Its plastic heat distortion temperature is 93-118 ℃, does not absorb water and is non-reactive with common chemicals like acids and alkalis.

This technology has already been adopted in various international standards including ASTM and AASHTO standards. These slump cones are more long lasting than the metal ones, with more durability towards weather and with lesser chances of dimensional distortion. However, these cones may have the following general disadvantages as well:

a) Plastic is generally susceptible to aging. So, the slump cones made of ABS or PP may have adverse effects if left exposed to sunlight for extended periods of time.
b) Plastic may be more susceptible to scratches due to the extent of tamping involved in the test procedure. Scratches will hinder the plastic flow of concrete and will hinder the accuracy of the test results.

In the Indian context, due consideration should be given to the climate in various parts of the Indian subcontinent as well the prevalent practices in the construction sites. It should be ensured that these cones are suitable for use in the lab as well as in the construction site. These cones should be compactable with the tamping system used in India.

4. <u>International practice on the subject</u>

a) ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete

The standard covers the determination of slump of concrete, both in laboratory and in field. This standard covers both ABS moulds as well as metal moulds providing equal importance to both. In addition, the standard also provides the following minimum requirement of mechanical properties of the ABS plastic to be used for the cone making

Tensile modulus of elasticity at 23℃	2206 MPa
Tensile Strength	39 MPa
Percent elongation at break at 23℃	40%

(ASTM C 143 attached as **Annex 2**)

b) AASHTO T 119M/T 119-18 Slump of Hydraulic Cement Concrete

The standard covers the determination of slump of concrete, both in laboratory and in field. It primarily gives the specifications for metal slump cones and then adds on the following requirements to be met if the mould is to be constructed of an alternate material.

i) The mould shall meet the shape, height, and internal dimensional requirements of metal moulds.
ii) The mould shall be sufficiently rigid to maintain the specified dimensions and tolerances during use, resistant to impact forces, and shall be non-absorbent.
iii) The mould shall be demonstrated to provide test results comparable to those obtained when using a metal mould meeting the requirements of the AASHTOO standard.
iv) Test for comparability shall consist of not less than 10 consecutive pairs of comparisons performed at each of three different slumps ranging from 50 to 200 mm.

v) No individual test results shall vary by more than 15 mm from that obtained using the metal mould. The average test results of each slump range obtained using the mould constructed of alternative material shall not vary by more than 6 mm from the average of test results obtained using the metal mould.

(AASHTO T 119M/T 119-18 attached as **Annex 3**)

5. Properties of the raw material — ABS Plastic

ABS Plastic grains (picture courtesy: Wikipedia)

Acrylonitrile butadiene styrene (ABS) (chemical formula (C_8H_8) x·(C_4H_6) y·(C_3H_3N) z) is a common thermoplastic polymer with the following properties.

a) ABS can be used between -20 and 80 °C. Beyond this range, its mechanical properties will vary.
b) It has a density of 1.060 to 1.080 g/cc and is insoluble in water.
c) ABS has high impact resistance, toughness and rigidity when compared to other polymers.

d) ABS polymers are resistant to aqueous acids, alkalis, concentrated hydrochloric and phosphoric acids, alcohols and animal, vegetable and mineral oils, but they are swollen by glacial acetic acid, carbon tetrachloride and aromatic hydrocarbons and are attacked by concentrated sulfuric and nitric acids. They are soluble in esters, ketones (such as acetone), chloroform, and ethylene dichloride. They also offer poor resistance to chlorinated solvents and aldehydes.

e) The mechanical properties of ABS are as follows:

Young's Modulus (GPa)	2.28
Tensile Strength (MPa)	43
Flexural modulus (GPa)	2.48
Flexural Strength (MPa)	77
Notched Izod (kJ/m)	0.203
Heat Deflection Temperature, 1.81 MPa, (C)	81

6. ABS Slump Cones

The ABS slump cones are similar in appearance to the metal ones with the notable difference being that the ABS cones ae thicker (almost double the thickness of metal ones). Despite the added thickness, the ABS moulds are much lighter than the metal ones, with their average weight being less than a kilogram. Suggested specifications of ABS slump cone are shown in Fig 1.

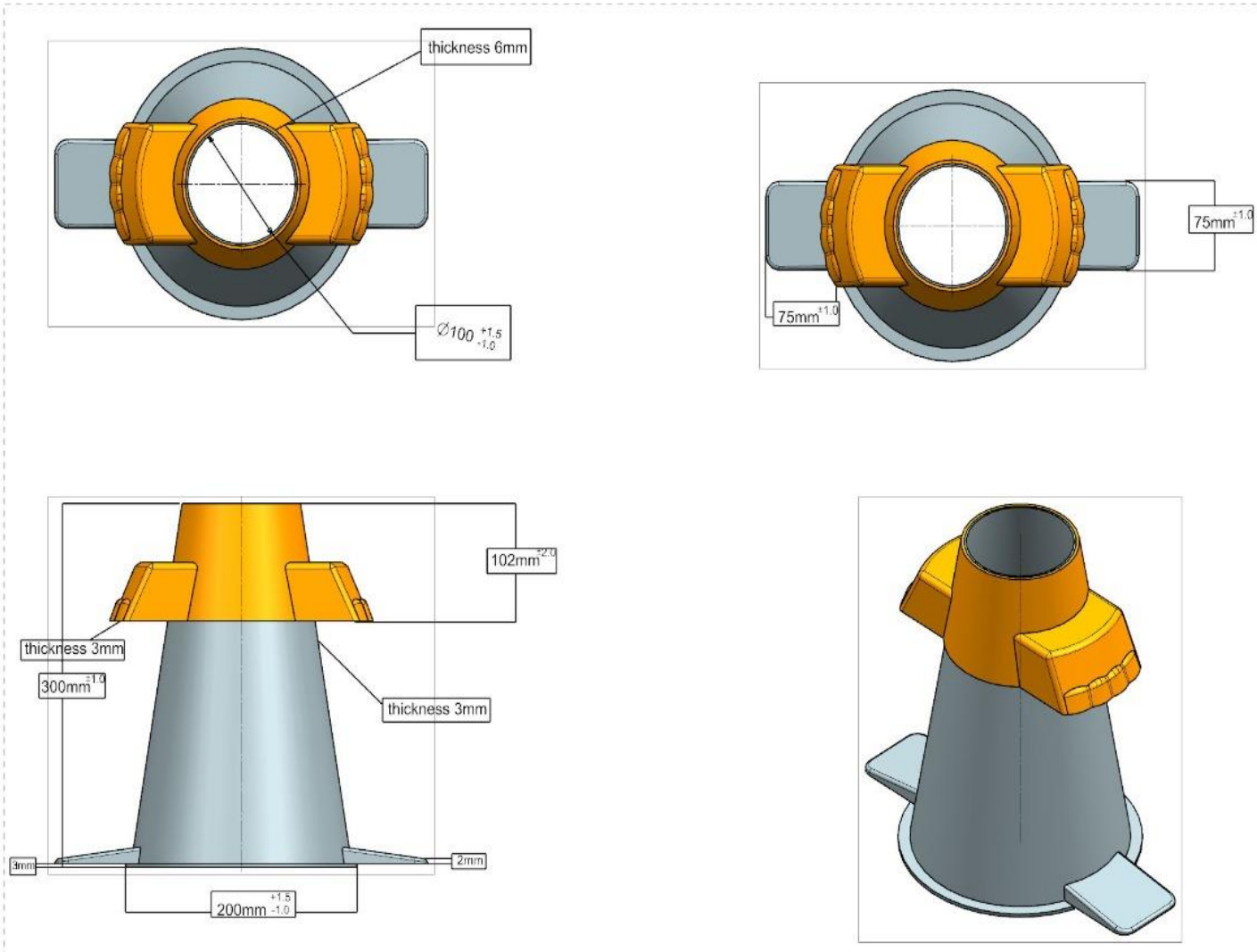

Fig 1. Suggested construction and dimension of seamless ABS Slump cones

7. <u>Quality testing of ABS cones in comparison with metal ones</u>

a) International test report

Deslauriers Inc, one of the leading manufacturers of concrete forming and testing accessories located in US had marketed ABS cones in the international market long back and they had got their product tested at H. H. Holmes Testing Laboratories Inc as far back as 1997.

(test report from H. H. Holmes Testing Laboratories Inc attached as **Annex 4**)

The testing done as per ASTM C143, compared the slumps obtained while using plastic and metal cones, for a variety of slumps. Ten comparisons were made for each slump range and it was observed that the average difference between the slumps obtained using metal and plastic cones were negligible, and the individual differences were less than 0.25 cm.

The report had concluded that the plastic slump cones marketed by Deslauriers were in compliance with ASTM C143.

b) NCCBM test report

A more detailed testing of the ABS plastic cones was done at the National Council for Cement and Building Materials, Ballabgarh with the cones provided by Mould Mart India, Delhi. The testing was done in order to ensure that the ABS moulds were compatible with the slump testing procedure given in IS 1199 (Part 2): 2018. The performance of the ABS slump cone apparatus was compared with the performance of the metal slump cone by taking 30 sets of slump measurements on various grades of fresh concretes in various slump ranges over a period of 60 days.

(test report from NCCBM attached as **Annex 5**)

As per the test report, it was observed that the maximum deviation between the results obtained using a metal cone and an ABS cone was around the range of 10 mm. Additionally, the dimensional stability of the ABS cone was also examined after every 10, 20 and 30 measurements and the deviations were found to be comparable with that of the metal cone and within the permissible limit specified by the Indian Standard.

As per the report, the variation in slump while using ABS and metal moulds are random and do not follow any specific pattern, which shows that there is no deterioration of the ABS slump cone due to repeated usage.

The report concluded that the ABS mould was compatible to be used as per the slump testing procedure in the Indian Standards and that the results were similar to those obtained while using a metal cone.

8. Conclusion and deliverables of the project

a) ABS cones have already been included in ASTM and AASHTO standards and are accepted internationally. Considering the extensive R&D carried out at NCCBM, it may be concluded that the product meets all the performance requirements as per the Indian standards as well. In addition to the above, the ABS cones are more economical than their standard quality metal counterparts, and will hence promote the use of these ISI marked user friendly products by the industry.

b) Developing an Indian standard for ABS slump cones will encourage the production of these cones in India and will aid towards the make-in-India initiative by the Central government. An added advantage is that ABS is an eco-friendly material and the discarded cones can be converted back to ABS granules and reused.

c) Adequate research has not been carried out on the prolonged effect of sunlight on ABS cones. If the ABS cones are to be used in construction sites in addition to laboratories, the effect of sunlight may also have to examined in detail.

d) IS 7320:1994 'Specification for concrete slump test apparatus' already covers the requirements of all parts of the metal slump cone assembly. While trying to migrate to using an ABS slump cone, the base plate and the tamping rod will remain the same as that used with the metal cone. Considering the above, we may bifurcate the existing IS 7320 by developing a part 2 for the standard focussing entirely on ABS slump cones with details of raw materials and with adequate sketches for

manufacture of the cone. For the other parts of the assembly, the existing IS 7320 may be referred to.

e) A draft standard as per the above points have been developed and is attached at **Annex 6**.

Acknowledgement and Bibliography

1) Certain inputs were provided by Mould Mart India, New Delhi, who are already manufacturing this product in India.
2) Discussions were held with experts from organizations from National Council of Cement and Building Materials, Ballabgarh, Indian Institute of Technology etc and inputs based on their experience with similar products were sought.
3) **https://en.wikipedia.org/wiki/Acrylonitrile_butadiene_styrene**
4) **https://www.deslinc.com/plastic-slump-cone**

List of Annexes

Annex 1	IS 7320:1974 Specification for concrete slump test apparatus
Annex 2	ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete
Annex 3	AASHTO T 119M/T 119-18 Slump of Hydraulic Cement Concrete
Annex 4	Test report from H. H. Holmes Testing Laboratories Inc, USA
Annex 5	Test report from National Council of Cement and Building Materials, Ballabgarh
Annex 6	Draft Standard IS 7320 (Part 2) for ABS slump cones prepared as per the research carried out for the Action Research.

APPENDIX - V

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS

Doc. No. : PRTD/AR/**PF:04**	Issue No. : 1	Issue Date 28 Apr 2020	**DECLARATION OF ORIGINAL WORK**

DECLARATION OF ORIGINAL WORK

I, ----------Divya S, Scientist C---------- (indicate official's Name & Designation), EmployeeNo ----------065765---------- hereby declare that the Action Research Projecttitled "----------Study of the application of new material (ABS plastic) in making concrete testing apparatus — Slump cone----------" is the original research work done by me. I have not copied from any other Action Research Project or any other work of similar nature and topic done by any person/institution/body either published or yet to be published. Data and information from other sources, used if any, have been with prior permission, wherever required and is duly acknowledged appropriately in the project report submitted by me.

This declaration is made on the ……Eighteenth…… day of……April……20…21……

Divya S

Digitally signed by Divya S
DN: c=IN, o=Bureau of Indian Standards, postalCode=110002, st=DELHI, 2.5.4.20=b1b366ee28c2e783449c7d9536eab3317c36a1d9dd1315c22519a5bc3ac782cb9, cn=Divya S
Date: 2021.04.18 11:41:42 +05'30'

Sign. of Officer with Date

*Note:*Joint Declaration should be submitted for Projects undertaken jointly

IS : 7320 -1974
(Reaffirmed 1999)
(Reaffirmed 2008)

Indian Standard

SPECIFICATION FOR CONCRETE SLUMP TEST APPARATUS

(Fourth Reprint NOVEMBER 2000)

UDC 666.972 : 620.192.2.05

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

Gr 2 *August* 1974

Indian Standard

SPECIFICATION FOR CONCRETE SLUMP TEST APPARATUS

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(*Continued on page* 8)

AMENDMENT NO. 1 MARCH 1984

TO

IS:7320-1974 SPECIFICATION FOR CONCRETE SLUMP TEST APPARTUS

Alterations

(*Page 3, clause 2.1, line 2*) - Substitute 'tamping bar' *for* 'tamping rod'.

(*Page 4, clause 4, Title*) - Substitute 'TAMPING BAR' *for* 'TAMPING ROD'.

(*Page 4, clause 4.1*) - Substitute the following for the existing matter:

'4.1 The tamping bar shall be a steel bar 16 mm in diameter, 600 mm long with a rounded working end'

(*Page 7, clause 5.1, line 2*) - Substitute 'bar' *for* 'rod'.

(BDC 2)

Printed at New India Printing Press, Khurja, India

Indian Standard

SPECIFICATION FOR CONCRETE SLUMP TEST APPARATUS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 21 February 1974, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The Indian Standards Institution has already published a series of standards on methods of testing cement and concrete. It has been recognized that reliable and inter comparable test results can be obtained only with standard testing equipment capable of giving the desired level of accuracy. The Sectional Committee has, therefore, decided to bring out a series of specifications covering the requirements of equipment used for testing cement and concrete, to encourage its development and manufacture in the country.

0.3 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.

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1. SCOPE

1.1 This standard covers the requirements of the apparatus used for determining the slump of fresh concrete as a measure of its consistency.

2. APPARATUS

2.1 The apparatus shall consist of a mould for the test specimen and a tamping rod.

3. MOULD

3.1 Shape and Dimensions — The mould for the test specimen shall be in the form of the frustum of a cone as shown in Fig. 1 or 2 and internal dimensions as given in Table 1.

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

TABLE 1 INTERNAL DIMENSIONS OF MOULD

(*Clause* 3.1)

Sl No.	Details	Dimension mm	Tolerance (*see* Note) mm
(1)	(2)	(3)	(4)
i)	Bottom diameter	200	+ 3 − 1·5
ii)	Top diameter	100	+ 3 − 1·5
iii)	Height	300	± 1·5

NOTE — Diameter and height measured anywhere on the mould shall not differ from the nominal dimension (that is 200, 100 and 300 mm) by more than the specified tolerance.

3.1.1 Where no tolerance has been specified for a particular dimension, it will mean that reference is being made to the nominal dimension.

3.2 Material — The mould shall be made of galvanized iron sheet or any other suitable metal not readily attacked by cement paste; aluminium shall not be used. The metal shall be at least 1·6 mm thick.

3.3 Construction — The mould may be constructed either with or without a seam. When a seam is provided, the seam shall be essentially as shown in Fig. 2.

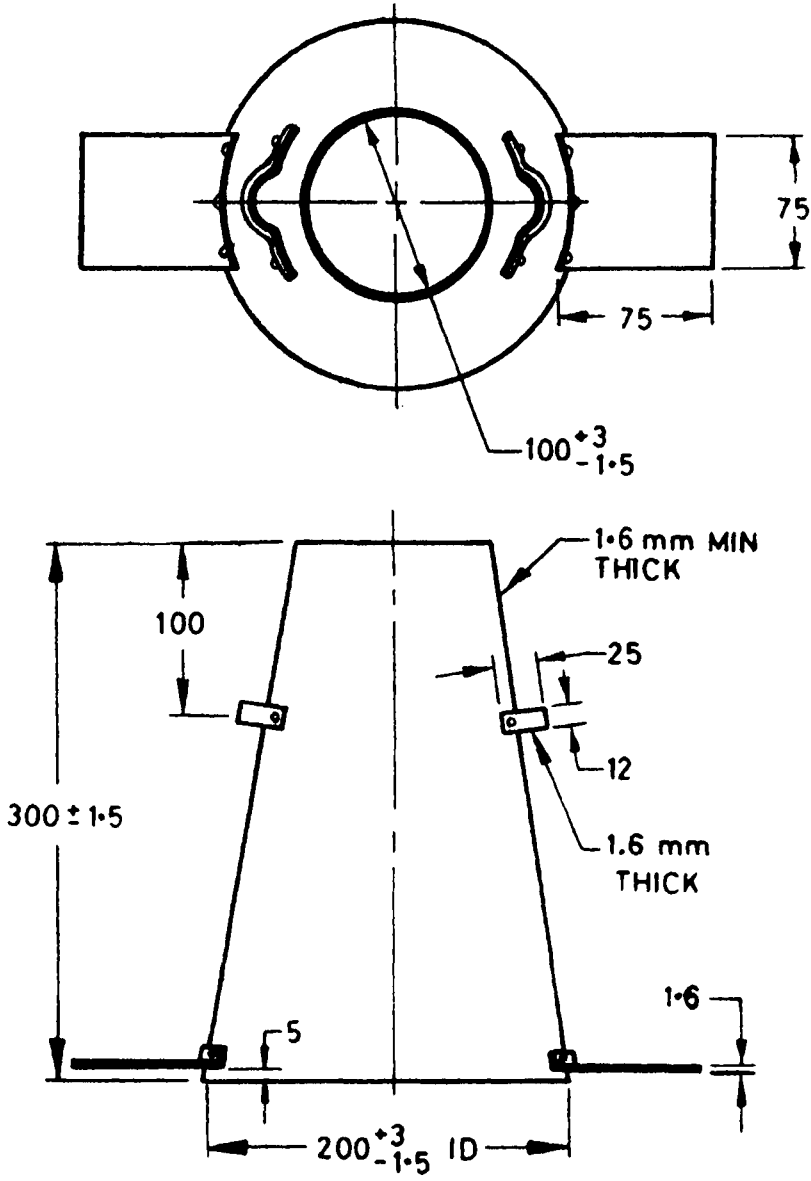
3.3.1 The top and bottom of the mould shall be open and parallel to each other and at right angles to the axis of the cone. The internal surface of the mould shall be smooth and shall be free from dents and projections, such as protruding rivets.

3.3.2 The mould shall be provided with foot pieces and handles to facilitate lifting it from the moulded concrete test specimen. The shape and dimensions of the foot pieces and handles may be as shown in Fig. 1 and 2. Attachments shall be riveted, welded or brazed to the mould. Any rivet used in the construction of the mould shall be countersunk on the inside of the cone.

NOTE — A mould which clamps to a non-absorbent base plate or an apparatus with a suitable guide attachment for measuring height of the moulded concrete may also be accepted provided it otherwise conforms to the requirements of the specification.

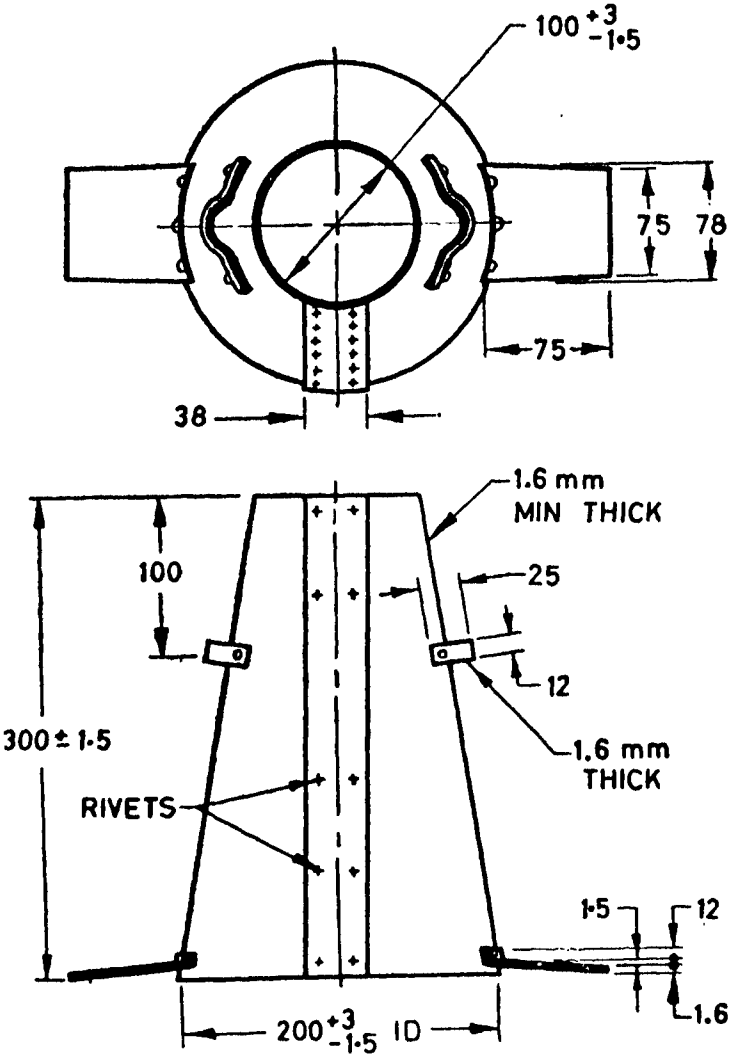
4. TAMPING ROD

4.1 The tamping rod shall be a round straight steel rod, 16 mm diameter and 600 mm long. The tamping end of rod shall be rounded to a hemispherical tip, the diameter of which shall be 16 mm.



All dimensions in millimetres.

FIG. 1 MOULD (SEAMLESS) FOR SLUMP TEST OF CONCRETE



All dimensions in millimetres.

FIG. 2 A MOULD (WITH SEAM) FOR SLUMP TEST OF CONCRETE

5. MARKING

5.1 The following information shall be clearly and indelibly marked on the mould and the rod in a way that it does not interfere with the performance of this apparatus:

a) Name of manufacturer or his registered trade-mark or both, and

b) Date of manufacture.

5.1.1 The apparatus may also be marked with the Standard Mark.

5.1.2 The use of the 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 Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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Designation: C143/C143M – 12

Standard Test Method for Slump of Hydraulic-Cement Concrete[1]

This standard is issued under the fixed designation C143/C143M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This test method covers determination of slump of hydraulic-cement concrete, both in the laboratory and in the field.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* (**Warning**—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.[2])

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field

C138/C138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

C172 Practice for Sampling Freshly Mixed Concrete

C173/C173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

D638 Test Method for Tensile Properties of Plastics

3. Summary of Test Method

3.1 A sample of freshly mixed concrete is placed and compacted by rodding in a mold shaped as the frustum of a cone. The mold is raised, and the concrete allowed to subside. The vertical distance between the original and displaced position of the center of the top surface of the concrete is measured and reported as the slump of the concrete.

4. Significance and Use

4.1 This test method is intended to provide the user with a procedure to determine slump of plastic hydraulic-cement concretes.

NOTE 1—This test method was originally developed to provide a technique to monitor the consistency of unhardened concrete. Under laboratory conditions, with strict control of all concrete materials, the slump is generally found to increase proportionally with the water content of a given concrete mixture, and thus to be inversely related to concrete strength. Under field conditions, however, such a strength relationship is not clearly and consistently shown. Care should therefore be taken in relating slump results obtained under field conditions to strength.

4.2 This test method is considered applicable to plastic concrete having coarse aggregate up to 1½ in. [37.5 mm] in size. If the coarse aggregate is larger than 1½ in. [37.5 mm] in size, the test method is applicable when it is performed on the fraction of concrete passing a 1½-in. [37.5-mm] sieve, with the larger aggregate being removed in accordance with the section titled "Additional Procedure for Large Maximum Size Aggregate Concrete" in Practice C172.

4.3 This test method is not considered applicable to non-plastic and non-cohesive concrete.

NOTE 2—Concretes having slumps less than ½ in. [15 mm] may not be adequately plastic and concretes having slumps greater than about 9 in. [230 mm] may not be adequately cohesive for this test to have significance. Caution should be exercised in interpreting such results.

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.60 on Testing Fresh Concrete.

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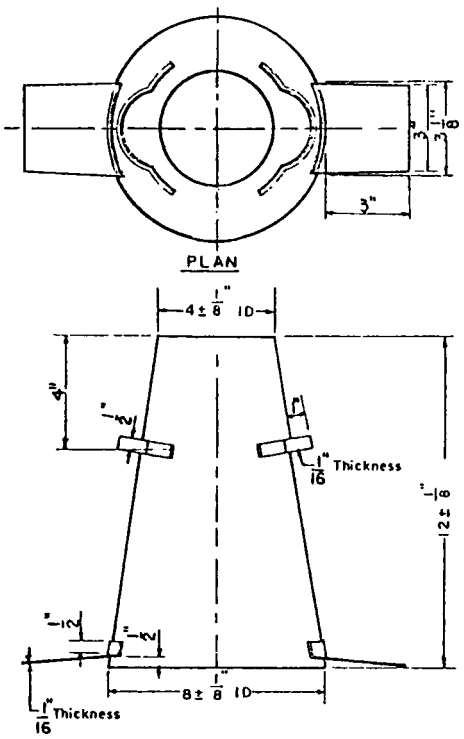
[2] Section on Safety Precautions, Manual of Aggregate and Concrete Testing, *Annual Book of ASTM Standards*, Vol. 04.02.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

5. Apparatus

5.1 *Mold*—The test specimen shall be formed in a mold made of metal or plastic not readily attacked by the cement paste. The mold shall be sufficiently rigid to maintain the specified dimensions and tolerances during use, resistant to impact forces, and shall be non-absorbent. Metal molds shall have an average thickness of not less than 0.060 in. [1.5 mm] with no individual thickness measurement less than 0.045 in. [1.15 mm]. Plastic molds shall be ABS plastic or equivalent (Note 3) with a minimum average wall thickness of 0.125 in. [3 mm], with no individual thickness measurement less than 0.100 in. [2.5 mm]. The manufacturer or supplier shall certify the materials used in mold construction are in compliance with the requirements of this test method. The mold shall be in the form of the lateral surface of the frustum of a cone with the base 8 in. [200 mm] in diameter, the top 4 in. [100 mm] in diameter, and the height 12 in. [300 mm]. Individual diameters and heights shall be within ±⅛ in. [3 mm] of the prescribed dimensions. The base and the top shall be open and parallel to each other and at right angles to the axis of the cone. The mold shall be provided with foot pieces and handles similar to those shown in Fig. 1. The mold shall be constructed without a seam. The interior of the mold shall be relatively smooth and free from projections. The mold shall be free from dents, deformation, or adhered mortar. A mold which clamps to a nonabsorbent base plate is acceptable instead of the one illustrated, provided the clamping arrangement is such that it can be fully released without movement of the mold and the base is large enough to contain all of the slumped concrete in an acceptable test.



Dimensional Units									
in.	1/16	1/8	1/2	1	3	3 1/8	4	8	12
mm	[2]	[3]	[15]	[25]	[75]	[80]	[100]	[200]	[300]

FIG. 1 Mold for Slump Test

NOTE 3—ABS (Acrylonitrile Butadiene Styrene) plastic exhibits the following minimum mechanical properties:

Tensile modulus of elasticity, at 73 °F [23 °C]	320 000 psi	[2206 MPa]
Tensile strength (Test Method D638)	5670 psi	[39 MPa]
Percent Elongation at Break, at 73 °F [23 °C]	40%	

5.1.1 Check and record conformance to the mold's specified dimensions when it is purchased or first placed in service and at least annually thereafter.

5.1.1.1 If the condition of any individual mold is suspected of being out of tolerance from the as manufactured condition, a single comparative test shall be performed. If the test results differ by more than 0.50 in. [15 mm] from that obtained using the metal mold, the mold shall be removed from service.

5.2 *Tamping Rod*—A round, smooth, straight steel rod, with a ⅝ in. [16 mm] ± 1/16 in. [2 mm] diameter. The length of the tamping rod shall be at least 4 in. [100 mm] greater than the depth of the mold in which rodding is being performed, but not greater than 24 in. [600 mm] in overall length (Note 4). The rod shall have the tamping end or both ends rounded to a hemispherical tip of the same diameter as the rod.

NOTE 4—A rod length of 16 in. [400 mm] to 24 in. [600 mm] meets the requirements of the following: Practice C31/C31M, Test Method C138/C138M, Test Method C143/C143M, Test Method C173/C173M, and Test Method C231.

5.3 *Measuring Device*—A ruler, metal roll-up measuring tape, or similar rigid or semi-rigid length measuring instrument marked in increments of ¼ in. [5 mm] or smaller. The instruement length shall be at least 12 in. [300 mm].

5.4 *Scoop*—of a size large enough so each amount of concrete obtained from the sampling receptacle is representative and small enough so it is not spilled during placement in the mold.

6. Sample

6.1 The sample of concrete from which test specimens are made shall be representative of the entire batch. It shall be obtained in accordance with Practice C172.

7. Procedure

7.1 Dampen the mold and place it on a rigid, flat, level, moist, nonabsorbent surface, free of vibration, and that is large enough to contain all of the slumped concrete. It shall be held firmly in place during filling and perimeter cleaning by the operator standing on the two foot pieces or by a clamping arrangement to a base plate as described in 5.1. From the sample of concrete obtained in accordance with Section 6, immediately fill the mold in three layers, each approximately one third the volume of the mold (See Note 5). Place the concrete in the mold using the scoop described in 5.4. Move the scoop around the perimeter of the mold opening to ensure an even distribution of the concrete with minimal segregation.

NOTE 5—One third of the volume of the slump mold fills it to a depth of 2⅝ in. [70 mm]; two thirds of the volume fills it to a depth of 6⅛ in. [160 mm].

7.2 Rod each layer 25 times uniformly over the cross section with the rounded end of the rod. For the bottom layer, this will necessitate inclining the rod slightly and making approximately half of the strokes near the perimeter, and then progressing with vertical strokes spirally toward the center. Rod the bottom layer throughout its depth. For each upper layer, allow the rod to penetrate through the layer being rodded and into the layer below approximately 1 in. [25 mm].

7.3 In filling and rodding the top layer, heap the concrete above the mold before rodding is started. If the rodding operation results in subsidence of the concrete below the top edge of the mold, add additional concrete to keep an excess of concrete above the top of the mold at all times. After the top layer has been rodded, strike off the surface of the concrete by means of a screeding and rolling motion of the tamping rod. Continue to hold the mold down firmly and remove concrete from the area surrounding the base of the mold to preclude interference with the movement of slumping concrete. Remove the mold immediately from the concrete by raising it carefully in a vertical direction. Raise the mold a distance of 12 in. [300 mm] in 5 ± 2 s by a steady upward lift with no lateral or torsional motion. Complete the entire test from the start of the filling through removal of the mold without interruption and complete it within an elapsed time of 2½ min.

7.4 Immediately measure the slump by determining the vertical difference between the top of the mold and the displaced original center of the top surface of the specimen. If a decided falling away or shearing off of concrete from one side or portion of the mass occurs (Note 6), disregard the test and make a new test on another portion of the sample.

NOTE 6—If two consecutive tests on a sample of concrete show a falling away or shearing off of a portion of the concrete from the mass of the specimen, the concrete probably lacks necessary plasticity and cohesiveness for the slump test to be applicable.

8. Report

8.1 Report the slump in terms of inches [millimetres] to the nearest ¼ in. [5 mm] of subsidence of the specimen during the test.

9. Precision and Bias[4]

9.1 *Precision*—The estimates of precision for this test method are based upon results from tests conducted in Fayetteville, Arkansas by 15 technicians from 14 laboratories representing 3 states. All tests at 3 different slump ranges, from 1.0 in. [25 mm] to 6.5 in. [160 mm], were performed using one load of truck-mixed concrete. The concrete was delivered and tested at a low slump, with water then being added and mixed into the remaining concrete to independently produce moderate and finally high-slump concrete. The concrete mixture that used a No. 67 crushed limestone aggregate and a washed river sand, contained 500 lb of cementitious materials per cubic yard [297 kg of cementitious material per cubic metre]. The 500 lb [227 kg] were equally divided between a C150, Type I/II cement and a Class C fly ash. A double dosage of a chemical retarder was used in an attempt to minimize slump losses and maintain workability of the concrete. Concrete temperatures ranged from 86 to 93 °F [30 to 34 °C]. Slump losses averaged 0.68 in. [17 mm] during the 20 min required to perform a series of 6 tests at 1 slump range. Testing was performed alternately using metal and plastic molds, which were determined to produce comparable results. Precision data thus applies to both metal and plastic molds. A total of 270 slump tests were performed.

9.1.1 *Inch-Pound [SI]*—The data used to develop the precision statement were obtained using metric units (millimetres). The precision values shown in inch-pound units are conversions from the millimetre measurements, which were recorded to the nearest 1 mm.

9.1.2 *Measure of Variability*—The standard deviation was determined to be the most consistent measure of variability and was found to vary with the slump value.

9.1.3 *Single-Operator Precision*—The single-operator standard deviation represented by (1s) is shown in Table 1 by average slump values. The reported results for the replicate readings apply to tests conducted by the same operator performing successive tests, one immediately following the other. Acceptable results of two properly conducted tests by the same operator on the same material (Note 7) will not differ from each other by more than the (d2s) value of the last column of Table 1 for the appropriate slump value and single-operator precision.

9.1.4 *Multilaboratory Precision*—The multilaboratory standard deviation represented by (1s) is shown in Table 1 by average slump values. The reported results for the replicate readings apply to tests conducted by different operators from different laboratories performing tests less than 4 min apart. Therefore, acceptable results of two properly conducted slump tests on the same material (Note 7) by two different laboratories will not differ from each other by more than the (d2s) value of the last column of Table 1 for the appropriate slump value and multilaboratory precision.

NOTE 7—"Same materials," is used to mean freshly mixed concrete from one batch.

TABLE 1 Precision

Slump and Type Index	Standard Deviation (1s)[A]		Acceptable Range of Two Results (d2s)[A]	
Single-Operator Precision:	in.	[mm]	in.	[mm]
Slump 1.2 in. [30 mm]	0.23	[6]	0.65	[17]
Slump 3.4 in. [85 mm]	0.38	[9]	1.07	[25]
Slump 6.5 in. [160 mm]	0.40	[10]	1.13	[28]
Multilaboratory Precision:				
Slump 1.2 in. [30 mm]	0.29	[7]	0.82	[20]
Slump 3.4 in. [85 mm]	0.39	[10]	1.10	[28]
Slump 6.5 in. [160 mm]	0.53	[13]	1.50	[37]

[A] These numbers represent, respectively, the (1s) and (d2s) limits as described in Practice C670.

[4] The test data used to develop this precision statement were based on tests performed in September 1997. Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C09-1022.

9.2 *Bias*—This test method has no bias since slump is defined only in terms of this test method.

10. Keywords

10.1 concrete; concrete slump; cone; consistency; plasticity; slump; workability

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this test method since the last issue, C143/C143M–10a that may impact the use of this test method. (Approved November 1, 2012)

(*1*) Revised 5.1 to remove the comparative testing requirements for plastic molds.

(*2*) Deleted old 5.1.2, 5.1.2.1, Note 3, and Note 4.

(*3*) Added new Note 3.

Standard Method of Test for

Slump of Hydraulic Cement Concrete

AASHTO Designation: T 119M/T 119-18

Technical Subcommittee: 3b, Fresh Concrete

Release: Group 1 (April)

ASTM Designation: C143/C143M-15a

AASHTO

American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004

Standard Method of Test for

Slump of Hydraulic Cement Concrete

AASHTO Designation: T 119M/T 119-18

Technical Subcommittee: 3b, Fresh Concrete

Release: Group 1 (April)

ASTM Designation: C143/C143M-15a

1. SCOPE

1.1. This test method covers determination of slump of concrete, both in the laboratory and in the field.

1.2. The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the inch-pound units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.3. The text of the standard reference notes and footnotes provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.4. *This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

Warning—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- R 60, Sampling Freshly Mixed Concrete
- T 23, Making and Curing Concrete Test Specimens in the Field
- T 121M/T 121, Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- T 152, Air Content of Freshly Mixed Concrete by the Pressure Method
- T 196M/T 196, Air Content of Freshly Mixed Concrete by the Volumetric Method

2.2. *ASTM Standards*:

- C150/C150M, Standard Specification for Portland Cement
- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

3. SUMMARY OF TEST METHOD

3.1. A sample of freshly mixed concrete is placed and compacted by rodding in a mold shaped as the frustum of a cone. The mold is raised and the concrete allowed to subside. The vertical distance between the original and the displaced position of the center of the top surface of the concrete is measured and reported as the slump of the concrete.

4. SIGNIFICANCE AND USE

4.1. This test method is intended to provide the user with a procedure to determine the slump of plastic hydraulic cement concretes.

Note 1—This test method was originally developed to provide a technique to monitor the consistency of unhardened concrete. Under laboratory conditions, with strict control of all concrete materials, the slump is generally found to increase proportionally with the water content of a given concrete mixture and thus to be inversely related to concrete strength. Under field conditions, however, such a strength relationship is not clearly and consistently shown. Care should therefore be taken in relating slump results obtained under field conditions to strength.

4.2. This test method is considered applicable to plastic concrete having coarse aggregate passing the 37.5-mm [1.5-in.] sieve. If the plastic concrete includes coarse aggregate particles sized larger than 37.5 mm [1.5 in.], the larger aggregate particles are to be removed according to Section 6 of R 60 before testing.

4.3. This test method is not considered applicable to nonplastic and noncohesive concrete.

Note 2—Concretes having slumps less than 15 mm [0.5 in.] may not be adequately plastic and concretes having slumps greater than about 230 mm [9 in.] may not be adequately cohesive for this test to have significance. Caution should be exercised in interpreting such results.

5. APPARATUS

5.1. *Mold*—The test specimen shall be formed in a mold made of metal not readily attacked by the cement paste. The metal shall not be thinner than 1.5 mm [0.060 in.] and, if formed by the spinning process, there shall be no point on the mold at which the thickness is less than 1.15 mm [0.045 in.]. The mold shall be in the form of the lateral surface of the frustum of a cone with the base 203 mm [8 in.] in diameter, the top 102 mm [4 in.] in diameter, and the height 305 mm [12 in.]. Individual diameters and heights shall be within ±3.2 mm [0.125 in.] of the prescribed dimensions. The base and the top shall be open and parallel to each other and at right angles to the axis of the cone. The mold shall be provided with foot pieces and handles similar to those shown in Figure 1. The mold shall be constructed without a seam. The interior of the mold shall be relatively smooth and free from projections. A mold that clamps to a nonabsorbent base plate is acceptable instead of the one illustrated, provided the clamping arrangement is such that it can be fully released without movement of the mold and the base is large enough to contain all of the slumped concrete in an acceptable test.

5.1.1. Check and record conformance to the mold's specified dimensions when it is purchased or first placed in service and at least annually thereafter.

5.1.2. *Mold with Alternative Materials*:

5.1.2.1. Molds other than metal are permitted if the following requirements are met: The mold shall meet the shape, height, and internal dimensional requirements of Section 5.1. The mold shall be sufficiently rigid to maintain the specified dimensions and tolerances during use, resistant to impact forces, and shall be nonabsorbent. The mold shall be demonstrated to provide test results

comparable to those obtained when using a metal mold meeting the requirements of Section 5.1. Comparability shall be demonstrated on behalf of the manufacturer by an independent testing laboratory. Test for comparability shall consist of not less than 10 consecutive pairs of comparisons performed at each of three different slumps ranging from 50 to 200 mm [2 to 8 in.]. No individual test results shall vary by more than 15 mm [0.50 in.] from that obtained using the metal mold. The average test results of each slump range obtained using the mold constructed of alternative material shall not vary by more than 6 mm [0.25 in.] from the average of test results obtained using the metal mold. Manufacturer comparability test data shall be available to users and laboratory inspection authorities (see Note 4). If any changes in material or method of manufacture are made, tests for comparability shall be repeated.

Note 3—The phrase "consecutive pairs of comparisons" does not mean without interruption or all in 1 day. At a schedule selected by the testing entity, the pairs of tests leading to 10 consecutive pairs may be accomplished in small groups. The word consecutive prevents ignoring pairs of tests that may not meet criteria.

Note 4—Because the slump of concrete decreases with time and higher temperatures, it will be advantageous for the comparability tests to be performed by alternating the use of metal cones and alternative material cones, to utilize several technicians, and to minimize the time between test procedures.

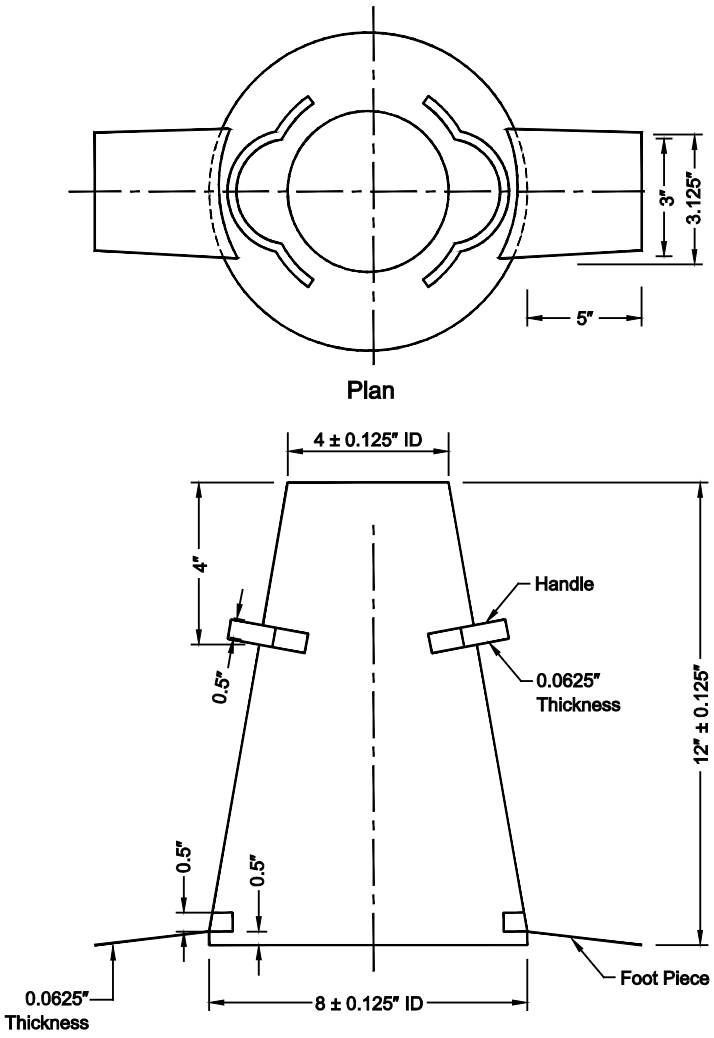
5.1.2.2. If the condition of any individual mold is suspected of being out of tolerance from the as manufactured condition, a single comparative test shall be performed. If the test results differ by more than 15 mm [0.50 in.] from that obtained using the metal mold, the mold shall be removed from service.

5.2. *Tamping Rod*—A round, straight, steel rod, with a 16 ± 2-mm [$\frac{5}{8}$ ± $\frac{1}{16}$-in.] diameter. The length of the tamping rod shall be at least 100 mm [4 in.] greater than the depth of the measure in which rodding is being performed but not greater than 600 mm [24 in.] in overall length (see Note 5). The length tolerance for the tamping rod shall be ±4 mm [±$\frac{1}{8}$ in.]. The rod shall have the tamping end or both ends rounded to a hemispherical tip of the same diameter as the rod.

Note 5—A rod length of 400 mm [16 in.] to 600 mm [24 in.] meets the requirements of the following AASHTO Test Methods: T 23, T 119M/T 119, T 121M/T 121, T 152, and T 196M/T 196.

5.3. *Measuring Device*—A ruler, metal roll-up measuring tape, or similar rigid or semirigid length measuring instrument marked in increments of 5 mm [0.25 in.] or smaller. The instrument length shall be at least 300 mm [12 in.].

5.4. *Scoop*—A scoop of a size large enough so each amount of concrete obtained from the sampling receptacle is representative and small enough so it is not spilled during placement in the mold.



Dimensional Units

mm	2	3	15	25	75	80	100	200	300
in.	[0.0625]	[0.125]	[0.5]	[1]	[3]	[3.128]	[4]	[8]	[12]

Figure 1—Mold for Slump Test

6. SAMPLE

6.1. Obtain a representative sample of cement concrete according to R 60. If the plastic concrete includes coarse aggregate particle sized larger than 37.5 mm [1.5 in.], remove the larger sized aggregate particles according to Section 6 of R 60.

Note 6—Slump testing shall begin within 5 min of obtaining the sample.

7. PROCEDURE

7.1. Dampen the inside of the mold and place it on a dampened, rigid, nonabsorbent surface that is level and firm.

7.2. Hold the mold firmly in place during filling and perimeter cleaning by standing on the two foot pieces or by clamping the foot pieces to a base plate.

7.3. Use the scoop to fill the mold one-third full by volume, to a depth of approximately 70 mm [2.75 in.].

7.4. Consolidate the layer with 25 strokes of the tamping rod, using the rounded end. Distribute the strokes evenly over the entire cross section of the concrete. For the bottom layer, incline the rod slightly and make approximately half the strokes near the perimeter, then progress with vertical strokes, spiraling toward the center.

7.5. Use the scoop to fill the mold two-thirds full by volume, to a depth of approximately 160 mm [6.5 in.]. Consolidate this layer with 25 strokes of the tamping rod; penetrate approximately 25 mm [1.0 in.] into the bottom layer. Distribute the strokes evenly.

7.6. Use the scoop to fill the mold to overflowing. Consolidate this layer with 25 strokes of the tamping rod; penetrate approximately 25 mm [1.0 in.] into the second layer. Distribute the strokes evenly. If the concrete falls below the top of the mold, stop, add more concrete, and continue rodding for a total of 25 strokes. Keep an excess of concrete above the top of the mold at all times. Distribute strokes evenly as before.

7.7. Strike off the top surface of concrete with a screeding and rolling motion of the tamping rod.

7.8. Clean overflow concrete away from the base of the mold.

7.9. Carefully raise the mold vertically 300 mm [12 in.] in 5 ± 2 s by a steady upward lift with no lateral or torsional (twisting) motion imparted to the concrete.

7.10. Complete the entire operation, from the start of the filling through removal of the mold, within $2^{1}/_{2}$ min.

7.11. Immediately measure the slump.

7.11.1. Invert the slump mold and set it next to the specimen.

7.11.2. Lay the tamping rod across the mold so that it is over the test specimen.

7.11.3. Measure the distance between the bottom of the rod and the displaced original center of the top of the specimen to the nearest 5 mm [0.25 in.].

7.12. Do not reuse the tested specimen.

Note 7—It is recommended not to reuse the tested concrete slump specimen for project-related materials. However, for lab testing, the specimen may be reused if thoroughly remixed with remaining representative sample.

Note 8—If a decided falling away or shearing off of concrete from one side or a portion of the mass occurs, disregard the test and make a new test on another portion of the sample. If two consecutive tests on a sample of concrete show a falling away or shearing off of a portion of the concrete from the mass of the specimen, the concrete probably lacks the plasticity and cohesiveness necessary for the slump test to be applicable.

8. REPORT

8.1. Record the slump to the nearest 5 mm [0.25 in.].

9. PRECISION AND BIAS

9.1. *Precision*—The estimates of precision for this test method are based on results from tests conducted in Fayetteville, Arkansas, by 15 technicians from 14 laboratories representing three states. All tests at three different slump ranges, from 25 mm [1.0 in.] to 160 mm [6.5 in.], were performed using one load of truck-mixed concrete. The concrete was delivered and tested at a low slump, with water then being added and mixed into the remaining concrete to independently produce moderate and finally high-slump concrete. The concrete mixture that used a No. 67 crushed limestone aggregate and a washed river sand contained 297 kg of cementitious material per cubic meter [500 lb of cementitious materials per cubic yard]. The 297 kg of cementitious material [500 lb] were equally divided between an ASTM C150/C150M, Type I/II cement and a Class C fly ash. A double dosage of a chemical retarder was used in an attempt to minimize slump losses and maintain workability of the concrete. Concrete temperatures ranged from 30 to 34°C [86 to 93°F]. Slump losses averaged 17 mm [0.68 in.] during the 20 min required to perform a series of six tests at one slump range. Testing was performed alternately using metal and plastic molds, which were determined to produce comparable results. Precision data thus applies to both metal and plastic molds. A total of 270 slump tests were performed.

9.1.1. *SI [Inch-Pound]*—The data used to develop the precision statement were obtained using metric units (millimeters). The precision values shown in inch-pound units are conversions from the millimeter measurements, which were recorded to the nearest 1 mm.

9.1.2. *Measure of Variability*—The standard deviation was determined to be the most consistent measure of variability and was found to vary with the slump value.

9.1.3. *Single-Operator Precision*—The single-operator standard deviation represented by (1s) is shown in Table 1 by average slump values. The reported results for the replicate readings apply to tests conducted by the same operator performing successive tests, one immediately following the other. Acceptable results of two properly conducted tests by the same operator on the same material (Note 8) will not differ from each other by more than the (d2s) value of the last column of Table 1 for the appropriate slump value and single-operator precision.

Table 1—Precision

	Standard Deviation (1s)[a]		Acceptable Range of Two Results (d2s)[a]	
Slump and Type Index	mm	[in.]	Mm	[in.]
Single-operator precision:				
Slump 30 mm [1.2 in.]	6	[0.23]	17	[0.65]
Slump 85 mm [3.4 in.]	9	[0.38]	25	[1.07]
Slump 160 mm [6.5 in.]	10	[0.39]	28	[1.10]
Multilaboratory precision:				
Slump 30 mm [1.2 in.]	7	[0.29]	20	[0.82]
Slump 85 mm [3.4 in.]	10	[0.39]	28	[1.10]
Slump 160 mm [6.5 in.]	13	[0.53]	37	[1.50]

[a] These numbers represent, respectively, the (1s) and (d2s) limits as described in ASTM C670.

9.1.4. *Multilaboratory Precision*—The multilaboratory standard deviation represented by (1s) is shown in Table 1 by average slump values. The reported results for the replicate readings apply to tests conducted by different operators from different laboratories performing tests less than 4 min apart. Therefore, acceptable results of two properly conducted slump tests on the same material (Note 8) by two different laboratories will not differ from each other by more than the (d2s) value of the last column of Table 1 for the appropriate slump value and multilaboratory precision.

Note 9—"Same materials" is used to mean freshly mixed concrete from one batch.

9.2. *Bias*—This test method has no bias because slump is defined in terms of this test method.

10. KEYWORDS

10.1. Concrete; cone; consistency; plasticity; slump; workability.

H. H. HOLMES TESTING LABORATORIES, INC.

170 Shepard Avenue • Wheeling, Illinois 60090 • 847-541-4040 Fax: 847-537-9098

November 3, 1997

Thor L. Moody
Deslauriers, Inc.
P.O. Box 189
Bellwood, IL 60104

Subject: Comparative Tests - Plastic Slump Cone v.s. Spun Metal Slump Cone

Dear Mr. Moody:

In accordance with your request we have performed a series of comparative tests utilizing a new plastic slum cone and a new spun metal slump cone, both provided by Deslauriers, Inc. The equipment used in the test and the methods employed were in accordance with ASTM Standard C143 (97). A total of ten (10 comparisons were made for each of three (3) different ranges of slump, resulting in a total of thirty (30 individual comparisons. At all of the slump ranges tested, the plastic slump cone was determined to meet th comparative criterion spelled out by the standard. The following summarizes the data:

	2" to 4"		4" to 6		6" to 8"	
	Plastic	Metal	Plastic	Metal	Plastic	Metal
1.	2.25	2.25	5.00	4.75	6.50	6.50
2.	2.00	2.25	4.25	4.00	6.25	6.25
3.	3.25	3.25	5.25	5.25	7.50	7.75
4.	2.75	2.50	4.00	4.00	7.25	7.25
5.	2.50	2.50	5.75	5.75	7.75	7.50
6.	2.00	2.00	4.25	4.50	6.25	6.25
7.	2.50	2.50	5.00	5.00	7.50	7.25
8.	2.75	3.00	5.75	5.75	7.00	7.00
9.	3.25	3.25	4.25	4.25	6.75	6.75
10.	3.75	3.75	5.25	5.25	6.75	7.00
Ave:	2.70	2.73	4.87	4.85	6.95	6.95
Ave. Diff:	**0.03**		**0.02**		**0.00**	
>Single Diff:	**0.25**		**0.25**		**0.25**	

Based upon the requirements contained in C143 for alternative materials, and the test data as presented above, the Deslauriers Plastic Slump Cone is found to be in compliance with the requirements of the standard.

Respectfully Submitted,
H. H. Holmes Testing

Ken Clibourn
Vice President
wpwin/testing/holmes

Centre for Construction Development & Research
National Council for Cement and Building Materials
(Under the Administrative Control of Ministry of Commerce & Industry, Government of India)
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स्पीड पोस्ट / ई-मेल

Ref: सीडीआर/एसटी-205
12 जून 2019

श्री तरन सेठी
बिक्री और विपणन प्रमुख
मोल्ड मार्ट इंडिया
4/20 कीर्ति नगर औद्योगिक क्षेत्र
नई दिल्ली - 110045

Through: Head of Centre, CDR

Sub: **"Evaluation of Slump Cone as per procedure of IS 1199 (Part 2): 2018."**
Your Ref.: **MMI/18-19/BIS/2990 dated 21.01.2019**

श्रीमान,

उपरोक्त विषय के संदर्भ में हम यहां एबीएस (एक्रिलोनिट्राइल ब्यूटाडीन स्टाइरिन) सलम्प कोन के मूल्यांकन की अंतिम रिपोर्ट आईएस 1199 (पार्ट 4): 2018 की प्रकिया के अनुसार संलग्न कर रहे हैं। कृप्या प्रति प्राप्ति के बाद सूचित करें।

धन्यवाद!

भवदीय
राष्ट्रीय सीमेन्ट एवं भवन सामग्री परिषद्

पी एन ओझा 12/6/19
महाप्रबंधक
निर्माण विकास एंव अनुसंधान केन्द्र

12/6/19

EVALUATION OF SLUMP CONE AS PER PROCEDURE OF IS:1199 (PART 2) 2018

FOR

MOULD MART INDIA
4/20 KIRTI NAGAR INDUSTRIAL AREA
NEW DELHI 110015

CDR/ST 205
JUNE 2019
FINAL REPORT

Centre for Construction Development and Research
NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
34 Km Stone, Delhi-Mathura Road, NH-2, Ballabgarh – 121 004, Haryana

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Prepared By **M K Mandre (Team Member)**	(Signature) 12.6.19
Checked By **P N Ojha (General Manager-CDR)**	(Signature) 12/6/19
Approved By **P N Ojha (General Manager-CDR)**	(Signature) 12/6/19

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1.0 Background

The sponsor Taran Sethi, Sales & Marketing Head, Mould Mart India, 4/20 Kirti Nagar Industrial Area New Delhi requested National Council for Cement and Building Materials (NCB) Ballabhgarh to take up the evaluation of ABS (Acrylonitrile Butadiene Styrene) Slump cone as per procedure of IS 1199 (Part 2):2018. NCB took this R&D project as per scope of work is given in para 2.0.

2.0 Scope of Work

Performance of ABS (Acrylonitrile Butadiene Styrene) slump cone apparatus will be compared with respect to metal slump cone apparatus. 30 set of slump measurement data will be taken on various grade of concrete in fresh state, in various slump ranges over a period of 60 days. Dimensions of ABS slump cone apparatus will be measured at every 10 nos. of measurement.

3.0 Material Received

One set of ABS (Acrylonitrile Butadiene Styrene) slump cone apparatus was received at NCB Ballabhgarh on 17-01-2019 for evaluation.

4.0 Test standard and methodology

4.1 Slump cone test as per IS 1199 (Part 2): 2018

This test measures the fresh concrete consistency by compacting fresh concrete into a frustum of cone, having top diameter 100±2 mm, bottom diameter 200 ±2mm and height 300 ±2mm. the test procedure is as given below.

1) Sampling of fresh concrete is carried out as per IS:1199 Part 1.
2) Slump cone is dampened by wet cloth and excess water was wiped out.
3) Slump cone is placed on level surface and appox.1/3 height was filled with fresh concrete sample. The fresh concrete is compacted by 16 mm plain rod with 25 strokes.
4) Similarly, two more layers is compacted and finished the top surface through trowel.
5) The slump cone is raised up and slump of fresh concrete is measured.

4.2 Methodology of comparison (Metal slump cone & ABS slump cone) and test results

Performance of ABS (Acrylonitrile Butadiene Styrene) slump cone was compared with respect to metal slump cone. 30 set of slump measurement data was taken on various grade of concrete in fresh state, in various slump ranges over a period of 60 days. Measurements taken by metal slump cone and ABS (Acrylonitrile Butadiene Styrene) slump cone are given in table 1. The deviation of slump cone test value w.r.t. metal slump cone is given in column 5 of table 1.

Table 1: Measurement data of metal slump cone and ABS slump cone

S. No.	Grade of concrete /W/c ratio	Slump test value of fresh concrete		Deviation from Metal slump cone (in mm)
		By Metal slump cone	By ABS slump cone	
1	2	3	4	5
Set 1				
1	M30/0.45	180	190	190-180 = +10
2	M25/0.50	170	160	-10
3	M30/0.40	200	190	-10
4	M25/0.50	60	65	+5
5	M35/0.38	130	135	+5
6	M30/0.45	20	20	0
7	M30/0.45	40	35	-5
8	M30/0.45	140	145	+5
9	M30/0.47	190	175	-15
10	M25/0.45	150	140	-10
Set 2				
11	M25/0.45	95	80	-15
12	M25/0.45	130	125	-5
13	M35/0.40	100	110	+10
14	M35/0.42	170	190	+20
15	M25/0.50	65	60	-5
16	M30/0.45	90	85	-5
17	M25/0.50	120	110	-10
18	M25/0.48	110	115	+5
19	M25/0.45	30	25	-5
20	M25/0.45	100	105	+5
Set 3				
21	M35/0.40	50	40	-10
22	M35/0.40	100	95	-5
23	M35/0.42	170	160	-10
24	M25/0.50	60	50	-10
25	M25/0.48	100	105	+5
26	M25/0.50	130	135	+5
27	M25/0.45	50	50	0
28	M25/0.45	10	135	-5
29	M25/0.39	120	125	+5
30	M25/0.41	135	140	+5

Dimensions of ABS slump cone was measured at every 10 nos. of measurements. The dimension measurement of metal slump cone and ABS slump cone is represented in Table 2.

Table 2: Dimension measurement of metal slump cone and ABS slump cone

S. No.	Dimension Interval	Metal slump cone			ABS slump cone		
		Top dia.	Bottom dia.	Height of cone	Top dia.	Bottom dia.	Height of cone
1	Initial dimensions	101.8	199.3	301.7	100.1	200.2	300.1
2	After 10 measurements	102.0	200.1	301.3	101.1	200.3	300.1
3	After 20 measurements	101.7	200.0	301.3	101.2	200.1	299.9
4	After 30 measurements	100.9	200.1	300.3	101.0	200.0	300.1

All dimensions are in mm.
Thickness of ABS slump cone material – 3.0 mm.

5.0 Discussion on results

From the data analysis of table 1 Col.5, it is observed that the deviation in slump value is positive and negative with respect to metal slump cone. Its indicate the randomness of test and material of cone is not affecting the slump value.

The dimensions of cone are within the permissible limits of IS 1199 (Part 2): 2018.

6.0 Conclusion

This may be concluded from the data generated from Table 1 and Table 2, that the supplied ABS slump cone apparatus can be used to measure the slump value of fresh concrete.

Yours faithfully
National Council for Cement and Building Materials

12/6/19

P N Ojha
General Manager-CDR

12/6/19

----End of report----

Draft Indian Standard

SPECIFICATION FOR CONCRETE SLUMP TEST APPARATUS PART II ABS SLUMP CONES

1 SCOPE

This standard covers the requirements of the apparatus used for determining the slump of fresh concrete as a measure of its consistency. This part of the standard specifically covers the requirements of ABS (acrylonitrile -butadiene-styrene copolymer) slump cones.

2 REFERENCE

The standard listed below contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication, the edition indicated is valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS	*Title*
7320 (Part 1)	Specification For Concrete Slump Test Apparatus Part I Metal Slump Cones (*to be prepared*)

3 APPARATUS

3.1 The apparatus shall consist of a mould for the test specimen. The tamping rod for tamping the specimen may be as per IS 7320 Part 1.

4 MOULD

4.1 Shape and Dimensions – The mould for the test specimen shall be in the form of the frustum of a cone as shown in Fig. 1 and internal dimensions as given in Table 1. The material shall be at least 3 mm thick. An additional reinforcement shall be provided on the top part of the cone in such a manner that dimensional stability or deformation shall be minimized.

Table 1 Internal Dimensions of Mould
(*Clause* 4.1)

Sl No.	**Details**	**Dimension** (mm)	**Tolerance** (mm)
(1)	**(2)**	**(3)**	**(5)**

i)	Bottom diameter	200	+1.5 -1.0
ii)	Top diameter	100	+1.5 -1.0
iii)	Height	300	±1.0

4.2 The conformance to the cone's specified dimensions shall be checked and recorded when it is purchased or first placed in service and at least annually thereafter.

4.2.1 If the condition of any individual cone is suspected of being out of tolerance from the as manufactured condition, a single comparative test shall be performed. If test results differ by more than 15mm from that obtained by using the metal cone, the cone may be removed from service.

4.2.2 Where no tolerance has been specified for a particular dimension, it will mean that reference is being made to the nominal dimension.

4.3 Material – The mould shall be made rigid ABS plastic granule with injection moulded process for better finish /tolerance. HI121 ABS with the properties as given in Table 2 shall be used.

Table 2 Properties of ABS

(*Clause* 4.3)

Sl No.	**Property**	**Requirement**
(1)	**(2)**	**(3)**
i)	Tensile modulus of elasticity at 23°C, in MPA	2206
ii)	Tensile Strength, in MPa	39
iii)	Percent elongation at break at 23°C	40

4.4 Construction – The mould may be constructed without a seam.

4.4.1 The top and bottom of the mould shall be open and parallel to each other and at right angles to the axis of the cone. The internal surface of the mould shall be smooth and shall be free from dents and projections, such as protruding rivets.

4.4.2 The mould shall be provided with foot pieces and handles to facilitate lifting it from the moulded concrete test specimen. The shape and dimensions of the foot pieces and handles of ASB plastic injection moulded cone may be as shown in Fig. 1 The foot pieces may be moulded to base of cone in one piece. There shall be a reinforced collar aligned in such a manner which gives added strength to the mould. Lifting handles may also be moulded together. The complete cone shall avoid brazing, welding or riveting.

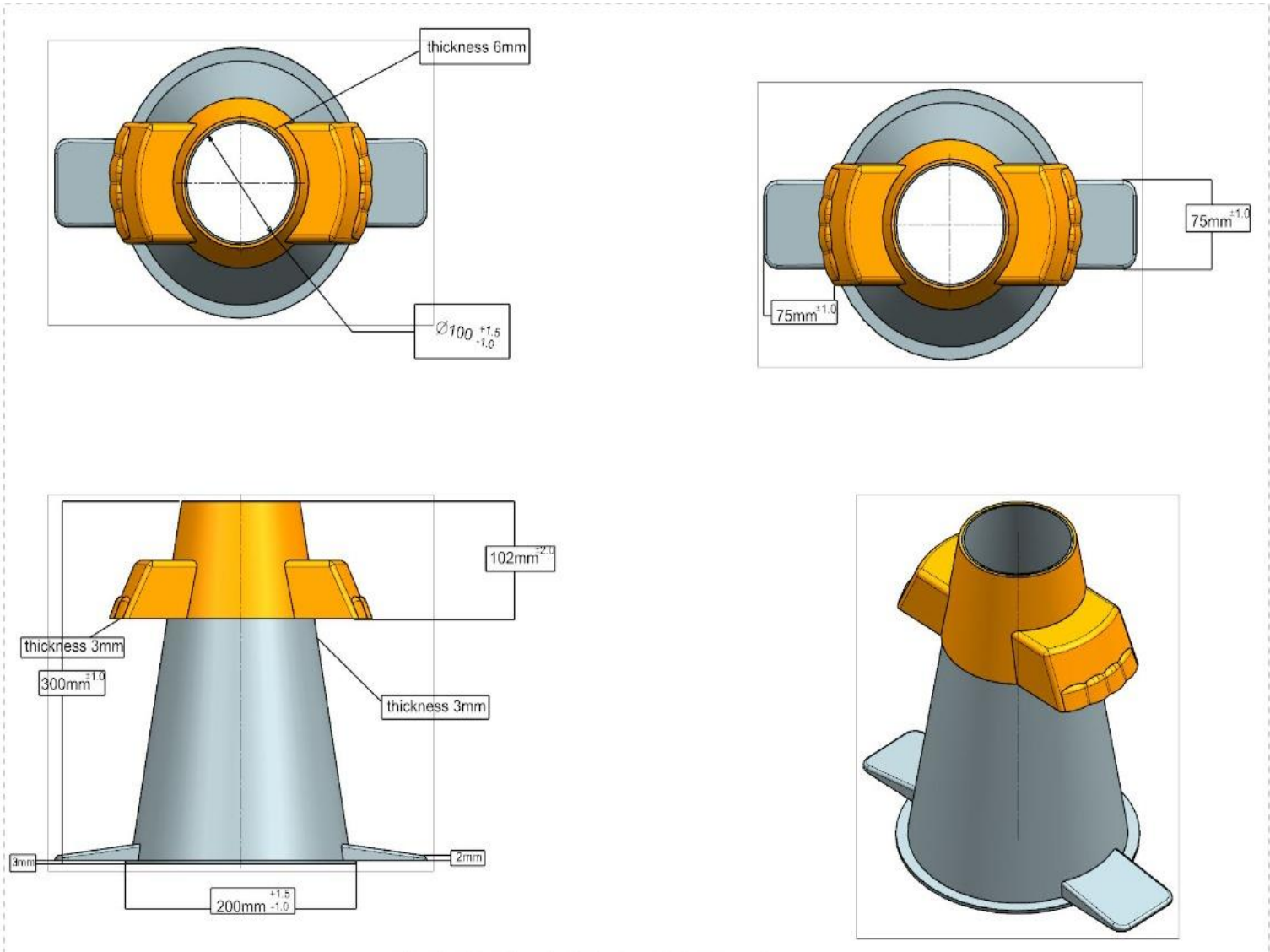

Fig 1 ABS seamless mould

4.5 STORAGE

While not in use, the cone shall be cleaned with a soft cloth and stored vertically and protected from sunlight.

5 MARKING

5.1 The following information shall be clearly and indelibly marked on the mould and the rod in a way that it does not interfere with the performance of this apparatus:

a) Name of manufacturer or his registered trade-mark or both, and
b) Date of manufacture.

5.2 BIS Certification Marking

Each block may also be marked with the Standard Mark.

5.2.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 2016 and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.