भारतीय मानक ब्यूरो
(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)
BUREAU OF INDIAN STANDARDS
(Ministry of Consumer Affairs, Food & Public Distribution, Govt. of India)

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व्यापक परिचालन मसौदा

हमारा संदर्भ : सीईडी 02:2/टी-52 **01 अगस्त 2025**
तकनीकी समिति : सीमेंट और कंक्रीट अनुभागीय समिति , सीईडी 02

प्राप्तकर्ता :
1. **सिविल अभियांत्रिकी विभाग परिषद, सीईडीसी के सभी सदस्य**
2. **सीमेंट और कंक्रीट अनुभागीय समिति , सीईडी 02**
3. **सीईडी 02 की उपसमितियों और अन्य कार्यदल के सभी सदस्य**
4. **रुचि रखने वाले अन्य निकाय।**

महोदय/महोदया,

निम्नलिखित मानक का मसौदा संलग्न है:

प्रलेख संख्या	शीर्षक
सीईडी 2 (28017)WC	**कंक्रीट के लिए मिलावा के लिए परीक्षण की पद्धति** **भाग 2 यांत्रिक गुणों का निर्धारण का भारतीय मानक मसौदा** *(आईएस 2386 का पहला पुनरीक्षण)* *(ICS 91.100.30)*

कृपया इस मसौदे का अवलोकन करें और अपनी सम्मतियाँ यह बताते हुए भेजे कि यह मसौदा प्रकाशित हो तो इन पर अमल करने में आपको व्यवसाय अथवा कारोबार में क्या कठिनाइयां आ सकती हैं।

सम्मतियाँ भेजने की अंतिम तिथि: 30 सितम्बर 2025

सम्मति यदि कोई हो तो कृपया अधोहस्ताक्षरी को ई-मेल द्वारा **ced2@bis.gov.in** पर या उपरलिखित पते पर, संलग्न फोर्मेट में भेजें। सम्मतियाँ बीआईएस ई-गवर्नेंस पोर्टल, **www.manakonline.in** के माध्यम से ऑनलाइन भी भेजी जा सकती हैं।

यदि कोई सम्मति प्राप्त नहीं होती है अथवा सम्मति में केवल भाषा संबंधी त्रुटि हुई तो उपरोक्त प्रालेख को यथावत अंतिम रूप दे दिया जाएगा। यदि सम्मति तकनीकी प्रकृति की हुई तो विषय समिति के अध्यक्ष के परामर्श से अथवा उनकी इच्छा पर आगे की कार्यवाही के लिए विषय समिति को भेजे जाने के बाद प्रालेख को अंतिम रूप दे दिया जाएगा।

यह प्रालेख भारतीय मानक ब्यूरो की वेबसाइट **www.bis.gov.in** पर भी उपलब्ध हैं।

धन्यवाद।

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वैज्ञानिक ई एवं प्रमुख
सिविल अभियांत्रिकी विभाग

संलग्न: उपरलिखित

भारतीय मानक ब्यूरो
(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)
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WIDE CIRCULATION DRAFT

Our Reference: CED 02:2/T-52 **01 August 2025**

TECHNICAL COMMITTEE:CEMENT AND CONCRETE SECTIONAL COMMITTEE, CED 02

ADDRESSED TO:

1. All Members of Civil Engineering Division Council, CEDC
2. All Members of Cement and Concrete Sectional Committee, CED 02 and its Subcommittees
3. All Members of Subcommittees, Panels and Working Groups under CED 02
4. All others interested.

Dear Sir/Madam,

Please find enclosed the following draft:

Doc No.	Title
CED 2 (28017)WC	**Draft Indian Standard Methods of Test for Aggregates for Concrete Part 2 Determination of Mechanical Properties** (*first revision* of IS 2386) (*ICS 91.100.30*)

Kindly examine the attached draft and forward your views stating any difficulties which you are likely to experience in your business or profession, if this is finally adopted as National Standard.

Last Date for comments: 30 September 2025

Comments if any, may please be made in the enclosed format and emailed at ced2@bis.gov.in or sent at the above address. Additionally, comments may be sent online through the BIS e-governance portal, www.manakonline.in.

In case no comments are received or comments received are of editorial nature, kindly permit us to presume your approval for the above document as finalized. However, in case comments, technical in nature are received, then it may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

The document is also hosted on BIS website www.bis.gov.in.

Thanking you,

Yours faithfully,
Sd/-
Dwaipayan Bhadra
Scientist 'E' & Head
Civil Engineering Department

Encl: As above

FORMAT FOR SENDING COMMENTS ON THE DOCUMENT

[Please use A4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/ table/figure, etc, be stated on a fresh row. Information/comments should include reasons for comments, technical references and suggestions for modified wordings of the clause. Comments through e-mail to **ced2@bis.gov.in** shall be appreciated.]

Doc. No.: CED 02(28017)WC

BIS Letter Ref: CED 02:2/T-52

Title: Draft Indian Standard Methods of Test for Aggregates for Concrete: Part 2 Determination of Mechanical Properties (*first revision of IS 2386*) (*ICS 91.100.30*)

Last date of comments: 30 September 2025

Name of the Commentator/ Organization: _____

Sl No.	Clause/ Para/ Table/ Figure No. commented	Type of Comment (General/ Technical/ Editorial)	Comments/ Modified Wordings	Justification of Proposed Change

NOTE- Kindly insert more rows as necessary for each clause/table, etc

BUREAU OF INDIAN STANDARDS

DRAFT STANDARD FOR COMMENTS ONLY

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Draft Indian Standard

METHODS OF TEST FOR AGGREGATES FOR CONCRETE

Part 2 Determination of Mechanical Properties

(*first revision of IS 2386*)

Cement and Concrete	Last Date for Comments:
Sectional Committee, CED 02	**30 September 2025**

Cement and Concrete Sectional Committee, CED 02

FOREWORD

(Formal clauses will be added later.)

One of the major contributing factors to the quality of concrete is the quality of aggregates used therein. The test methods given in this standard are intended to assist in assessing the quality of aggregates. In a given situation, for a particular aggregate, it may not be necessary to assess all the qualities and therefore it is necessary to determine beforehand the purpose for which a concrete is being used and the qualities of the aggregate which require to be assessed. Accordingly, the relevant test methods may be chosen from amongst the various tests covered in this standard.

This standard was first published in 1963 as 'Indian Standard Methods of Test for Aggregates for Concrete' in eight parts as given below.

Part 1 Particle size and shape
Part 2 Estimation of deleterious materials and organic impurities
Part 3 Specific gravity, density, voids, absorption and bulking
Part 4 Mechanical properties
Part 5 Soundness
Part 6 Measuring mortar making properties of fine aggregate
Part 7 Alkali aggregate reactivity
Part 8 Petrographic examination

In this revision, the Committee decided to group the different test methods based upon properties of the aggregates under the following five parts for the convenience of the users. Also, the test methods given in this standard have been harmonized with the ongoing revision of IS 383.

Part 1 Determination of Physical Properties
Part 2 Determination of Mechanical Properties
Part 3 Determination of Durability Properties

Part 4 Determination of Chemical requirements and Hazardous Substances
Part 5 Petrographic examination of aggregates

The Sectional Committee responsible for the preparation of this standard has taken into consideration the views of the concrete specialists, testing authorities, consumers and technologists and has related the standard to the practices followed in this country. Further the need for international co-ordination among standards prevailing in different countries of the world has also been recognized.

In the formulation of this standard, assistance has been derived from the following publications:

EN 1097-1 2024 Tests for mechanical and physical properties of aggregates: Part 1 Determination of the resistance to wear (Micro-Deval).

EN 1097-8 2020 Tests for mechanical and physical properties of aggregates: Part 8 Determination of the polished stone value.

This standard contributes to the United Nations Sustainable Development Goal 9: ‘Industry, Innovation and Infrastructure' towards building resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

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: 2022 Rules for Rounding Off Numerical values (*second revision*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

BUREAU OF INDIAN STANDARDS

Draft Indian Standard

METHODS OF TEST FOR AGGREGATES FOR CONCRETE

Part 2 Determination of Mechanical Properties
(*first revision of IS 2386*)

Cement and Concrete	Last Date for Comments:
Sectional Committee, CED 02	**25 September 2025**

1 SCOPE

This standard (Part 2) covers the following tests for aggregates for concrete:

a) Determination of aggregate abrasion value
b) Determination of the Micro-Deval coefficient
c) Determination of aggregate crushing value
d) Determination of ten percent fines value
e) Determination of aggregate impact value
f) Determination of polished stone value
g) Determination of aggregate surface abrasion value
h) Determination of crushing strength

2 REFERENCES

The standards given below contain provisions, which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were 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 given below.

IS No./Doc. No.	*Title*
IS 9376: 1979	Specification for apparatus for measuring aggregate crushing value and ten percent fines value
CED 02 (27866)	Draft Indian Standard Aggregates — Specification: Part 1 Coarse and fine aggregates for concrete (*fourth revision*)
CED 02 (27867)	Draft Indian Standard Aggregates — Specification: Part 2 Fine aggregate for masonry and plaster (*fourth revision*)
CED 02 (28016)	Draft Indian Standard Methods of test for aggregates for concrete: Part 1 Determination of physical properties (*first revision*)

3 DETERMINATION OF AGGREGATE ABRASION VALUE

3.1 Test for Abrasion of Coarse Aggregates by the Use of Los Angeles Machine

3.1.1 *Objective*

This test covers method of determining the abrasion value of coarse aggregate by the use of Los Angeles machine.

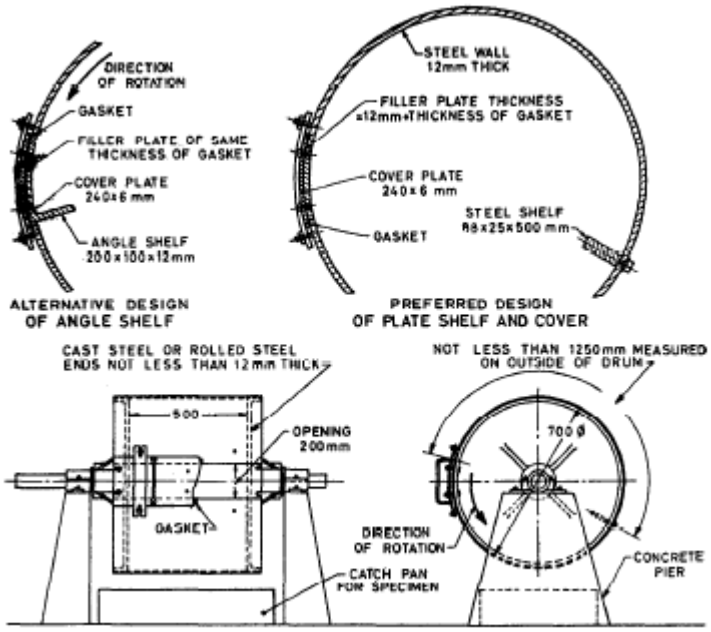
3.1.2 *Apparatus*

The apparatus shall consist of the following:

a) *Los Angeles machine* - The Los Angeles abrasion testing machine, conforming in all its essential characteristics to the design shown in Fig. 1, shall be used. The machine shall consist of a hollow steel cylinder, closed at both ends, having an inside diameter of 700 mm and an inside length of 500 mm. The cylinder shall be mounted on stub shafts attached to the ends of the cylinders but not entering it, and shall be mounted in such, a manner that it may be rotated about its axis in a horizontal position. An opening in the cylinder shall be provided for the introduction of the test sample. The opening shall be closed dust-tight with a removable cover bolted in place. The cover shall be so designed as to maintain the cylindrical contour of the interior surface unless the shelf is so located that the charge will not fall on the cover, or come in contact with it during the test. A removable steel shelf, projecting radially 88 mm into the cylinder and extending its full length, shall be mounted along one element of the interior surface of the cylinder. The shelf shall be of such thickness and so mounted, by bolts or other approved means, as to be firm and rigid. The position of the shelf shall be such that the distance from the shelf to the opening, measured along the circumference of the cylinder in the direction of rotation, shall be not less than 1 250 mm.

NOTES

1 The use of the shelf of wear-resistant steel, rectangular in cross-section and mounted independently of the cover, is preferred. However, a shelf consisting of a section of rolled angle, properly mounted on the inside of the cover plate, may be used, provided the direction of rotation is such that the charge will be caught. On the outside face of the angle.
2 Shaft bearing will be mounted on concrete piers or other rigid supports.
3 Suggested horse power for motor is not less than one.



All dimensions in millimetres.

FIG. 1 LOS ANGELES ABRASION TESTING MACHINE

b) *Sieves* — IS Sieve as per grade of sample and the IS test sieve of 1.70 mm.

3.1.3 *Abrasive Charge* — The abrasive charge shall consist of cast iron spheres or steel spheres approximately 48 mm in diameter and each weighing between 390 g and 445 g.

3.1.3.1 The abrasive charge, depending upon the grading of the test sample shall be as below:

Grading	*Number of Spheres*	*Weight of Charge (g)*
(1)	(2)	(3)
A	12	5 000 ± 25
B	11	4 584 ± 25
C	8	3 300 ± 20
D	6	2 500 ± 15
E	12	5 000 ± 25
F	12	5 000 ± 25
G	12	5 000 ± 25

3.1.3.2 *Test sample* — The test sample shall consist of clean aggregate which has been dried in an oven at 105°C to 110°C upto two successive weight after 1 hour of further drying do not differ by 0.01 percent of the earlier weight to substantially constant weight and shall conform to one of the gradings shown in Table 1. The grading or gradings used shall be those most nearly representing the aggregate furnished for the work.

Table 1 Grading of Test Samples
(*Clause* 3.1.3.2)

Sl. No.	Sieve Size		Weight of Test Sample (in gm) for Grade						
	Passing mm	Retained on mm	A	B	C	D	E	F	G
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	80	63	–	–	–	–	2 500	–	–
ii)	63	50	–	–	–	–	2 500	–	–
iii)	50	40	–	–	–	–	5 000	5 000	5 000
iv)	40	25	1 250	–	–	–	–	5 000	5 000
v)	25	20	1 250	–	–	–	–	–	–
vi)	20	12.5	1 250	2 500	–	–	–	–	–
vii)	12.5	10	1 250	2 500	–	–	–	–	–
viii)	10	6.3	–	–	2 500	–	–	–	–
ix)	6.3	4.75	–	–	2 500	–	–	–	–
x)	4.75	2.36	–	–		5 000	–	–	–
NOTE — Tolerance of ± 2 percent permitted.									

3.1.4 *Procedure*

3.1.4.1 The test sample and the abrasive charge shall be placed in the Los Angeles abrasion testing machine and the machine rotated at a speed of 30 rev/min to 33 rev/min. For gradings A, B, C and D, the machine shall be rotated for 500 revolutions; for gradings E, F and G, it shall be rotated for 1 000 revolutions. The machine shall be so driven and so counter-balanced as to maintain a substantially uniform peripheral speed. If an angle is used as the shelf, the machine shall be rotated in such a direction that the charge is caught on the outside surface of the angle. At the completion of the test, the material shall be discharged from the machine and a preliminary separation of the sample made on a sieve coarser than the 1.70 mm IS Sieve. The finer portion shall then be sieved on a 1.70 mm IS Sieve.

3.1.4.2 The material coarser than the 1.70 mm IS Sieve shall be washed dried in an oven at 105°C to 110°C upto two successive weight after 1 hour of further drying do not differ by more than 0.1 percent to a substantially constant weight, and accurately weighed to the nearest gram. The difference between the original weight and the final weight of the test sample shall be expressed as a percentage of the original weight of the test sample to nearest 0.1 units. The mean of two results shall be reported as the percentage of wear.

3.1.5 *Reporting of Results*

Express the mean value to the nearest whole number. The size fraction used should be given in the test report.

4 DETERMINATION OF THE MICRO-DEVAL COEFFICIENT

4.1 Objective

This section specifies a procedure for measuring the resistance to wear of a sample of aggregate. This procedure only applies to samples in wet condition. This section applies to natural or artificial aggregates used in construction.

4.2 Principle

The test determines the Micro-Deval coefficient which is the percentage of the original sample reduced to a size smaller than 1.70 mm during rolling. The test consists of measuring the wear produced by friction between the aggregates and an abrasive charge in a rotating drum under defined conditions. When rolling is complete, the percentage retained on a 1.70 mm sieve is used to calculate the Micro-Deval coefficient.

4.3 Apparatus

4.3.1 *Micro-Deval Apparatus* — A typical Micro-Deval apparatus as shown in Fig. 2. It shall consist of one of four hollow drums, closed at one end, having an inside diameter of (200 ± 1) mm and an internal length measured from the base to the inside of the lid of (154 ± 1) mm. The drums shall be made of stainless steel at least 3 mm thick which are placed on two shafts which rotate on a horizontal axis. The insides of drums shall be free of protrusions resulting from welding or the method of attachment. The drums shall be closed by flat lids at least 8 mm thick and fitted with watertight and dust tight seals. The abrasive charge shall consist of steel balls having (10 ± 0.5) mm in diameter. It should have a suitable motor to drive the drums at a regular speed of rotation of (100 ± 5) rev/min. It should have a counter or other device, which automatically stops the motor after the specified number of revolutions.

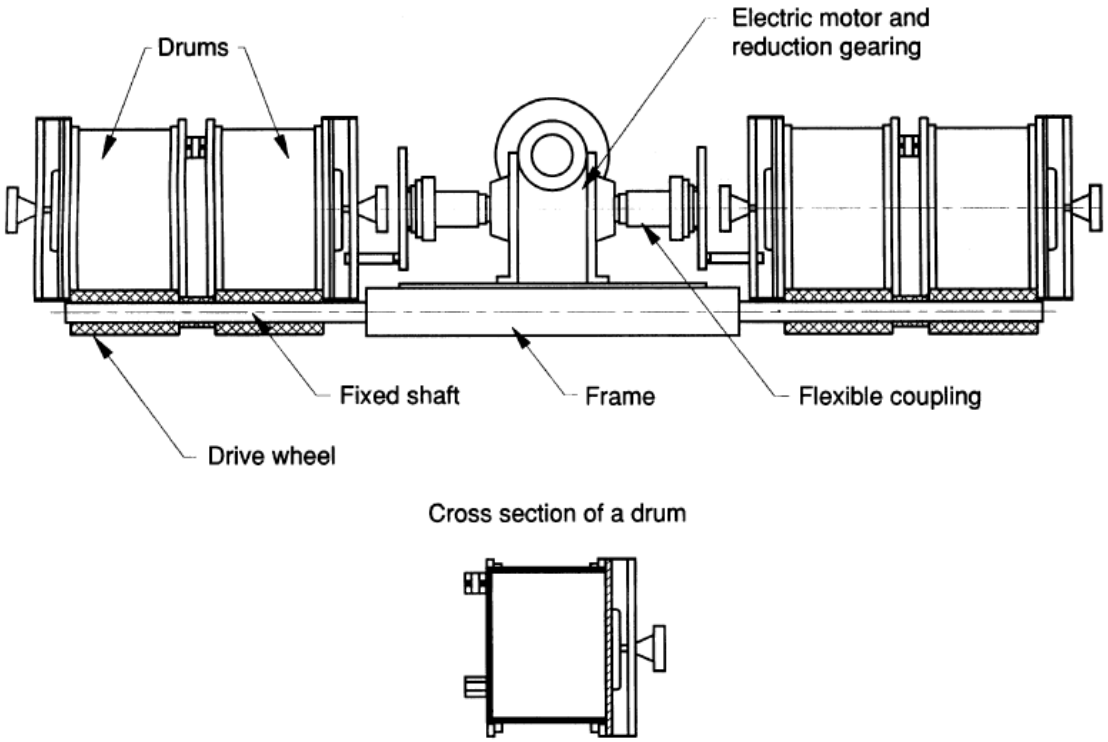


FIG. 2 MICRO-DEVAL APPARATUS

4.3.2 Balance, capable of weighing the test specimen to an accuracy of 0.1 percent of the mass of the test portion.

4.3.3 *Test sieves* — 1.70 mm, 10 mm and 12.5 mm.

4.3.4 Ventilated oven, controlled to maintain a temperature of (110 ± 5)°C.

4.3.5 Graduated glass measuring cylinder for measuring volume of water.

4.4 Preparation of sample for testing

The mass of the sample for testing should be at least 2 kg of particles in the 10 mm to 12.5 mm size range.

> NOTE — Alternative size fractions for different end uses are given in Table 2.
> The test shall preferably be carried out on aggregate passing the 12.5 mm sieve and retained on the 10 mm sieve. Wash the particles and dry them in the oven at (110 ± 5) °C to constant mass. Allow the particles to cool to ambient temperature.

4.5 Test procedure

Place each test specimen into a separate drum. Add sufficient steel balls to each drum to give a charge of (5 000 ± 5) g. Add 2.5 Litres of water to each drum. Fit a lid to each drum, and place each drum on the two shafts. Rotate the drums at a speed of (100 ± 5) rev/min for (12 000 ± 10) revolutions. After the test, collect the aggregate

and the steel balls in a pan, taking care to avoid the loss of any aggregate. Using a washing bottle, carefully wash the inside of the drum and the lid and retain the washings. Empty the material and all the washings on to the 1.70 mm sieve protected by a 10 mm guard sieve. Wash the materials in a stream of clean water.

Carefully separate the aggregate particles retained on the 10 mm guard sieve from the steel balls, taking care not to lose any aggregate particles. The aggregate particles may be picked out by hand, or the balls may be removed from the sieve using a magnet.

Place the aggregate particles retained on the 10 mm guard sieve onto a tray. Add the material retained on the 1.70 mm sieve to the same tray. Dry the tray and its contents in the oven at (110 ± 5)°C upto two successive weights after 1 hour of further drying do not differ by 0.1 percent. Record the mass (m) retained on the 1.70 mm sieve to the nearest gram.

4.6 Calculation and expression of results

For each test specimen calculate the Micro-Deval coefficient, M_{DE}, to the nearest 0.1 units using the following equation:

$$M_{DE} = (500 - m)/5$$

where,
M_{DE} is the Micro-Deval coefficient (in the wet condition);
m is the mass of the oversize fraction retained on a 1.70 mm sieve, in grams
Using the values obtained for the two test specimens, calculate the mean value of Micro-Deval coefficient.

4.7 Report

Express the mean value to the nearest whole number. The size fraction used should be given in the test report.

5 DETERMINATION OF AGGREGATE CRUSHING VALUE

5.1 Objective

This method of test covers the procedure for determining the aggregate crushing value of coarse aggregate.

NOTE — The aggregate crushing value' gives a relative measure of the resistance of an aggregate to crushing under a gradually applied compressive load. With aggregate of aggregate crushing value' 30 or higher, the result may be anomalous, and in such cases the 'ten percent fines value' should be determined instead.

5.2 Apparatus

The apparatus for the standard test shall consist of the following:

a) An open-ended 150 mm cylindrical cell with appropriate base plate and plunger, metal measure and tamping rod conforming to IS 9376;
b) A balance of capacity 3 kg, readable and accurate to 0.1 percent of mass of the test portion;
c) IS Sieves of sizes 12.5 mm, 10 mm and 2.36 mm or as per Table 2 for non-standard sizes of aggregates;
d) A compression testing machine capable of applying a load of 400 kN is not more than 10 min at a uniform rate of loading. The machine may be used with or without a spherical seating.

5.3 Preparation of Test Sample

The material for the standard test shall consist of aggregate passing a 12.5 mm IS Sieve and retained on a 10 mm IS Sieve and shall be thoroughly separated on these sieves before testing. For other sizes, the material shall be separated on the appropriate sieves given in Table 2.

Table 2 Details of Aggregate Crushing Test for Non-Standard Sizes of Aggregate
(*Clauses* 5.2, 5.3 *and* 5.4.2)

Sl. No.	**Nominal Sizes (IS sieves) (mm)**		**Diameter of Cylinder to be used** (cm)	**Size of IS Sieve for Separating Fines**
	Passing through	Retained on		
(1)	(2)	(3)	(4)	(5)
i)	25	20	15.0	4.75 mm
ii)	20	12.5	15.0	3.35 mm
iii)	10	6.3	15.0 or 7.5	1.70 mm
iv)	6.3	4.75	15.0 or 7.5	1.18 mm
v)	4.75	3.35	15.0 or 7.5	850 micron
vi)	3.35	2.36	15.0 or 7.5	600 micron

NOTE – About 6.5 kg of natural aggregate is required to provide the two test samples for the 15 cm cylinder and about 1 kg for the 7.5 cm cylinder. For lightweight aggregate, the quantity will vary depending on the density of the aggregate.

5.3.1 The aggregate shall be tested in a surface-dry condition. If dried by heating, the period of drying shall not exceed four hours, the temperature shall be 100°C to 110°C and the aggregate shall be cooled to room temperature before testing.

5.3.2 The quantity of aggregate shall be such that the depth of material in the cylinder, after tamping shall be 10 cm.

5.3.3 The appropriate quantity may be found conveniently by filling the cylindrical measure in three layers of approximately equal depth, each layer being tamped 25 times with the rounded end of the tamping rod and finally levelled off, using the tamping rod as a straight-edge.

5.3.4 The weight of material comprising the test sample shall be determined (Weight A) and the same weight of sample shall be taken for the repeat test.

5.4 Test Procedure

The cylinder of the test apparatus shall be put in position on the baseplate and the test sample added in thirds, each third being subjected to 25 strokes from the tamping rod. The surface of the aggregate shall be carefully levelled and the plunger inserted so that it rests horizontally on this surface, care being taken to ensure that the plunger does not jam in the cylinder.

5.4.1 The apparatus, with the test sample and plunger in position, shall then be placed between the platens of the testing machine and loaded at as uniform a rate as possible so that the total load is reached in 10 min. The total load shall be 400 kN.

5.4.2 The load shall be released and the whole of the material removed from the cylinder and sieved on a 2.36 mm IS Sieve for the standard test, or the appropriate sieve given in Table 2. The fraction passing the sieve shall be weighed (Weight B).

In all of these operations, care shall be taken to avoid loss of the fines. Two tests shall be made.

NOTE

1 *Aggregate larger than* 12.5 *mm* – In general, the larger sizes of aggregate will give a higher aggregate crushing value, but the relationship between the values obtained with different sizes will vary from one aggregate to another. Particular care shall be taken with larger sizes of aggregate to ensure that the plunger does not jam in the cylinder.

2 *Aggregate smaller than* 10 *mm* – In general, the smaller sizes of aggregate will give a lower aggregate crushing value, but the relationship between the values obtained with different sizes will vary from one aggregate to another. The tests on smaller aggregate may be made either using the standards apparatus described above or a smaller apparatus consisting of a 75 mm cylindrical cell with appropriate accessories conforming to IS 9376. In case a smaller apparatus is used, the errors for the smaller sizes of aggregates tested in the smaller apparatus are compensated since the results obtained with the smaller apparatus have been found to be slightly higher than those with the standards apparatus.

For testing aggregate smaller than 10 mm:

a) The form and dimensions of the 7.5 cm cylinder.
b) The tamping rod shall be 8 mm in diameter and 30 cm long, rounded at one end.
c) The balance shall be of capacity 500 g, readable and accurate to 0.2 g.
d) The IS Sieves shall be as given in Table 3.
e) The compression testing machine shall be capable of applying a load of 100 kN uniformly in 10 minutes
f) The metal measure shall be 6 cm in diameter and 9 cm in height.
g) The depth of material in the 7.5 cm cylinder shall be 5 cm after tamping.

5.5 Calculation

The ratio of the weight of fines formed to the total sample weight in each test shall be expressed as a percentage, the result being recorded to the 0.1 units:

Aggregate crushing value = $\frac{B}{A} \times 100$

where,
B = Weight of fraction passing the appropriate sieve, and
A = Weight of surface dry sample.

5.6 Reporting of Results

The mean of the two results shall be reported to the nearest whole number as the 'aggregate crushing value' of the size of material tested, which shall be stated.

6 DETERMINATION OF TEN PERCENT FINES VALUE

6.1 Objective

This method of test covers the procedure for determining the 'ten percent fines' value of coarse aggregates.

NOTE — The' ten percent fines' value gives a measure of the resistance of an aggregate to crushing, that is, applicable to all aggregates. The test shall be carried out, when the crushing value is more than 30 percent.

6.2 Apparatus

The apparatus for the standard test shall consist of the following:

a) A 150 mm cylindrical cell with appropriate plunger and base plate, tamping rod and metal measure conforming to IS 9376;
b) A balance of capacity 3 kg, readable and accurate to one gram;
c) IS Sieves of sizes 12.5 mm, 10 mm and 2.36 mm;
d) A compression testing machine capable of applying a load of 500 kN in not more than 10 min at a uniform rate of loading. The load may vary from 0.5 to 500 kN; and means of measuring the reduction in the distance between the platens of the testing machine to the nearest one millimetre during the test (for example, a dial gauge).

6.3 Preparation of Test Sample

The material for the test shall consist of aggregate passing a 12.5 mm IS Sieve and retained on a 10 mm IS Sieve and shall be thoroughly separated on these sieves before testing.

6.3.1 The aggregate shall be tested in a surface-dry condition. If dried by heating, the period of drying shall not exceed four hours, the temperature shall be 100°C to 110°C and the aggregate shall, be cooled to room temperature before testing.

6.3.2 The quantity of aggregate shall be such that the depth of material in the cylinder, after tamping shall be about 10 cm.

6.3.2.1 The appropriate quantity may be found conveniently by filling the cylindrical measure in three layers of approximately equal depth, each layer being tamped 25 times with the tamping rod and finally levelled off, using the tamping rod as a straight-edge, care being taken in the case of weaker materials not to break the particles.

6.3.3 The weight of material comprising the test sample shall be recorded (Weight A) and the same weight of sample shall be taken for the repeat test.

NOTE — About 6.5 kg of natural aggregate is required to provide the two rest samples. Less of light weight aggregate is required.

6.4 Test Procedure

The cylinder of the test apparatus shall be put in position on the baseplate and the test sample added in thirds, each third being subjected to 25 strokes from the tamping rod. The surface of the aggregate shall be carefully levelled and the plunger inserted so that it rests horizontally on this surface, care being taken to ensure that the plunger does not jam in the cylinder.

6.4.1 The apparatus, with the test sample and plunger in position, shall then be placed in the compression testing machine. The load shall be applied at a uniform rate so as to cause a total penetration of the plunger in 10 minutes of about:

a) 15.0 mm for rounded or partially rounded aggregates (for example, uncrushed gravels),
b) 20.0 mm for normal crushed aggregates, and
c) 24.0 mm for honeycombed aggregates (for example, expanded shales and slags).

These figures may be varied according to the extent of the rounding or honeycombing.

6.4.2 After reaching the required maximum penetration, the load shall recorded in kN and be released and the whole of the material removed from the cylinder and sieved on a 2.36 mm IS Sieve. The fines passing the sieve shall be weighed, and this weight expressed as a percentage of the weight of the test sample. Normally, this percentage will fall within the range 7.5 to 12.5, but if it does not, a further test shall be made at a load adjusted as seems appropriate to bring the percentage fines within the range of 7.5 to 12.5.

6.4.3 A repeat test shall be made at the load that has given a percentage fines within the range 7.5 to 12.5.

6.5 Calculations

The mean percentage fines from the two tests at this load shall be used in the following formula to calculate the load required to give 10 percent fines:

Load required for 10 percent fines = $\frac{14\times x}{y+4}$

where,

x = load in kN, and

y = mean percentage fines from two tests at x kN load.

6.6 Reporting of Results

The load required to produce 10 percent fines shall be reported to the nearest 10 kN for loads of 100 kN or more and to the nearest 5 kN for loads of less than 100 kN.

7 DETERMINATION OF AGGREGATE IMPACT VALUE

7.1 Objective

This method of test covers the procedure for determining the aggregate impact value of coarse aggregate.

NOTE — The 'aggregate impact value' gives a relative measure of the resistance of an aggregate to sudden shock or impact, which in some aggregates differs from Its resistance to a slow compressive load.

7.2 Apparatus

The apparatus shall consist of the following:

a) An impact testing machine of the general form shown in Figure 3 and complying with the following:

1) Total weight not more than 60 kg nor less than 45 kg.
2) The machine shall have a metal base weighing between 22 kg and 30 kg with a plane lower surface of not less than 30 cm diameter, and shall be supported on a level and plane concrete or stone block or floor at least 45 cm thick. The machine shall be prevented from rocking either by fixing it to the block or floor or by supporting it on a level and plane metal plate cast into the surface of the block or floor.
3) A cylindrical steel cup of internal dimensions: Diameter 102 mm, Depth 50 mm and not less than 6.3 mm thick with its inner surface casehardened, that can be rigidly fastened at the centre of the base and easily removed for emptying.
4) A metal bult or hammer weighing 13.5 kg to 14.0 kg, the lower end of which shall be cylindrical in shape, 100.0 mm in diameter and 5 cm long, with a 2 mm chamfer at the lower edge, and case-hardened. The hammer shall slide freely between vertical guides so arranged that the lower (cylindrical) part of the hammer is above and concentric with the cup.
5) Means for raising the hammer and allowing it to fall freely between the vertical guides from a height of 380 mm ± 5.0 mm on to the test sample in the cup, and means for adjusting the height of fall within 5 mm.
6) Means for supporting the hammer whilst fastening or removing the cup.
7) *Measure* — A cylindrical metal measure, tared to the nearest gram, of sufficient rigidity to retain in form under rough usage, and of the following internal dimensions: Diameter 75 mm and Depth 50 mm.

8) *Tamping Rod* — A straight metal tamping rod of circular cross-section 10 mm in diameter and 230 mm long, rounded at one end.
9) Balance – A balance of capacity not less than 500 g, readable and accurate to 0.1 g.
10) *Oven* – A well-ventilated oven, thermostatically controlled to maintain a temperature of 100°C to 110°C.

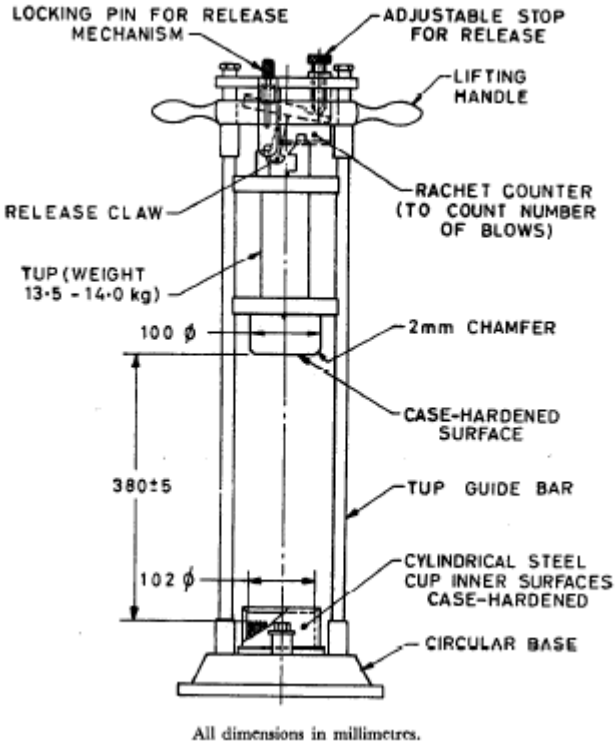


FIG. 3 AGGREGATE IMPACT TEST MACHINE

7.3 Preparation of the Test Sample

7.3.1 The test sample shall consist of aggregate the whole of which passes a 12.5 mm IS Sieve and is retained on a 10 mm IS Sieve. The aggregate comprising the test sample shall be dried in an oven for a period of four hours at a temperature of 105°C to 110°C upto two successive weight after 1 hour of further drying do not differ by more than 0.1 percent.

7.3.2 The measure shall be filled about one-third full with the aggregate and tamped with 25 strokes of the rounded end of the tamping rod. Further similar quantity of aggregate shall be added and a further tamping of 25 strokes given. The measure shall finally be fined to overflowing tamped 25 times and the surplus aggregate struck off, using the tamping rod as a straight-edge. The net weight of aggregate in the measure shall be recorded to the nearest gram (Weight A) and this weight of aggregate shall be used for the duplicate test on the same material.

7.4 Test Procedure

7.4.1 The impact machine shall rest without wedging or packing upon the level plate, block or floor, so that it is rigid, and the hammer guide columns are vertical.

7.4.2 The cup shall be fixed firmly in position on the base of the machine and the whole of the test sample placed in it and compacted by a single tamping of 25 strokes of the tamping rod.

7.4.3 The hammer shall be raised until its lower face is 380 mm above the upper surface of the aggregate in the cup and allowed to fall freely on to the aggregate. The test sample shall be subjected to a total of 15 such blows each being delivered at an interval of not less than one second.

7.4.4 The crushed' aggregate shall then be removed from the cup and the whole of it sieved on the 2.36 mm IS Sieve until no further significant amount passes in one minute. The fraction passing the sieve shall be weighed and recorded to an accuracy of 0.1 g (Weight B). The fraction retained on the sieve shall also be weighed and recorded to same accuracy (Weight C) and, if the total weight (B+C) is less than the initial weight (Weight A) by more than one gram, the result shall be discarded and a fresh test made. Two tests shall be made.

7.5 Calculations

The ratio of the weight of fines formed to the total sample weight in each test shall he expressed as a percentage, the result being recorded to the 0.1 unit:

$$\text{Aggregate impact value} = \frac{B}{A} \times 100$$

where,
B = weight of fraction passing 2.36 mm IS Sieve, and
A = weight of oven-dried sample

7.6 Reporting of Results

The mean of the two results shall be reported to the nearest whole number as the aggregate impact value of the tested material.

8 DETERMINATION OF THE POLISHED-STONE VALUE

8.1 Objective

The object of this test is to determine the polished-stone value which gives a relative measure of the extent to which different types of roadstone in the wearing surface will polish under traffic. The results of this test are used for comparative purposes only; limits cannot, at present, be specified for the polished-stone value in any particular set of circumstances. Where the wearing surface of a road consists largely of stone, the state of polish of the stone will be the dominant factor but other factors also affect the resistance of the surface to skidding.

The test is in two parts:

a) Samples of stone are subjected to an accelerated polishing action in a special machine.
b) The state of polish reached by each sample is measured by means of a suitable friction test and is expressed as the 'polished-stone value'.

8.2 Apparatus

The apparatus shall consist of the following:

a) An accelerated polishing machine (*see* Figure 4) which shall be rigidly mounted on a firm, level and non-resilient base of stone or concrete and shall include:
b) A road wheel having a flat periphery, and of such a size and shape as to permit fourteen of the specimens to be clamped on the periphery so as to form a continuous surface of stone particles 45 mm wide and 405 mm in diameter.
c) Means for rotating the road wheel about its own axis at a speed of 320 rev/min to 325 rev/min.
d) Means for bringing the surface of a rubber-tyred wheel of 20 cm diameter and 5 cm breadth to bear on the stone surface of the road wheel with a total load of 40 kg. The tyre shall be an industrial 8 x 2 pneumatic 4 ply rating smooth hand-truck tyre with a hardness of 55 ± 5 and shall be inflated to a pressure of 3.15 ± 0.15 kg/cm^2. It shall be free to rotate on its own axis, which shall be parallel with the axis of the road wheel; the plane of rotation of the tyre shall be accurately in line with that of the road wheel. Before a new tyre is used on an actual test, it shall be given a preliminary run of 3 h with sand and 3 h with emery flour, as in an actual test, but using spare specimens. The tyre shall be discarded after 30 test runs have been made with it, or sooner if it shows signs of irregular wear.
e) Means to feed the sand specified in **8.3** and water at a uniform rate and in such a way that the sand and water are continuously and uniformly spread over the surfaces of the tyre and the specimens where they are in contact. This requires about 12 g/min of sand and 20 g/min of water.
f) Means to feed the emery powder specified in **8.3** and water a uniform rate and in such a way that the emery powder and water are continuously and uniformly spread over the surface of the tyre and the specimens where they are in contact. This requires about 2 g/min of emery powder and 5 g/min of water.
g) A friction tester complying with the requirements set out in **8.6** and **8.7**.
h) The IS Sieves shall be of the following sizes:
10 mm, 8.0 mm (both perforated plate), 425 microns, 300 microns, 212 microns and 150 microns (fine mesh).

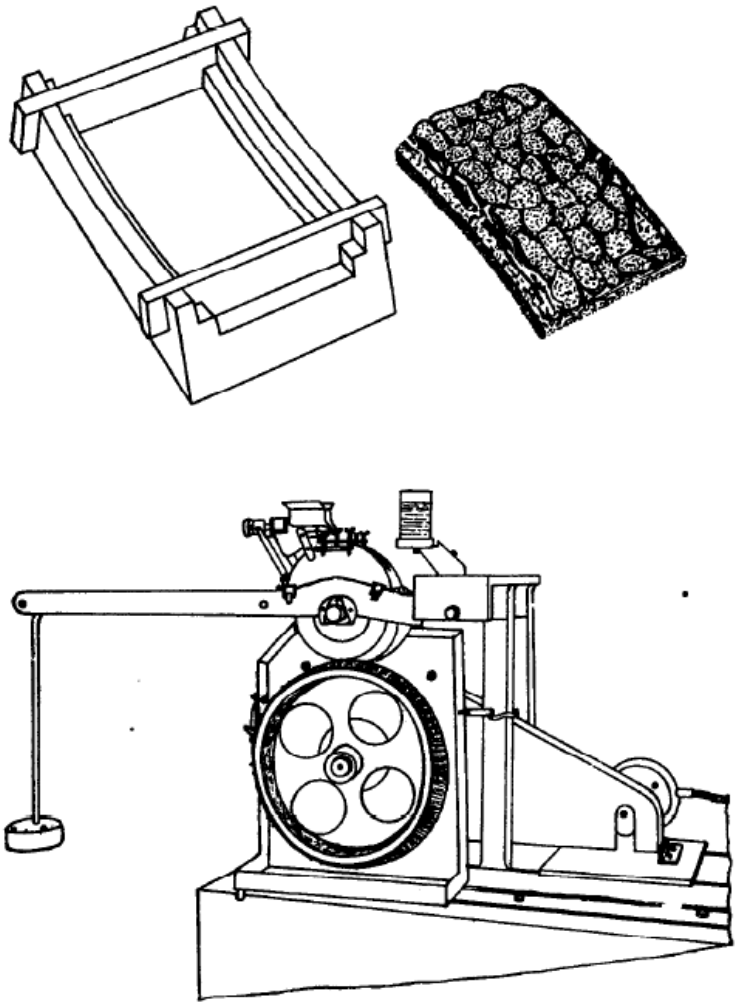


FIG. 4 SPECIMEN AND APPARATUS FOR ACCELERATED POLISHING

8.3 Materials — A supply of clean, hard siliceous sand, graded within the following limits; about 2.5 kg will be required for each test run:

Passing IS Sieve (1)	*Percentage by Weight* (2)
425 - micron	100
300 - micron	85-100
212 - micron	20-50
150 - micron	0-5

A supply of air-floated emery powder, 100 percent finer than 0.06 mm and not less than 70 percent finer than 0.002 mm; about 350 g will be required for each test run.

8.4 Preparation of Specimens

At least 3 kg of 10 mm particles shall be available for each sample to be tested. The particles actually used in the preparation of the test specimens shall all pass the

10 mm IS sieve and be retained on the 8.0 mm IS sieve and shall be neither flaky nor elongated. These shall be clean and free from dust.

8.4.1 When it is desired to test materials larger than 10 mm which may have characteristics differing from particles of the test size, the particles for the specimen should be obtained by crushing the larger particles.

8.4.2 Each specimen shall consist of a single layer of 40 to 50 of the particles spaced as closely as possible and covering an area of 90.5 mm x 44.5 mm, set in a sand-cement mortar with their exposed surfaces proud of the mortar. The surface of the specimen shall be flat across the shorter dimension but shall be curved in the arc of a circle of 400 mm diameter along the longer dimension. The individual particles shall be mounted in such a way that the surfaces exposed to wear are as nearly flat as possible, and in any case present no sharp edges to the polishing tyre. The specimens shall be not less than 12.5 mm thick, and shall be of such a shape as to permit their being clamped round the flat periphery of the road wheel of the accelerated polishing machine so as to form a continuous outer surface of particles with an outer diameter of 405 mm. At least two specimens shall be made from each material to be tested.

8.5 Accelerated Polishing of Specimens

The specimens shall be rigidly clamped round the periphery of the road wheel of the accelerated polishing machine; the wheel will accommodate 14 specimens, and it has been found useful when mounting the specimens on the wheel to insert strips of polythene about 0.25 mm thick between and beneath them. The pneumatic-tyred wheel shall be brought to bear on the surface of the specimens with a total load of 40 kg and the road wheel started up and brought to a speed of 320 rev/min to 325 rev/min. Water and the sand specified in **8.3** shall be fed continuously at the rates specified in **8.2** (a) on the road wheel while it rotates at 320 rev/min to 325 rev/min for a period of 3 hours ± 5 min.

8.5.1 The machine and specimens shall then be thoroughly cleaned by washing so that all traces of sand are removed and the machine operated for a further three hours as described in **8.5**, except that in place of the sand and water the air-floated emery powder specified in **8.3** and water shall be fed continuously at the rates specified in **8.2** (a). After 3 hours ± 5 min running with the emery powder, the machine shall be stopped and the machine and specimens cleaned. The specimens after polishing are extremely sensitive to handling, and fingering of the polished surfaces shall be avoided. The specimens shall then be tested on the friction tester as described in **8.6**.

8.6 Friction Tester

The friction test shall be made with a tester (*see* Fig. 5) constructed to drawings supplied by the Road Research Laboratory, UK. The tester shall provide:

a) a spring-loaded rubber slider of the weight, size and shape specified below, mounted on the end of a pendulum arm so that the sliding edge is 50 cm from the axis of suspension.
b) means for setting the column of the instrument vertical.

c) means for rigidly locating one of the curved specimens from the accelerated polishing machine with its longer dimension in the track of the pendulum, centrally with respect to the rubber slider and to the axis of suspension of the pendulum.
d) means for raising and lowering the axis of suspension of the pendulum so that the slider can (1) swing clear of the surface of the specimen or (2) be set to slide over a fixed length of surface of 75 ± 2.5 mm.
e) means for holding and releasing the pendulum arm so that it falls freely from a horizontal position.
f) a pointer balanced about the axis of suspension indicating the position of the pendulum arm throughout its forward swing, and moving over a circular scale drawn up as specified in **8.6.1** to **8.6.3**. The weight of the pointer shall be not more than 85 g and the friction in the pointer mechanism shall be adjustable so that, with the pendulum arm swinging freely from a horizontal position, the outward tip of a 30 cm long pointer may be brought to rest on the forward swing of the arm at a point 10 mm below the horizontal.

8.6.1 The weight of the swinging arm including the slider shall be 2.500 ± 0.025 kg, the centre of gravity lying on the axis of the arm at a distance of 405 ± 5 mm from the centre of suspension.

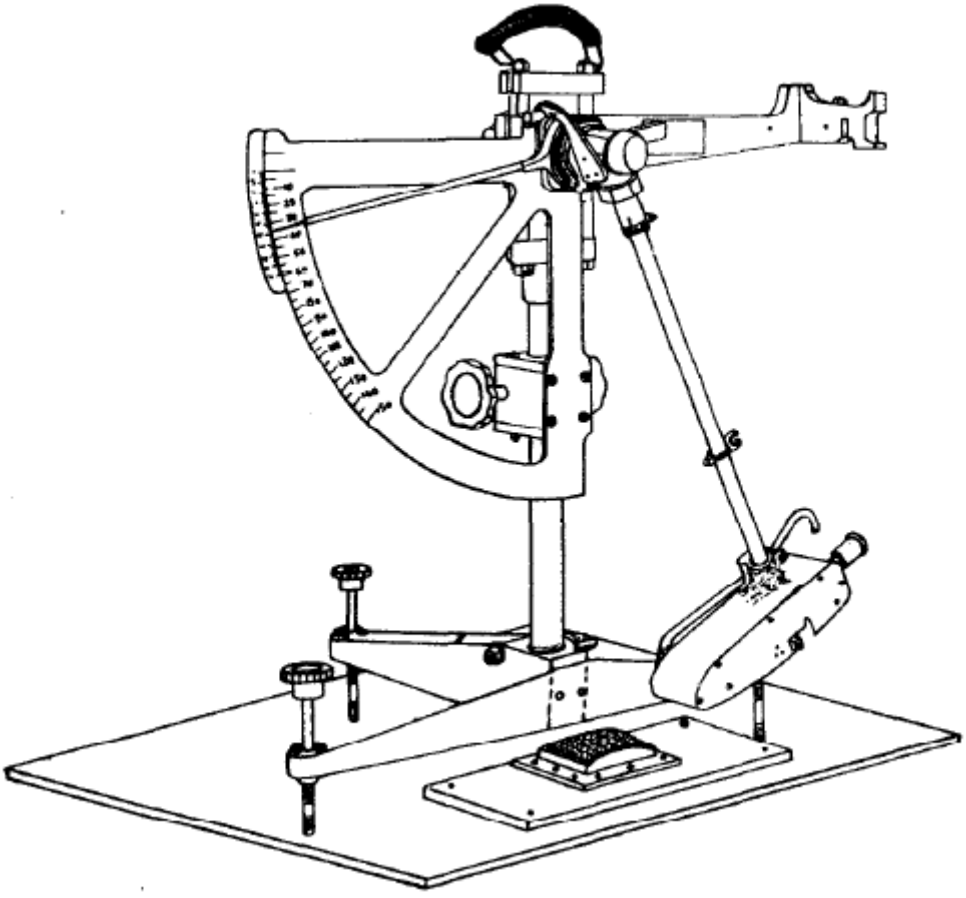


FIG. 5 APPRATUS USED TO MEASURE THE COEFFICIENT OF FRICTION OF THE SPECIMEN

8.6.2 The slider shall consist of a rubber pad 32 mm wide and 6.5 mm thick held on a rigid base with a total weight of 25 g ± 2 g which is mounted on an axis set at an angle of 20 degrees with the horizontal when the pendulum is at the lowest point of its swing, so that (a) only the rear edge of the slider contacts the test surface, and (b) the slider can turn about its axis without obstruction to follow unevenness of the surface, perpendicular to the plane of the pendulum swing. The slider shall be spring loaded against the test surface and the load on the slider shall be 2.25 kg ± 0.05 kg in its mean position; the change in load on the slider shall be not greater than 190 g/ cm deflection of the slider.

8.6.3 The slider shall be made from rubber tested and specially selected for the purpose. Before use, each working end of a new slider shall be roughened by swinging it at least 10 times over a dry, unpolished specimen, which shall not be one of the specimens to be tested. Each slider shall be used for not more than 500 swings with each of the two usable ends, and shall, in any case, be discarded not more than one year after the date it is supplied.

NOTE — Recent research has thrown new light on the properties of rubber that govern its frictional resistance. Until the results of this research can be applied on a commercial scale, it is essential that the rubber for we in the slider be carefully tested and selected. When so selected, it should last without any ageing effect for at least a year; full instructions on this and other points relating to the use of the portable tester are issued with each instrument.

8.6.4 All bearings and working parts of the instruments shall be enclosed as far as possible, and all materials used shall be suitably treated to prevent corrosion under wet conditions.

8.7 Calibration of the Tester

The scale of the instrument when used for this test shall give the coefficient of friction, expressed as a percentage, and shall be drawn up by means of the following equation:

$$\mu = \frac{WXZ}{PDp} \times 100$$

where,

μ = effective coefficient of friction, expressed as a percentage;
W = weight in kg of the swinging arm;
X = distance in cm of the effective centre of gravity of the arm from the centre of oscillation;
Z = vertical distance of the edge of the scale zero of the scale, which shall be 10 mm below the horizontal when the arm is released to swing freely of the horizontal;
P = normal load in kg on the slider;
D = sliding distance in cm; and
p = length in cm of the pointer.

The instrument shall be cross-checked with the Road Research Laboratory standard machine on the following wetted surfaces:

a) A glass plate.
b) Five smooth-looking surfaces having a texture depth less than 0.25 mm and covering a range of coefficients of friction, expressed as a percentage, of at least 25 percent to 75 percent.
c) Five rough-looking surfaces having a texture depth greater than 0.51 mm and covering a range of coefficients of friction, expressed as a percentage, of at least 35 percent to 70 percent.

On these tests no pairs of results on any surface shall differ by more than ± 3 percent and the mean results for the 11 samples shall not differ by more than ± 2.5 percent.

8.8 Friction Test Procedure

The test shall be made at a temperature of 27 ºC ± 2 ºC.

8.8.1 The tester shall rest upon a firm level surface and the levelling screws shall be adjusted so that the column is vertical. The axis of suspension of the pendulum shall then be raised so that the arm swings freely, and the friction in the pointer mechanism shall be adjusted so that when the pendulum arm and pointer are released from the right-hand horizontal position the pointer comes to rest at the zero position on the scale.

8.8.2 The specimen shall then be rigidly located with its longer dimension lying in the track of the pendulum, and centrally with respect to the rubber slider and to the axis of suspension of the pendulum. The height of the axis of suspension of the pendulum shall then be adjusted so that in traversing the specimen the rubber slider is in contact with it over the whole width of the slider and over a length of 75 mm ± 2.5 mm of the specimen under a normal load of 2.25 kg ± 0.05 kg. The surfaces of the specimen and the rubber slider shall then be wetted with a copious supply of clean water, care being taken not to disturb the slider from its set position. The pendulum and pointer shall then be released from the horizontal position and the reading of the pointer recorded to the nearest whole number.

8.8.3 The procedure shall then be repeated with a second specimen of the same material.

8.8.4 If the values obtained from the two specimens differ by more than 3 percent, a further specimen or specimens shall be tested until two values agree within this limit.

NOTE — If the tester has not been used for eight hours previously, five swings shall be made on a spare specimen before an actual test is made.

8.9 Reporting of Results

The mean of the two values of the coefficient of friction, expressed as a percentage, and Polished Stone Value shall be reported to the nearest whole number.

9 DETERMINATION OF THE AGGREGATE SURFACE ABRASION VALUE

9.1 Objective

The aggregate surface abrasion value method should be used when particular types of skid resistant aggregates (typically those with a PSV of 60 or greater) which can be susceptible to abrasion under traffic, are required. The Aggregate surface abrasion value is carried out on aggregate passing a 12.5 mm test sieve and retained on a 10 mm test sieve.

9.2 Apparatus

9.2.1 *Abrasion Machine* — consisting of a machined flat circular cast iron or steel grinding lap wheel not less than 600 mm in diameter, which can be rotated in a horizontal plane at a rpm of 28 to 31 per minute. The abrasion machine shall be fitted with a revolution counter and the accessories as mentioned below in **9.2.2** to **9.2.7**.

9.2.2 At least two machined metal moulds for preparing specimens, manufactured with removable ends and with internal dimensions of (92 ± 0.1) mm long, (54 ± 0.1) mm wide and (16 ± 0.1) mm deep.

9.2.3 At least two machined metal trays or metal backing plates for holding the prepared specimens.

> NOTE —Trays made from 5 mm mild steel plate and with internal dimensions of (92.0 ± 0.1) mm long by (54.0 ± 0.1) mm wide by (8.0 ± 0.1) mm deep are suitable.

9.2.4 At least two machined flat plates made from 5 mm mild steel plate with dimensions of (115 ± 0.1) mm long by (75 ± 0.1) mm wide.

9.2.5 Means for locating two of the trays (or specimens with backing plates) with their centre points 260 mm from the centre of the lap diametrically opposite to each other and with their long sides lying in the direction of rotation of the lap wheel. The trays shall be free to move in a vertical plane but restrained from moving in the horizontal plane.

9.2.6 Two weights, each with a rounded base for pressing the test specimen against the surface of the lap wheel and each having a means for adjusting their mass, including test specimen and tray, to (2 000 ± 10) g.

9.2.7 A means for feeding fine aggregate continuously on the lap wheel in front of each test specimen at a rate of (800 ± 100) g/min and for removing the fine aggregate after it has passed under the test samples.

9.2.8 Balance, of at least 2.5 kg capacity, accurate to 0.1 percent of weight of sample to be tested.

9.2.9 Two small fine-haired brushes.

9.2.10 Brush, with stiff bristles.

9.2.11 Clamp, such as a 200 mm G-clamp.

9.3 Materials

9.3.1 *Abrasive* — consisting of round grained silica fine aggregate (sand) containing at least 96 percent quartz. All of the fine aggregate (sand) shall pass the 850 µm sieve and be retained on the 300 µm sieve. Additionally, at least 75 percent of the fine aggregate (sand) shall pass the 600 µm test sieve and be retained on the 425 µm sieve. The fine aggregate (sand) shall be dry and shall not have been used previously.

NOTE — About 30 kg is required for each test.

9.3.2 Synthetic resin and hardener, together with a release agent such as liquid car polish, a suitable liquid cleaner liquid and a container for mixing the resin.

NOTES

1 The cleaner should be used to clean moulds, tools, etc., as required.
2 Filler can be added to the resin to make it less fluid. The resin can also be added to the mould in two layers.

9.3.3 Fine aggregate (sand), to prevent the resin from squeezing up between the individual pieces of aggregate.

NOTES

1 Fine aggregate (sand) passing the 300 µm test sieve is suitable.
2 Regular testing of very hard aggregates can visibly score the machined surface of the lap wheel. The surface should be inspected between test runs and any grooves greater than 0.2 mm deep should be rectified by machining.

9.3.4 Test sieves, with square apertures and sizes 12.5 mm, 10 mm, 850 µm, 600 µm, 425 µm and 300 µm.

9.4 Preparation of test specimens

9.4.1 *Test portion*

Reduce the laboratory sample such that test portion consisting of aggregate passing the 12.5 mm sieve and retained on the 10 mm sieve. The mass of the test portion shall be sufficient to allow two test specimens to be prepared as specified in **9.4.2**. After sieving the aggregate, wash to remove surface dust and allow surface to dry in air. The aggregate shall be tested in surface-dry condition and shall be at room temperature before the preparation of the test portion as specified in **9.4.2**.

9.4.2 *Specimens*

Prepare two specimens for each test. Lightly coat the internal faces and top edges of the mould with release agent using one fine-haired brush. From the prepared test

portion, select as many particles as possible, but never less than 24, and place them in the mould in a single layer with their flattest surface lying at the bottom of the mould.

NOTE – The surface texture of the particles which are to be exposed to the abrasive action should be representative of the average surface texture of the aggregate. Particles of differing appearance should be distributed randomly between the two specimens. Poorly selected specimens will give unrepresentative results. Fill the interstices between the pieces of aggregate to approximately three-quarters of their depth with the fine aggregate (sand) and level the fine aggregate (sand) with the other fine-haired brush. Mix sufficient resin and hardener and fill the mould to overflowing. Coat one side of the flat plate with the release agent and place it firmly on the mould, coated side down. Hold the plate in position with the clamp. When the resin has hardened (usually after 30 min), remove the plate and trim off the excess resin with a knife or spatula. Remove the specimen from the mould, remove the loose fine aggregate (sand) with the stiff brush and weigh the specimen to the nearest 0.1 g (mass A). Reject any specimen with resin exposed at the surface or with disturbed particles.

9.5 Procedure

Fit each specimen into one of the machined metal trays or metal backing plates, taking care to ensure a tight fit. Weigh a specimen in its tray with one of the weights and adjust the mass until the total is (2 000 ± 10) g. Repeat for the second specimen, tray or backing plate and weight.

NOTE

1 The abrasion of the aggregate during the procedures described in this clause can generate particles that could be injurious to health. It is essential that appropriate precautions are taken, such as by the use of dust masks or dust containing and/or extracting facilities. Locate the two specimens in the abrasion machine with the aggregate particles resting on the lap wheel over the whole face area. Then place the appropriate weights centrally on the specimens. Turn the lap wheel through 500 revolutions at a speed of 28 rev/min to 31 rev/min. Feed the abrasive fine aggregate (sand) continuously onto the lap wheel immediately in front of, and across the full width of, each test specimen at a rate of (800 ± 100) g/min for each specimen.

2 A feeder slot width of about 1.3 mm may be suitable. To ensure that the abrasive fine aggregate (sand) is fed beneath each specimen, lift each of them clear of the lap wheel for one revolution before the start of abrasion and at every 100^{th} revolution thereafter. Remove the abrasive fine aggregate (sand) with a rubber-edged blade, mounted so that the rubber edge rests lightly on the lap wheel for its full width, and discard the abrasive fine aggregate (sand). If it becomes apparent that abrasion has reached the level of the resin backing (because of the nature of the aggregate) discontinue the test and report the number of revolutions. On completion of 500 revolutions, remove the test specimen from the machine and remove the trays or backing plates and weights. Weigh the specimens to the nearest 0.1 g (mass B).

9.6 Calculation and expression of results

Calculate the surface abrasion value of each test specimen, to three significant figures, in accordance with the following equation:

$$AAV = 0.003\ (A-B)/\ \rho_{ssd}$$

where,

A = Mass of specimen before abrasion, in grams;
B = Mass of specimen after abrasion, in grams;

ρ_{ssd} = Particle density of the aggregate (on saturated surface-dried basis) as determined in accordance with CED 02(28016) in kg per cubic metre.

NOTE — The calculation is based on the percentage loss in mass of an assumed 33 ml volume of the aggregate. Because of this assumption, AAV is reported as a dimensionless unit. Calculate the mean of the two results to two significant figures. Report the mean as the AAV, unless the individual results differ by more than 0.2 times the mean value.

9.7 Test report

The test report shall contain:

a) The aggregate abrasion value (AAV);
b) The values recorded for the two individual test specimens.

10 DETERMINATION OF CRUSHING STRENGTH

10.1 General

When aggregates are not available, this test may be used to give a direct measure of the stress in kg/cm^2 at ultimate failure of a rock under a slowly increasing compressive load. This is not, and should not be confused with, the 'sideway force coefficient' or the 'skid resistance value' determined on a road.

10.2 Apparatus

The apparatus shall consist of the following:

a) A compression testing machine of suitable capacity and at least one platen having a spherical seating of not more than 2.5 cm radius.
b) A well-ventilated oven, thermostatically controlled to maintain a temperature of 100°C to 110°C.

10.3 Test Specimens

The test specimens shall be cylinders of 25.5 mm mean diameter and of 25 mm ± 0.5 mm mean height. In any one specimen, the diameter shall not vary by more than 0.25 mm and the height by not more than 0.15 mm. The end faces shall be at right angles to the cylindrical axis and shall be lapped plane to an accuracy of 0 mm to 0.25 mm.

10.3.1 The samples from which the test specimens are prepared shall be taken from freshly quarried material and only from pieces which show no evidence of incipient fracture. When planes of structural weakness are discernible, the sample shall be so selected as to furnish some test specimens with the planes of structural weakness at right angles to the cylindrical axis of the specimen.

10.3.2 The size of the samples shall be approximately 8 cm x 4 cm x 4 cm if the test specimens are to be prepared by grinding only and 15 cm x 15 cm x 10 cm of the test specimens are to be prepared by drilling, sawing and grinding.

10.3.3 In the preparation of the test specimens, the rock shall not be subjected to any treatment (such as chipping with a hammer) liable to induce incipient fracture. A copious flow of cold water shall be used throughout all grinding, drilling and sawing operations, to ensure that the aggregate is not damaged by overheating.

10.3.4 The test specimens shall be dried for four hours in the oven at a temperature of 100 °C to 110 °C and cooled before test.

10.3.5 If no planes of structural weakness are apparent, three specimens shall be tested. If planes of structural weakness are apparent, four specimens shall be tested, of which two shall have the planes at right angles to the axis of the cylinder.

10.4 Procedure

The diameter and height of each specimen shall be measured to an accuracy of 0.025 mm. The specimen shall be placed centrally between the steel plates without packing.

10.4.1 Each test shall be a direct compression test in which the load is applied to the ends of the cylindrical test specimen at a rate of about 5 tonnes per minute. In making each test, the final load necessary to produce crushing of the specimen shall be observed.

10.5 Calculations

The stress shall be calculated in kg/cm^2 from the cross-sectional area of the specimen.

10.6 Reporting of Results

The value of the crushing stress for each individual specimen, and the average crushing stress shall be reported to the nearest 5 kg/cm^2. Any peculiar condition of a test specimen which might affect the result of the test, such as the presence of seams, fissures, etc. shall be noted in the report.

ANNEX A
(Foreword)

COMMITTEE COMPOSITION

Cement and Concrete Sectional Committee, CED 02

(*The Committee composition will be added after finalization*)

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