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# *Indian Standard*

# METHOD FOR DETERMINATION OF RESISTANCE TO WEAR BY ABRASION OF NATURAL BUILDING STONES

## *( First Revision )*

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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# *Indian Standard*

# METHOD FOR DETERMINATION OF RESISTANCE TO WEAR BY ABRASION OF NATURAL BUILDING STONES

# *( First Revision )*

## 0. FOREWORD

**0.1** This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 25 June 1972, after the draft finalized by the Stones Sectional Committee had been approved by the Civil Engineering Division Council.

**0.2** Natural building stones used in steps, floorings and pavements of buildings are subject to heavy wear and friction. Their durability under such circumstances can be ensured only when they have adequate hardness or abrasive resistance. This standard gives a laboratory method for ascertaining abrasive values of stones intended for such uses. This standard was first published in 1960 and is being revised to include such abradants which are indigenously available.

**0.3** In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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## 1. SCOPE

**1.1** This standard lays down the procedure for determination of abrasion resistance ( wear resistance ) of natural building stones.

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

## 2. TEST PIECES

**2.1** Test pieces shall be cube specimens of size 7·06 cm ± 2 percent (area of each face being 50 $cm^2$) taken from the sample selected. The specimens shall be obtained by saw cutting followed by finishing with grinding wheels. The use of chisel and hammer shall be avoided. All the faces of the specimen shall be made true and parallel by saw cutting and grinding.

**2.2** Not less than two test pieces shall be used for conducting the test.

## 3. ABRADANT

**3.1** The abradants for test shall be emery natural or emery synthetic, grit size 80 and shall conform to IS : 3178-1965*. The minimum hardness value shall be 8.

## 4. APPARATUS

**4.1 Abrasion Testing Machine** — The abrasion of specimens shall be carried out in a machine conforming essentially to the requirements described in Appendix A.

**4.2 Measuring Instrument** — A suitable instrument capable of measuring to an accuracy of 0·01 mm shall be used for determining the change in the thickness of the specimen after abrasion.

NOTE — The arrangement for measurement of thickness with the instrument may be as given in Fig. 1. Shoulders *A* and *B* are at right angles and the base *C* is machined at top to an accuracy of 0·01 mm. The test specimen shall be placed on the base with its wearing surface uppermost and sides in contact with the shoulders. The measuring instrument (or dial gauge) shall be set up firmly so that the contactor slightly presses on the surface of the specimen and the reading of the instrument taken. The position of the dial gauge and the setting of the contactor shall be the same during the subsequent measurement after abrasion.

## 5. TEST PROCEDURE

**5.1** The specimens shall be dried at 110°C for 24 h and then weighed to the nearest 0·1 g. The specimen after initial drying and weighing shall be placed in the thickness measuring apparatus (*see* **4·2**) with its wearing surface uppermost, and the reading of the measuring instrument taken.

The grinding path of the disc of the abrasion testing machine (*see* Appendix A) shall be evenly strewn with 20 g of the abrasive powder. The specimen shall then be fixed in the holding device with the surface to be ground facing the disc, and loaded at the centre with 30 kg. The

*Specification for abrasive, emery grain.

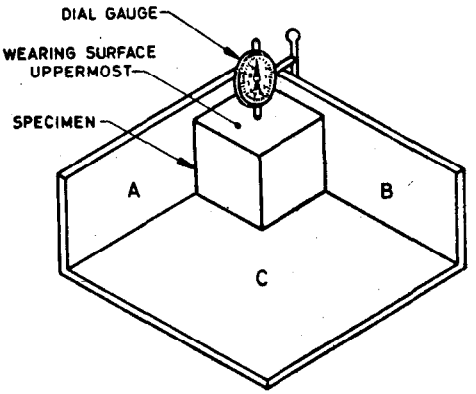



FIG. 1 ARRANGEMENT FOR MEASUREMENT OF THICKNESS

grinding disc shall then be put in motion at a speed of 30 rev/min. After every 22 revolutions, the disc shall be stopped, the abraded stone powder and the remainder of the abrasive powder shall be removed from the disc and fresh abrasive powder in quantities of 20 g applied each time. After 110 revolutions, the specimen shall be turned about the vertical axis through an angle of 90° and then the test continued under the same conditions until 220 revolutions have been completed altogether. The disc, the abrasive powder and the specimen shall be kept dry throughout the duration of the test. After the abrasion is over, the specimen shall be reweighed to the nearest 0·1 g. It shall then be placed in the thickness-measuring apparatus once again in the same manner and the reading taken with the same position and setting of the dial gauge as for the measurement before abrasion.

**5.2 Determination of Wear** — The wear shall be determined from the difference in readings obtained by the measuring instrument before and after the abrasion of the specimen. The value shall be checked up with the average loss in thickness of the specimen obtained by the following formula:

$$t = 10 \frac{(W_1 - W_2)\, V_1}{W_1 \times A}$$

where

$t$ = average loss in thickness in mm,
$W_1$ = initial weight in g of the specimen,
$W_2$ = final weight in g of the abraded specimen,
$V_1$ = initial volume in $cm^3$ of the specimen, and
$A$ = surface area in $cm^2$ of the specimen.

**5.3** The test shall be repeated on each one of the six faces of each specimen. Thus not less than twelve values for abrasion will be obtained.

## 6. REPORT

**6.1** The average of the abrasion values obtained in **5.3** shall be reported.

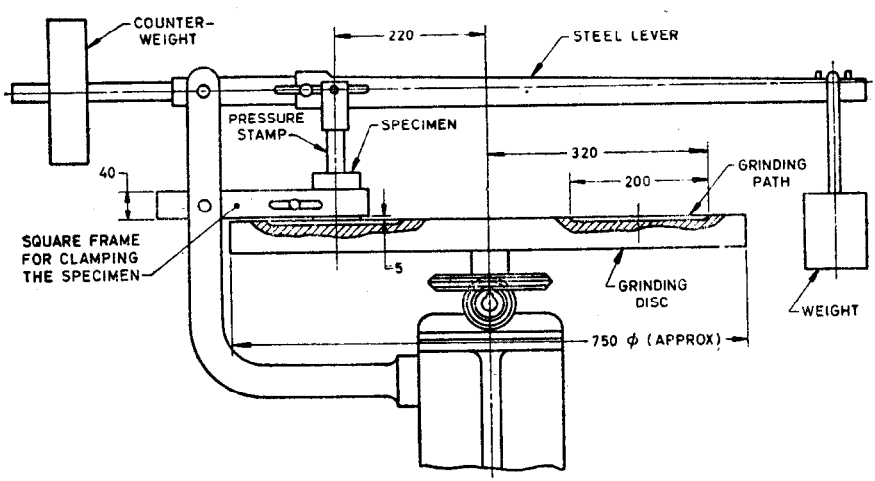
# APPENDIX A

*( Clauses* 4.1 *and* 5.1 )

## ESSENTIAL REQUIREMENTS OF THE ABRASION TESTING MACHINE

### A-1. GENERAL

**A-1.1** The testing apparatus shall be a grinding device consisting essentially of a horizontally fixed smooth grinding disc of about 750 mm diameter rotating about a vertical axis and furnished with a replaceable grinding path. The essential features are shown in Fig. 2.




All dimensions in millimetres.

FIG. 2 GENERAL FEATURES OF ABRASION TESTING MACHINE

## A-2. GRINDING PATH

**A-2.1** Cast iron shall be used as material for the grinding path. Its scaleroscope hardness shall lie between 30 and 50. This hardness shall be ascertained at least 10 times on the rim and at several points in the grinding path by means of a Shore's scaleroscope with diamond hammer.

**A-2.2** The grinding path shall be a 200-mm wide annular space on the grinding disc between distances of 120 and 320 mm from the centre. The grinding path shall be repaired and restored when it has worn out by more than 0·5 mm after use or when the furrows formed in it exceed 0·2 mm in depth. When the grinding path is restored, its hardness shall be determined afresh, when irreparable it shall be changed.

## A-3. ROTATION OF DISC

**A-3.1** The disc shall be driven at 30 $\pm$ 1 rev/min. There shall be automatic mechanisms for counting, indicating the revolutions of the disc and for stopping the disc after every 22 revolutions. Such mechanisms shall be checked for reliability prior to the test.

## A-4. HOLDING DEVICE FOR TEST SPECIMEN

**A-4.1** The holding device shall consist of an open square frame made of cast iron or steel; it shall be of suitable height, with its lower edge about 5 mm above the surface of the grinding disc and so positioned that centre of the specimen is at a distance of 220 mm from the centre of the disc. It shall necessarily, but loosely, hold the specimen.

## A-5. LOADING DEVICE

**A-5.1** The loading may be applied directly or through a lever device. The short arm of the lever shall be provided with a counterweight just to balance the weight of the long arm and of the weighing disc, so that the pressure stamp just touches the specimen prior to the loading.

**A-5.2** The lever shall move freely about the fulcrum without appreciable friction. During test, the lever shall remain nearly parallel to the upper surface of the disc. The connection of the pressure stamp to the lever shall be through a self-aligning joint permitting free relative movement but at the same time ensuring a central load on the specimen being tested.

**A-5.3** Suitable loading weight shall be applied at the end of the long arm of the lever so that, as magnified by the leverage, a net load of 30 kg is applied through the pressure stamp on to the specimen. The load shall be applied with a permissible deviation of one percent. The accuracy of the load shall be verified both by calculation and by measurement with suitable instruments.

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