Designation: C 241 – 90 (Reapproved 1997)ε1

# Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic[1]

This standard is issued under the fixed designation C 241; 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.*

ε[1] NOTE—Editorial changes were made in September 1997.

## 1. Scope

1.1 This test method covers the determination of the abrasion resistance of all types of stones for floors, steps, and similar uses where the wear is caused by the abrasion of foot traffic.

1.2 *This standard does not purport to address 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.*

## 2. Referenced Documents

2.1 *ASTM Standards:*

C 97 Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone[2]

C 119 Terminology Relating to Dimension Stone[2]

## 3. Terminology

3.1 *Definitions*—All definitions are in accordance with Terminology C 119.

## 4. Significance and Use

4.1 This test method is useful in indicating the differences in abrasion resistance between the various building stones. This test method also provides one element in comparing stones of the same type.

## 5. Apparatus

5.1 The abrasion testing apparatus shown in Fig. 1 shall be used. This apparatus consists essentially of a power-driven grinding lap, *A*, 10 in. (254 mm) in diameter, which is revolved at 45 rpm; three specimen holders, *B*, with superimposed weights; gears, *C*, for revolving the specimen; and a means of feeding abrasive at a constant rate to the lap. The guide rings, *D*, are clamped in position slightly above the specimen holders, and the 2000-g weight bearing on the specimen is the combined weight of the specimen holder, vertical shaft above with the attached spur gear, and a weight hopper, *E*, containing additional adjustment weights. The frame, *F*, carrying the guide rings is adjustable vertically to accommodate different specimen thicknesses. Gears, *C*, are adjusted on the shafts for each specimen thickness, so that they are slightly above the plate, *G*, throughout the test.

## 6. Sampling

6.1 The sample may be selected by the purchaser or his authorized agent but shall represent the average quality of the type or grade of stone under consideration. It shall be of sufficient size to permit the preparation of at least three test specimens, and one face should have the finish to be exposed to traffic. The sample preferably should be 1 in. (25.4 mm) thick and 8 in. (203.2 mm) square.

## 7. Test Specimens

7.1 At least three specimens 2 in. (50.8 mm) square and preferably 1 in. (25.4 mm) in thickness shall be sawed from the sample. The sharp edges shall be rounded by grinding to a radius of approximately 1/32 in. (0.8 mm) in order to prevent crumbling during the test.

## 8. Conditioning

8.1 Dry the specimens for 48 h in a ventilated oven at a temperature of 60 ± 2°C (140 ± 4°F). At the 46th, 47th, and 48th hour, weigh the specimens to ensure that the weight is the same. If the weight continues to drop, continue to dry the specimens until there are three successive hourly readings with the same weight. After removing the specimens from the oven, cool them to room temperature in a desiccator before testing them.

## 9. Procedure

9.1 Weigh the test specimens to the nearest 0.01 g; then place them in the abrasion testing apparatus and abrade for 225 revolutions of the grinding lap with No. 60 Alundum abrasive (Norton treatment 138S). Remove the specimens from the apparatus, brush them free of dust, and weigh to the same precision as for the original weights.

[1] This test method is under the jurisdiction of ASTM Committee C-18 on Dimension Stone and is the direct responsibility of Subcommittee C18.01 on Test Methods.

Current edition approved April 27, 1990. Published June 1990. Originally published as C 241 – 50 T. Last previous edition C 241 – 85ε[1].

[2] *Annual Book of ASTM Standards*, Vol 04.07.

*A*—Grinding lap.
*B*—Specimen holders.
*C*—Gears.
*D*—Guide rings.
*E*—Weight hopper.
*F*—Frame.
*G*—Plate.

**FIG. 1 Apparatus for Abrasion Resistance Test of Stone**

9.2 Place the specimens in water for an hour or more, surface dry them with a towel, and weigh again. Weigh the specimens in water and calculate the bulk specific gravity as described in Test Methods C 97.

NOTE 1—Humidity affects the results to some extent in that the rate of grinding is higher for higher humidity. For this reason it is advisable to make the test when the relative humidity is between 30 and 40 %.

NOTE 2—The supplier of the No. 60 Alundum abrasive, Norton, has indicated that the formula for Norton treatment 138S has been changed. The new abrasive is currrently more aggressive, resulting in lower abrasive hardness values ($H_a$) than when the standard was initially established. As such, care should be taken when interpreting $H_a$ values from tests using the new abrasive, particularly with regard to current ASTM stone standard specification requirements for abrasion resistance, which were developed when the original abrasive was still in use.

NOTE 3—A new abrasion resistance test has been adopted using the Taber Abraser (Test Method C 1353 for Abrasion Resistance of Dimension Stone by the Taber Abraser). Preliminary assessments indicate $H_a$ values established by the Test Method C 241 appear to be similar to values produced by Test Method C 1353, however more data are currently being studied by Subcommittee C18.03.

## 10. Calculation

10.1 Calculate the abrasion resistance of each specimen as follows (Note 4):

$$H_a = 10\,G(2000 + W_s)/2000\,W_a \quad (1)$$

where:

$G$ = bulk specific gravity of the sample,
$W_s$ = average weight of the specimen (original weight plus final weight divided by 2), and
$W_a$ = loss of weight during the grinding operation.

NOTE 4—The abrasive hardness value, $H_a$, is the reciprocal of the volume of material abraded multiplied by ten. The superimposed weight on the specimen is 2000 g and this is augmented by the weight of the specimen itself. The correction for the weight of the specimen, included in the formula, is based on the fact that the rate of abrasion is directly proportional to the weight. By basing the abrasive resistance values on the volumes, rather than the weights abraded, a better comparison is obtained for materials that vary considerably in bulk density.

## 11. Report

11.1 The average of the tests on individual specimens, expressed to two significant figures, shall be reported as the abrasive resistance of the sample, but all results shall be reported as information. The report shall identify the type and grade of stone, its source, and the approximate date of removal from the quarry.

## 12. Precision and Bias

12.1 Individual variations in a natural product may result in deviation from accepted values. A precision section will be added when sufficient data are available to indicate acceptable tolerances in repeatability and reproducibility.

## 13. Keywords

13.1 abrasion resistance; durability; stone