Designation: C 944 – 99

Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method[1]

This standard is issued under the fixed designation C 944; 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.

1. Scope

1.1 This test method covers a procedure for determining the resistance of either concrete or mortar to abrasion. This test method is similar to Procedure B of Test Method C 779.

1.2 The values stated in SI units or inch–pound units are to be regarded separately as standard. 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 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete[2]

C 418 Test Method for Abrasion Resistance of Concrete by Sandblasting[2]

C 779 Test Method for Abrasion Resistance of Horizontal Concrete Surfaces[2]

C 1138 Test Method for Abrasion Resistance of Concrete (Underwater Method)[2]

3. Significance and Use

3.1 This test method gives an indication of the relative wear resistance of mortar and concrete based on testing of cored or fabricated specimens. This test method has been successfully used in the quality control of highway and bridge concrete subject to traffic. Primarily intended for use on the top ends of 152-mm [6-in.] diameter concrete cores, mortar specimens, or other samples of concrete of insufficient test area to permit the conduct of tests by Test Method C 418 or C 779, this test method is also applicable on concrete surfaces in place by measuring the abrasion loss as described in Section 9, Procedure B, of Test Method C 779.

4. Apparatus

4.1 *Abrasion Device*—A drill press or similar device with a chuck capable of holding and rotating the abrading cutter at a speed of 200 r/min and exerting a force of either a normal load of 98 ± 1 N [22 ± 0.2 lbf] or a double load of 197 ± 2 N [44 ± 0.4 lbf] on the test specimen surface. Fig. 1 shows a commercial drill press and Fig. 2 illustrates details of the rotating cutter. The difficulty in maintaining a constant load on the abrading cutter when using the lever, gear, and spring system of a drill press has been eliminated by placing the desired load directly upon the spindle that turns the cutter. The machine consists essentially of a frame that supports the drive motor, stepped pulley, and spindle. A clamping device to hold the specimen is built into the base.

4.2 *Rotating Cutter*—A rotating cutter similar to that shown in Fig. 2 and Fig. 3 shall be used in which 22 37.5 mm [1.5 in.] diameter dressing wheels and 24 25.4 to 31.75 mm [1 to 1.25 in.] diameter washers are mounted. The washers as received shall be stacked and locked on a bolt for the purpose of reducing their diameter to the specified range to avoid restricting abrasion of the concrete by the washers. Cutter assembly, including washers, shall be locked onto horizontal rods such that individual dressing wheels are free to turn independently. The overall diameter of the cutter or the diameter of the circular area abraded is 82.5 mm [3¼ in.]. Care shall be taken to achieve constant contact between the rotating cutter and the entire test surface of the sample. This can be better accomplished if the cutters have a swivel connection allowing some vertical movement. If the dressing wheels have one rounded edge, they shall be mounted with the rounded edge toward the vertical shaft. The individual grinding wheel dressers on the horizontal shaft of the cutter shall be repositioned whenever a change in the diameter of the outer cutters becomes apparent. This is accomplished by reversing each set of dressing wheels to bring the smaller diameter cutters toward the vertical shaft.

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.62 on Abrasion Testing of Concrete.

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

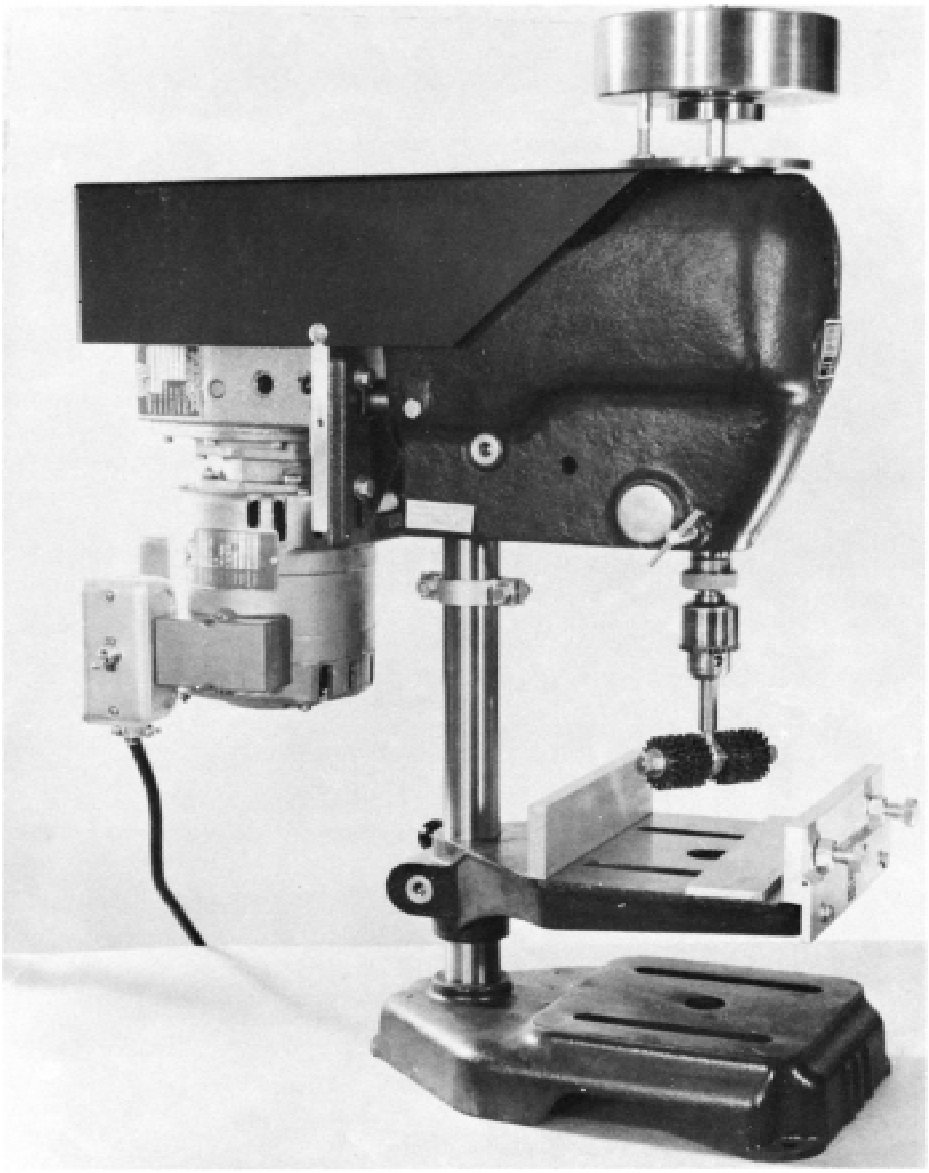

FIG. 1 Rotating-Cutter Drill Press

4.2.1 In making a test, the rotating cutter is held in a raised position by means of the rod provided, the specimen clamped securely in position, and motor started. The rotating cutter is then lowered into contact with the specimen for a specified time, after which the cutter is raised.

4.2.2 A set of dressing wheels shall be replaced periodically, preferably after each 90 min of use. The washers may be ground or replaced to maintain the proper diameter.

4.3 *Balance*—A balance having a capacity of at least 4 kg, and accurate to at least 0.1 g.

4.4 *Leveling Plate*—The base plate upon which the specimen rests shall be capable of rotating in the horizontal plane so that the specimens when placed thereon can be positioned to secure maximum contact with the rotating cutter throughout the full test area.

5. Sampling

5.1 Cores shall be taken in accordance with Test Method C 42.

6. Specimens

6.1 The specimens used in this test shall be of any size and shape that can be accommodated by the abrasion device and the balance provided. The surface to be tested shall be either formed or finished and shall be positioned in the plane of contact of the cutter.

7. Procedure

7.1 Determine the mass of the specimen to the nearest 0.1 g.

7.2 Fasten the specimens securely in the abrasion device so that the surface to be tested is normal to the shaft.

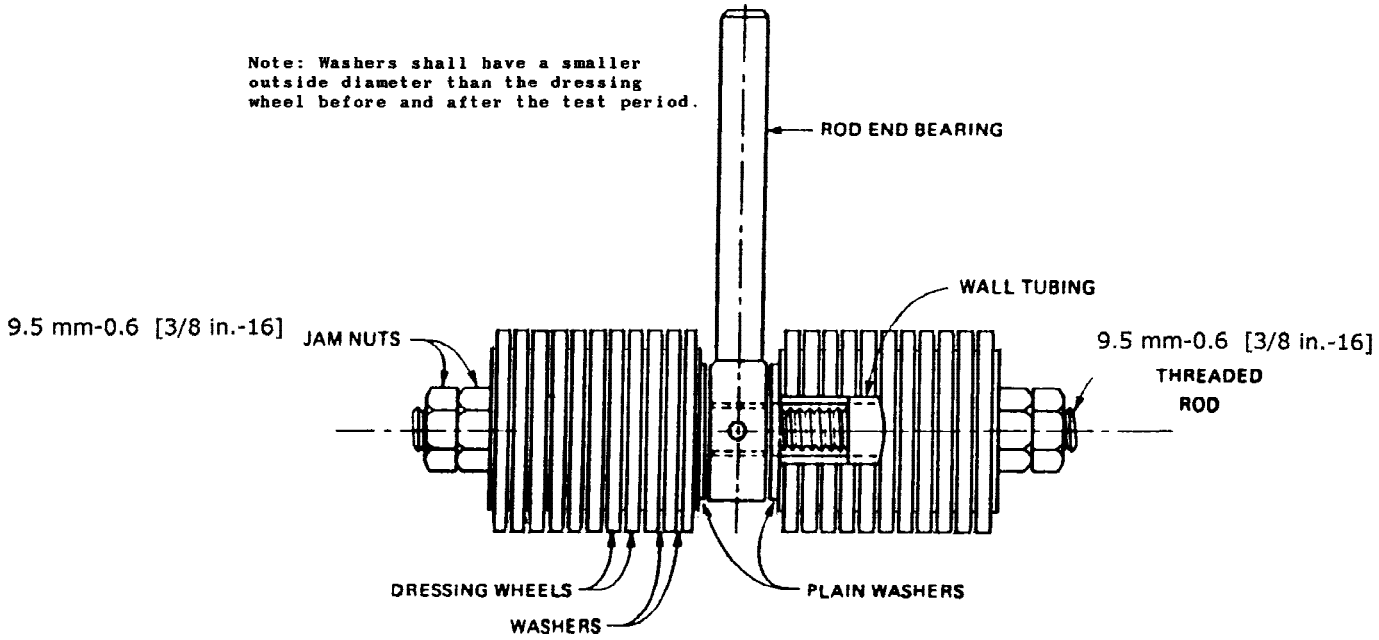

FIG. 2 Typical Rotating Cutters

7.3 Mount the rotating cutter device in the abrasion device.

7.4 Start the motor and lower the cutter slowly until just in contact with the surface of the specimen.

7.5 Continue abrasion with a normal or a double load on the specimen for 2 min after contact between the cutter and the surface. At the end of each 2-min abrasion period, remove the test specimen from the device and clean surfaces to remove debris using a soft brush or blow the surface with air. Determine the specimen mass to the nearest 0.1 g. The minimum test schedule shall involve three 2-min periods conducted on three separate areas of representative surfaces of the concrete or mortar.

7.6 For concrete that is highly resistant to abrasion additional testing may be required. Doubling the applied load, or the time, or both, as shown in the following chart, should provide more comprehensive information on such concrete.

Abrasion Cycle		Load, N (lbf)	Test Frequency/Period
A	Normal	98 (22)	3 × 2 min
B	Double load	197 (44)	3 × 2 min

7.7 When testing surfaces in place, or when the depth of wear is to be determined due to significant differences in surface density, refer to Test Method C 779 Procedure B, to determine abraded depth using the apparatus in this test method.

8. Report

8.1 Report the following information on:

8.1.1 Description of surface,

8.1.2 Size of specimen,

8.1.3 Type of finish,

8.1.4 Concrete compaction, age, and strength,

8.1.5 Applied surface treatment,

8.1.6 Time of abrasion and load used (normal or double),

8.1.7 Average loss in grams or depth of wear in millimetres and,

8.1.8 Loss in mass and time abraded.

9. Precision and Bias

9.1 *Precision*—Criteria for judging the acceptability of abrasion resistance test results obtained by this test method are as follows:

9.1.1 *Normal Load Condition*—The single-operator coefficient of variation has been found to be 21 %. Therefore, the results of two properly conducted tests by the same operator on similar samples should not differ from each other by more than 59 % of the average.

9.1.2 *Double Load Condition*—The single-operator coefficient of variation has been found to be 12.6 %. Therefore, the results of two properly conducted tests by the same operator on similar samples should not differ from each other by more than 36 % of their average.

9.2 *Bias*—The procedure in this test method has no bias because the value of abrasion resistance of concrete surfaces can be only defined in terms of a test method.

10. Keywords

10.1 abrasion; concrete; impact; mortar; wear

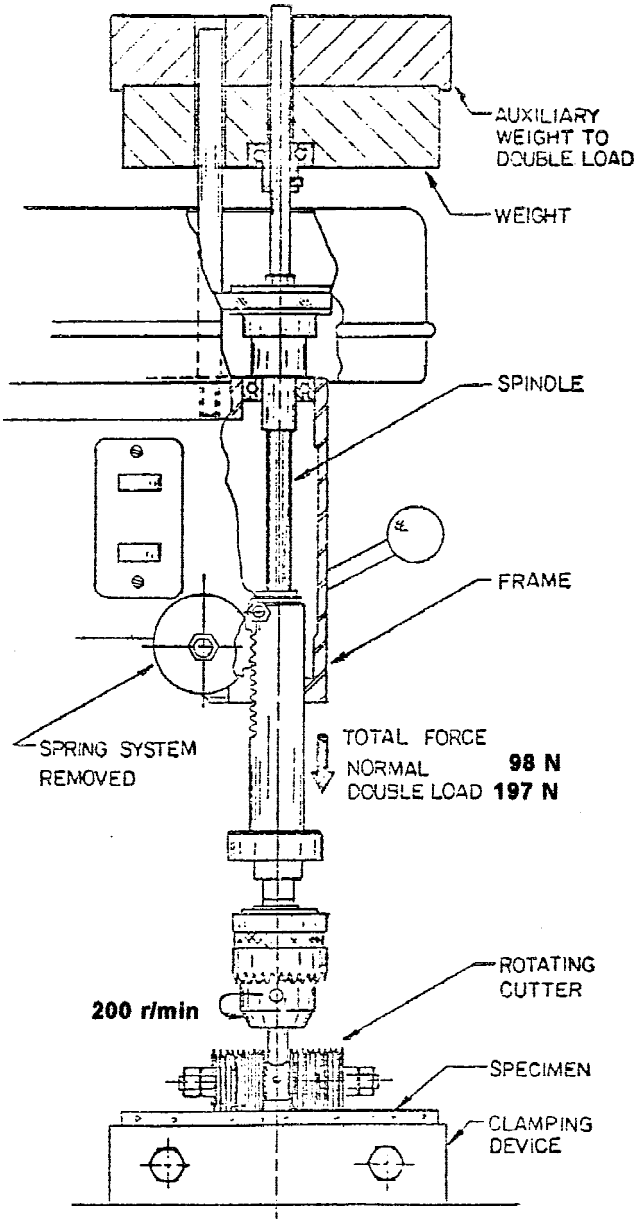

FIG. 3 Design Details of Rotating-Cutter Drill Press