



Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method¹

This standard is issued under the fixed designation C944/C944M; 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 [C779/C779M](#).

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:*²

[C42/C42M](#) Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

[C125](#) Terminology Relating to Concrete and Concrete Aggregates

[C418](#) Test Method for Abrasion Resistance of Concrete by Sandblasting

[C779/C779M](#) Test Method for Abrasion Resistance of Horizontal Concrete Surfaces

3. Terminology

3.1 For definitions of terms used in this standard, refer to Terminology [C125](#).

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.

Current edition approved Dec. 1, 2012. Published December 2012. Originally approved in 1980. Last previous edition approved in 2005 as C944 – 99(2005) ^{ϵ 1}. DOI: 10.1520/C0944_C0944M-12.

² 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.

4. Significance and Use

4.1 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 [C418](#) or [C779/C779M](#), this test method is also applicable on concrete surfaces in place by measuring the abrasion loss as described in Section 10, Procedure B, of Test Method [C779/C779M](#).

5. Apparatus

5.1 *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.

5.2 *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 [$3\frac{1}{4}$ 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

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

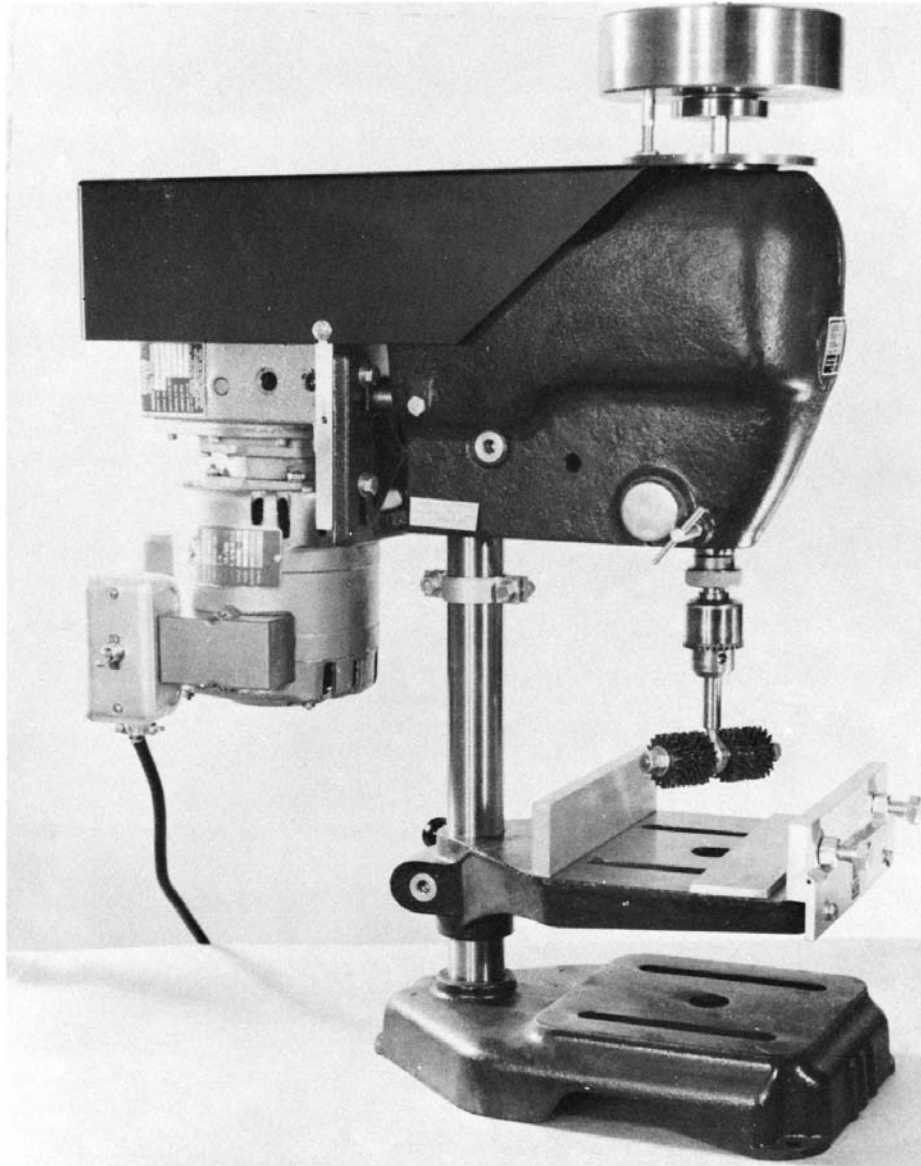


FIG. 1 Rotating-Cutter Drill Press

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.

NOTE 1—Dressing wheels, also known as “steel scarifier cutters,” with dimensions of 38.1 mm OD, 12.5 mm ID, 2.5 mm thick [1- $\frac{1}{2}$ in. OD, $\frac{1}{2}$ in. ID, $\frac{3}{32}$ in. thick] and Plain Steel SAE $\frac{1}{2}$ in. screw size, $1\frac{1}{32}$ in. ID, 1- $\frac{1}{16}$ in. OD, 0.074 in. thick Flat Washers (no metric equivalent available) have been found suitable for this purpose.

5.2.1 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.

5.2.2 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.

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

5.4 *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.

6. Sampling

6.1 Cores shall be taken in accordance with Test Method C42/C42M.

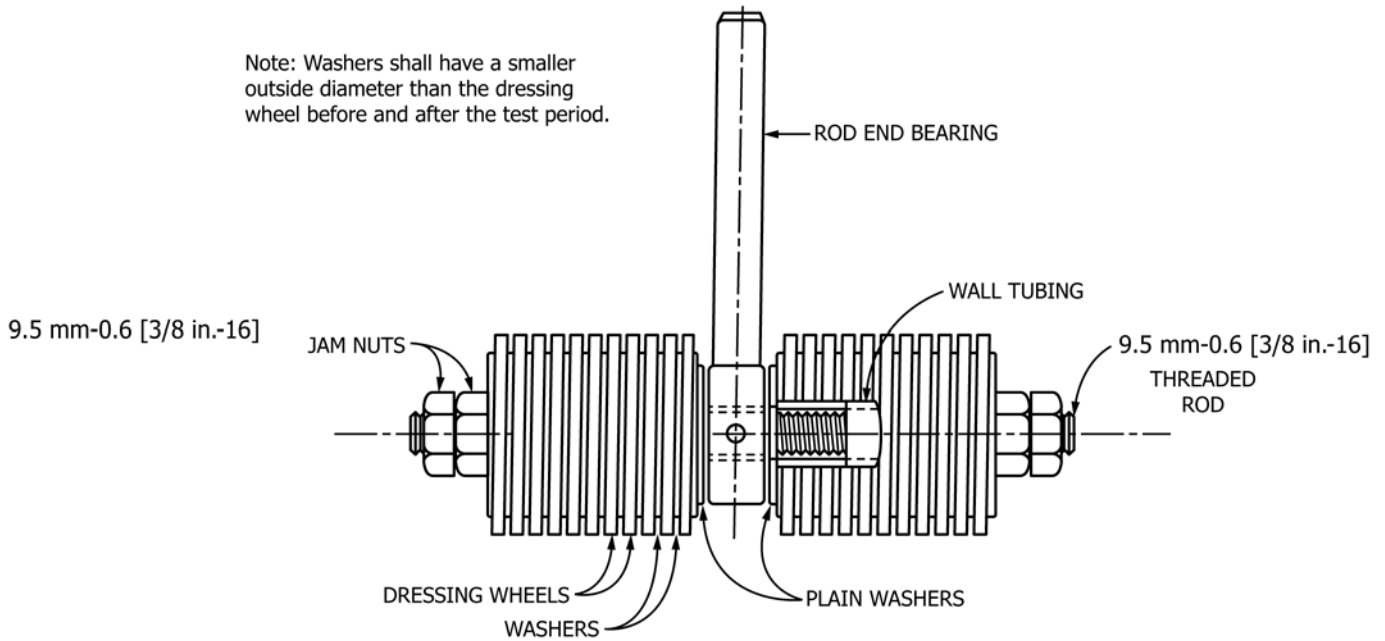


FIG. 2 Typical Rotating Cutters

7. Specimens

7.1 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.

8. Procedure

- 8.1 Determine the mass of the specimen to the nearest 0.1 g.
- 8.2 Fasten the specimens securely in the abrasion device so that the surface to be tested is normal to the shaft.
- 8.3 Mount the rotating cutter device in the abrasion device.
- 8.4 Start the motor and lower the cutter slowly until just in contact with the surface of the specimen.
- 8.5 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.

8.6 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

8.7 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 **C779/C779M** Procedure B, to determine abraded depth using the apparatus in this test method.

9. Report

- 9.1 Report the following information on:
 - 9.1.1 Description of surface,
 - 9.1.2 Size of specimen,
 - 9.1.3 Type of finish,
 - 9.1.4 Concrete compaction, age, and strength,
 - 9.1.5 Applied surface treatment,
 - 9.1.6 Time of abrasion and load used (normal or double),
 - 9.1.7 Average loss in grams or depth of wear in millimetres and,
 - 9.1.8 Loss in mass and time abraded.

10. Precision and Bias

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

10.1.1 *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.

10.1.2 *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.

10.2 *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.

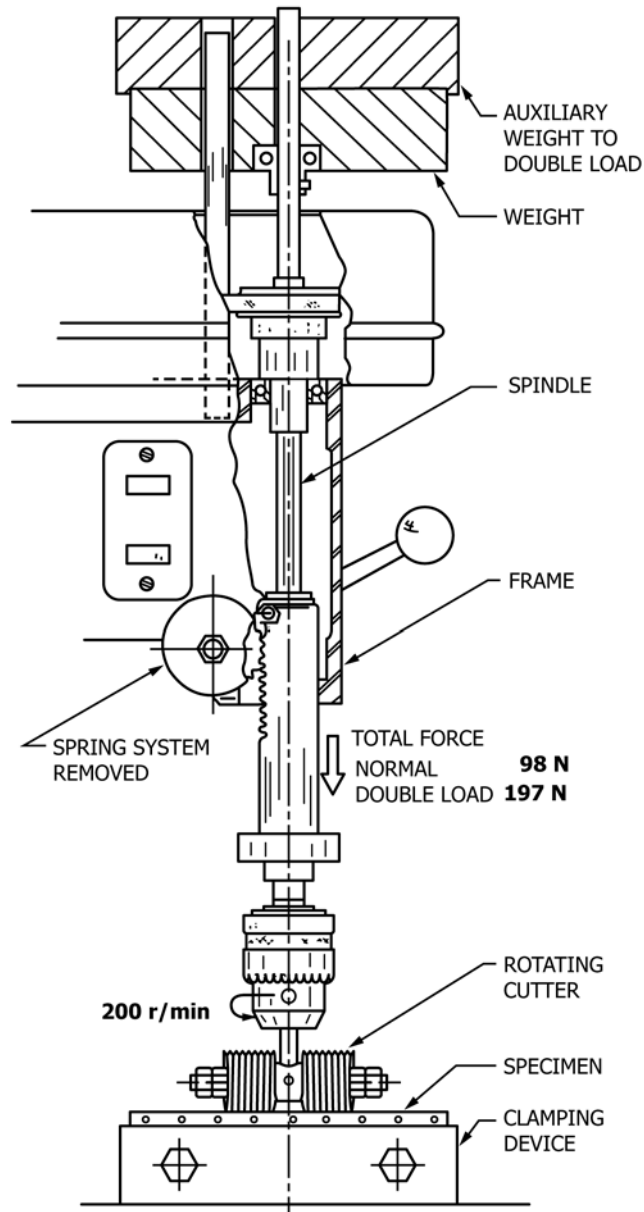


FIG. 3 Design Details of Rotating-Cutter Drill Press

11. Keywords

11.1 abrasion; concrete; impact; mortar; wear

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this test method since the last issue, C944 – 99(2005)^{e1}, that may impact the use of this test method. (Approved December 1, 2012)

- (1) Added new Section 3 Terminology, including reference to Terminology C125, and renumbered subsequent sections. (2) Added new Note 1.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>