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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Abrasive Wear Resistance of Cemented Carbides[1]

This standard is issued under the fixed designation B 611; 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.

ε[1] NOTE—Keywords were added editorially in September 1996.

1. Scope

1.1 This test method covers the determination of abrasive wear resistance of cemented carbides.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI equivalents of inch-pound units are in parentheses and may be approximate.

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:*

B 311 Test Method for Density Determination for Powder Metallurgy (P/M) Materials Containing Less Than Two Percent Porosity [2]

3. Terminology

3.1 *Definitions:*

3.1.1 *abrasion resistance*, *n*—the specimen's unit loss in volume per revolution of the steel wheel carrying the abrasive.

3.1.2 *abrasive wear*, *n*—that wear caused by a slurried abrasive on a rotating surface, contacting the specimen surface under pressure.

3.1.3 *wear number*, *n*—the reciprocal of the specimen's total volume loss in units of cm^{-3}.

4. Significance and Use

4.1 This test method provides a guide to determine the relative abrasive wear resistance of cemented carbides under high-stress abrasion conditions. The abrasive wear is not a measure of wear characteristics of carbides under all conditions and is not to be misconstrued as indicative of wear when carbides are used for machinery. It does show the difference in resistance to abrasive use for different carbide compositions and can be used as a practical test or as a research method for sorting out these differences.

5. Apparatus

5.1 *Vessel*, suitable for holding the abrasive slurry and the wheel (see Fig. 1). One suitable vessel is made of 3⁄16 -in. (5-mm) steel. The internal dimensions are 8¾ in. (220 mm) high, 9¾ in. (245 mm) long, and 2¼ in. (60 mm) wide, with a 5½ -in. (140-mm) radius at the bottom.

5.2 *Wheel*, made of annealed AISI 1020 steel, that rotates in the center of the vessel at 100± 5 rpm. The direction of rotation is from the slurry to the specimen. Four curved vanes are affixed to either side of the wheel to agitate and mix the slurry and to propel it toward the specimen. The maximum wheel diameter shall be 6.65 in. (169 mm) and the width shall be 0.500 ± 0.005 in. (12.7 ± 0.1 mm). The wheel shall be discarded when its diameter has decreased to 6.50 in. (165 mm) minimum, after repetitive use. In use, a slight burr will form at the periphery. This burr will compensate for wheel wear by widening the wear path in the specimen; it shall not be removed.

5.3 *Specimen Holder*, to be pressed against the periphery of the wheel. This specimen holder shall be mounted so that not more than 0.002 in. (0.05 mm) of side play occurs at the line of contact between the specimen and the wheel. The specimen holder shall be so placed that the specimen is tangential to the wheel at the center line of the wheel and specimen. A 10-kg weight shall be attached to the other end of the specimen holder lever arm. With a lever advantage of two-to-one, a force of 20 kg is thus applied to the specimen at the line of contact.

6. Test Specimen

6.1 The specimen shall be at least 3⁄16 in. (5 mm) thick and have a surface area large enough so that the wear will be confined within its edges. The specimen may be as large as the specimen holder of the apparatus will permit. Dimensional tolerances are not important, but the specimen shall be flat within a maximum of 0.004 in./in. (mm/mm). Surface finish of the specimen is not important, except that ground blanks shall be cleaned with a suitable solvent to remove all oils or waxes, and unground blanks shall be grit blasted to remove all adhering foreign particles.

7. Procedure

7.1 Weigh the specimen on an analytical balance to the nearest 0.0001 g.

[1] This test method is under the jurisdiction of ASTM Committee B-9 on Metal Powders and Metal Powder Productsand is the direct responsibility of Subcommittee B09.06on Cemented Carbides.

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[2] *Annual Book of ASTM Standards*, Vol 02.05.

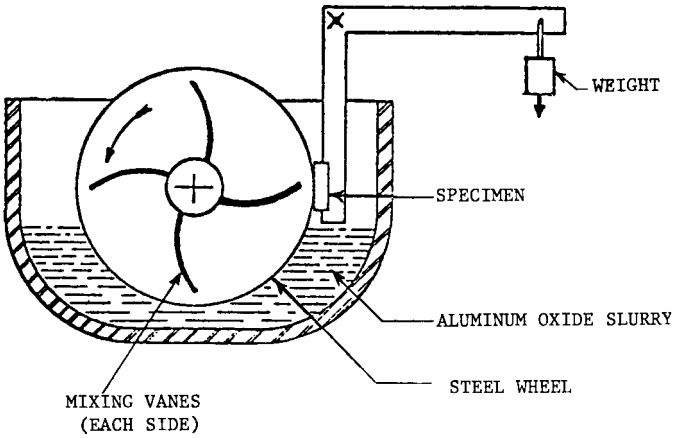

FIG. 1 Schematic Diagram of Abrasive Wear Resistance Apparatus

7.2 Determine the density in accordance with Test Method B 311.

7.3 Place the specimen in a specimen holder and fasten rigidly with set screws and pressure plates.

7.4 Insert the specimen holder into the abrasion wear test machine.

7.5 Release the 10-kg weight, causing the load to be applied to the specimen that is bearing against the wheel.

7.6 Plug the drain at the bottom of the vessel.

7.7 Pour aluminum oxide grit, 30 mesh,[3] into the vessel to within 1 in. (25 mm) of the center of the wheel. If a different abrasive is used it should be so noted in the report. Add water to the aluminum oxide in the proportion of 1 cm^3/4 g of grit.

7.8 Just as the water has seeped into the abrasive grit, start the rotation of the wheel and continue for 1000 revolutions (determine by means of a revolution counter). If the abrasive tends to accumulate at the end of the vessel opposite the specimen, stir and agitate with a rod to ensure that it is mixed into the slurry. Constantly check the wheel during the run to ensure that a thin film of abrasive slurry is evenly dispersed over the outside rim which is not in contact with the slurry.

7.9 Stop the rotation of the wheel after 1000 revolutions. Remove the drain block and flush the slurry out of the vessel. Do not re-use the abrasive grain; use fresh grain for every run.

7.10 Remove the sample from the specimen holder, rinse free of grit, and dry.

7.11 Weigh the specimen again to the nearest 0.0001 g.

8. Calculations

8.1 Calculate the abrasion resistance, *A*, in cubic centimetres per revolution, as follows:

$$A = (L/1000\ D) \times 10^5 \quad (1)$$

where:

L = weight loss, g, and
D = specimen density, g/cm^3.

8.2 Calculate the wear number, *W*, in reciprocal cubic centimetres, as follows:

$$W = D/L \quad (2)$$

9. Report

9.1 The manufacturer's grade designation, the manufacturer, and the abrasion resistance or wear number shall be included in the report.

10. Precision and Bias

10.1 The precision depends upon the relative abrasive resistance of the carbide being tested and since this test method covers a broad range of materials it cannot be determined at this time.

11. Keywords

11.1 abrasion resistance; abrasive wear; abrasive wear resistance; cemented carbides; hardmetals; powder metallurgy; wear number

[3] Norton's Alundum B or equivalent has been found satisfactory for this purpose.