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Standard Test Method for
Radial Crushing Strength, *K*, of Powder Metallurgy (P/M)(PM) Bearings and Structural Materials[1]

This standard is issued under the fixed designation B939; 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 the equipment and laboratory procedure for the determination of the radial crushing strength of materials using either a plain powder metallurgy (P/M)(PM) bearing or a thin-walled hollow cylindrical test specimen. This is a destructive test that produces quantitative results.

1.2 *Limitations*:

1.2.1 The principle of this procedure is based on the material being tested having minimal ductility. The permanent deflection of the cylinder during the test should not exceed 10 % of the outside diameter.

1.2.2 The radial crushing strength test results should be used only as a guide if the test specimen has a wall thickness that is greater than one-third of the outside diameter. These test results should then only be used for comparison with data from the test specimens of like materials and similar dimensions.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 With the exception of density values, for which the g/cm^3 unit is the industry standard, the values stated in inch-pound units are to be considered the standard. The values in SI units, shown in parenthesis have been converted in accordance with IEEE/ASTM Standard SI 10, may be approximate and are only included for information.

1.4 *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]

B243 Terminology of Powder Metallurgy

B438/B438M438 Specification for Bronze-Base Powder Metallurgy (P/M)(PM) Bearings (Oil-Impregnated)

B439 Specification for Iron-Base Powder Metallurgy (PM) Bearings (Oil-Impregnated) B612 Specification for Iron Bronze Sintered Bearings (Oil-Impregnated)

B782 Specification for Iron Graphite Sintered Bearings (Oil-Impregnated)

B925 Practices for Production and Preparation of Powder Metallurgy (PM) Test Specimens

2.2 *Practices for Production and Preparation of Powder Metallurgy (PM) Test Specimens*

E456 Terminology Relating to Quality and Statistics

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *IEEE/ASTM Standard:*

SI 10 American National Standard for Use of the International System of Units (SI): The Modern Metric System

2.3 *MPIF Standard:*[3]

MPIF Standard 55 Determination of Radial Crush Strength (*K*) of Powder Metallurgy (PM) Test Specimens

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

3. Terminology

3.1 *Definitions*—Definitions of powder metallurgy (P/M)(PM) terms can be found in Terminology B243. Additional descriptive information is available in the related material section of Vol 02.05 of the *Annual Book of ASTM Standards*.

4. Summary of Test Method

4.1 Radial crushing strength is determined by subjecting a plain sleeve bearing or a thin-walled cylindrical test specimen to a controlled compressive force applied perpendicular to its central axis under uniformly increasing load until fracture occurs.

4.2 The term radial crushing strength as used in this test method is the stress at fracture calculated from the breaking load and the dimensions of the test specimen.

5. Significance and Use

5.1 The radial crushing strength test is a destructive procedure used to determine a material strength characteristic of P/MPM bearings and hollow cylindrical test specimens. These data can be used to grade, classify, and evaluate the materials.

5.2 The P/MPM bearing Specifications B438/B438MB438, and B439 , B612, and B782 require the use of this test method as an acceptance test for the strength of oil-impregnated sintered bearings.

5.3 This test method may be used by powder producers and parts manufacturers as a lot acceptance test for metal powders and premixes lubricated powder mixtures intended for the production of porous parts.

5.4 Companies in the P/MPM industry use this test as a manufacturing control test because it is appropriate for production practices.

5.5 Radial crushing strength is a property of the P/MPM material but is not a design value. However, experience has shown that the radial crushing strength of a material is approximately twice itsthe ultimate tensile strength.

6. Apparatus

6.1 *Measuring Equipment*—Micrometers, calipers, and plug gages capable of measuring the inside and outside diameters and length of the test specimen to the nearest 0.001 in. (0.03 mm).

6.2 *Compression Testing Machine*—A compression machine capable of applying a controlled breaking force to the test specimen with an accuracy of 1 % and readable to the nearest 10 lbf (50 N).

6.3 *Loading Plates*—Two flat, ground-hardened hardened and ground steel plates of sufficient size to encompass the test specimen that, can be fastened to the press platens and that will remain parallel within 0.002 in./in. (mm/mm) under load.

7. Test Specimens

7.1 The test specimen shall be a right circular thin-walled hollow cylinder.

7.1.1 When metal powders are to be evaluated, the test specimen shall be produced according to the procedure in Practices

7.1 The test specimen shall be a hollow right circular thin-walled cylinder.

7.1.1 When PM bearings are to be tested, the test specimen shall be a plain sleeve bearing taken from a production lot or another bearing that has been machined to a plain cylindrical shape.

7.1.2 When metal powders are to be evaluated, the test specimen shall be produced according to the procedure in Practices B925.

7.1.2 If bearings are to be evaluated, the test specimen may be a plain sleeve bearing taken from a production lot or other bearing machined to a plain cylindrical shape.

8. Procedure

8.1 Clean any surface oil from the specimen and measure the outside diameter, inside diameter, and the length to the nearest 0.001 in. (0.03 mm).

8.2 Wipe the loading plates clean and lay the test specimen in the central region of the lower plate.

8.3 Bring the upper plate and test specimen into contact and slowly apply the diametrical load at a rate that does not exceed 0.2 in./min (5 mm/min) (see Fig. 1).

8.4 Using a scale on the compression testing machine that has a precision of 1 % or better of the crushing load, record to the nearest 10 lbf (50 N) the load at which the test specimen fractures or the first reading at which the applied load drops.

9. Calculation

9.1 Use Eq 1the following equation to calculate the radial crushing strength of the material in the specimen.

(1)   *Radial Crushing Strength, K = PD + d2LD − d2 2 = PD − tLt2*

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