Designation: B528 – 16

Standard Test Method for Transverse Rupture Strength of Powder Metallurgy (PM) Specimens[1]

This standard is issued under the fixed designation B528; 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 determination of the transverse rupture strength of sintered, including post-treated, powder metallurgy test specimens by subjecting them to a uniformly increasing transverse force under controlled conditions. The term "transverse rupture strength" as used herein, defines the stress, calculated from the flexure formula required to break a specimen as a simple beam supported near the ends and applying the force midway between the fixed line center of the supports.

1.2 *Limitations*— The transverse rupture test is only applicable to relatively brittle materials. In cases where a ductile specimen is being tested and the permanent deflection as a result of testing exceeds 0.02 in. (0.5 mm), the test results may be questionable.

1.3 Test Method B406 should be consulted for determining the transverse rupture strength of cemented carbides.

1.4 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.

1.5 *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

B312 Test Method for Green Strength of Specimens Compacted from Metal Powders

B406 Test Method for Transverse Rupture Strength of Cemented Carbides

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

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

3. Terminology

3.1 *Definitions*—For definitions of terms in this test method, see Terminology B243.

4. Significance and Use

4.1 This test method is used to measure the strength of sintered, including post-treated, specimens. Transverse rupture strength is not a design value. For many sintered materials, transverse rupture strength is approximately twice the ultimate tensile strength.

5. Apparatus

5.1 *Micrometer,* capable of measuring with a resolution of 0.0001 in. (0.002 mm).

5.2 *Transverse Rupture Strength Fixture,* as shown in Fig. 1.

5.3 *Compression Testing Machine,* readable to within 0.1 % of full scale reading. Use the lowest testing range that can provide a measurable result.

6. Test Specimen

6.1 The thin test specimen shall have the shape and dimensions shown in the figure titled PM Transverse Rupture Strength Test Specimen of Practices B925.

7. Procedure

7.1 Prepare test specimens by pressing and sintering using tooling shown in the figure titled Transverse Rupture Test Specimen, Typical Laboratory Tooling of Practices B925, or machine from finished parts. Measure the width and thickness of the specimens to the nearest 0.001 in. (0.02 mm) with a micrometer.

7.2 Locate the specimen in the transverse rupture test fixture perpendicular to the supporting rods. Apply compressive force

[1] This test method is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.05 on Structural Parts.

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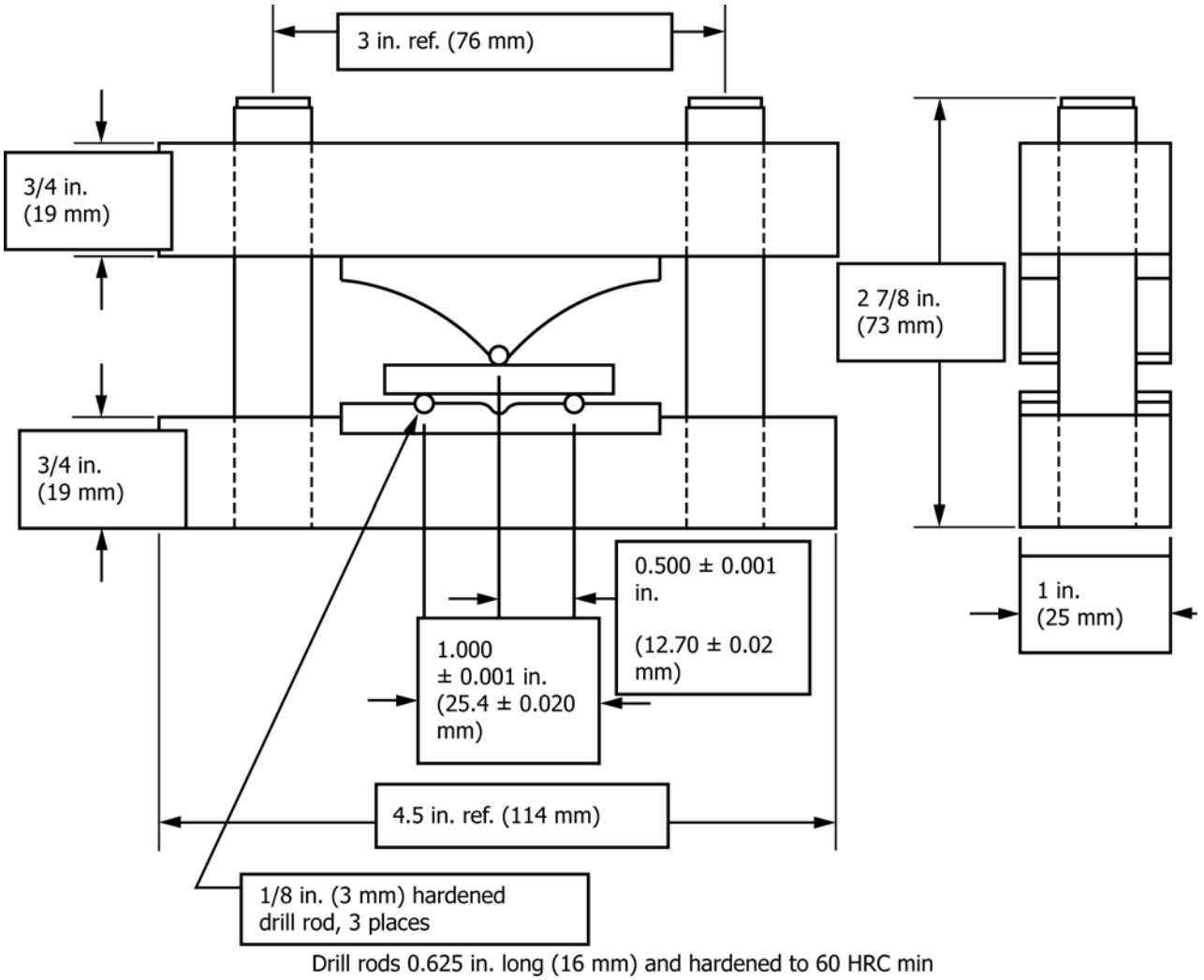
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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



NOTE 1—This fixture is used in Test Method B312.

FIG. 1 Transverse Rupture Test Fixture

parallel to the pressing direction of the specimen at a no-load crosshead speed of not greater than 0.2 in./min (5 mm/min) until rupture occurs. Record the load at which the specimen breaks (force required to rupture specimen, P).

8. Calculation

8.1 Calculate the transverse rupture strength of the specimen as follows:

$$TRS = (3 \times P \times L)/(2 \times T^2 \times W) \quad (1)$$

where:

- TRS = transverse rupture strength of the specimen, psi (MPa),
- P = force required to rupture the specimen, lbf (N),
- L = the distance between the centers of the supporting rods, 1.000 in. (25.4 mm),
- W = width of the specimen, in. (mm), and
- T = thickness of specimen, in. (mm).

9. Report

9.1 Report the transverse rupture strength as the average of at least three (3) tests to the nearest 1000 psi (10 MPa). When reporting the results, state the following supplementary data to clarify the results:

9.1.1 Identification of the material being tested, that is, composition, density, state of heat treatment, and compacted or machined specimen.

10. Precision and Bias[3]

10.1 The repeatability (r) and reproducibility (R) measurements were determined (1995) according to Practice E691 and are listed in Table 1 for six materials and a range of transverse rupture strength values. On the basis of test error alone, the

[3] The precision for this test method was developed by the Metal Powder Industries Federation (MPIF) and is used herein with their permission.

TABLE 1 Precision of Transverse Rupture Strength[A]

Material Designations	Density g/cm^3	Apparent Hardness	TRS psi	#Labs	(*r*) psi	(*R*) psi
F-0005-15	6.22	37 HRB	63 000	19	4800	7900
FC-0205-30	6.21	43 HRB	66 500	16	5600	11 500
F-0005-25	6.91	40 HRB	71 000	12	5500	14 000
FN-0208-35	6.95	77 HRB	123 500	19	6900	11 600
FL-4405-40	7.04	75 HRB	129 500	16	7000	13 800
FC-0208-50	6.69	81 HRB	144 000	12	12 500	21 000
FC-0208-65HT	6.43	31 HRC	138 500	22	15 400	28 000
F-0008-65HT	6.68	35 HRC	148 500	16	22 000	31 700
FLC-4608-70HT	6.69	31 HRC	174 000	14	28 800	41 500
FN-0205-105HT	6.93	31 HRC	191 500	14	23 700	40 500
FC-0205-90HT	7.03	41 HRC	236 000	16	28 100	42 400
FLN-4205-140HT	7.12	41 HRC	251 500	22	32 700	46 900
FLN2-4405-160HT	7.04	38 HRC	246 000	35	21 500	31 200

[A]The (*r*) and (*R*) values were determined from the testing of three (3) transverse rupture test specimens by each participating laboratory.

difference in absolute value of two test results obtained in the same laboratory will be expected to exceed (*r*) only 5 % of the time. If such a difference is found to be larger than (*r*), there is reason to question one or both results. Similarly, the difference in two test results obtained in different laboratories will be expected to exceed (*R*) only 5 % of the time. If the difference is found to be larger than (*R*), there is reason to question one or both measurements.

10.2 *Bias*—No information can be presented on the bias of the test procedure in Test Method B528 for measuring Transverse Rupture Strength because no material having an accepted reference value is available.

10.3 *Measurement Uncertainty*—The precision of Test Method B528 shall be considered by those performing the test when reporting Transverse Rupture Strength results.

11. Keywords

11.1 flexural strength; 3 Point Bend Test; transverse rupture; transverse rupture strength; TRS

SUMMARY OF CHANGES

Committee B09 has identified the location of selected changes to this standard since the last issue, B528 – 12, that may impact the use of this standard. (October 1, 2016)

(1) In 1.2, changed “0.020 in.” to “0.02 in.” and “0.50 mm” to “5 mm.”
(2) In 7.2, changed “0.2 in. (5.0 mm)/min” to “0.2 in./min (0.5 mm/min).”
(3) In 8.1, changed “t” to “T” and “w” to “W” in line with B09 Form & Style.
(4) In 9.1, added “as the average of at least three (3) tests.”
(5) In Fig. 1, added the length of the hardened drill rods and their minimum hardness.