Designation: B 528 – 99

Standard Test Method for Transverse Rupture Strength of Metal Powder Specimens[1]

This standard is issued under the fixed designation B 528; 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, metal powder 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 0.020 in. (0.50 mm), the test results may be questionable.

1.3 The values stated in inch-pound units are to be regarded as the standard. The SI values are provided for information only.

1.4 Test Method B 406 should be consulted for determining the transverse rupture strength of cemented carbides.

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:*

B 243 Terminology of Powder Metallurgy[2]

B 312 Test Method for Green Strength for Compacted Metal Powder Specimens[2]

B 406 Test Method for Transverse Rupture Strength of Cemented Carbides[2]

3. Terminology

3.1 *Definitions*—For definitions of terms in this test method, see Terminology B 243.

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 *Punches and Die (Fig. 1)*, for producing a test specimen in accordance with 6.1

5.2 Equipment capable of applying the required pressure to produce the standard test specimen.

5.3 *Balance*, suitable for weighing accurately to 0.01 g.

5.4 *Micrometer*, with a resolution of 0.0001 in. (0.002 mm).

5.5 *Transverse Rupture Strength Fixture*, as shown in Fig. 2.

5.6 *Compression Testing Machine*, capable of applying a breaking force on the test specimen with an accuracy of 1.0 % and readable to the nearest 10 lbf (50 N).

6. Test Specimen

6.1 The test specimen shall have the shape and dimensions shown in Fig. 3.

7. Procedure

7.1 Prepare test specimens by pressing and sintering using tooling described in Test Method B 312, or machine from finished parts. Measure the width and thickness of the specimens to the nearest 0.001 in. (0.03 mm) with a micrometer.

7.2 Locate the specimen in the transverse rupture test fixture perpendicular to the supporting rods. Apply compressive force parallel to the pressing direction of the specimen at a no-load crosshead speed of not greater than 0.2 in. (5.0 mm)/min until rupture occurs. Record this breaking force to the nearest 10 lbf (50 N).

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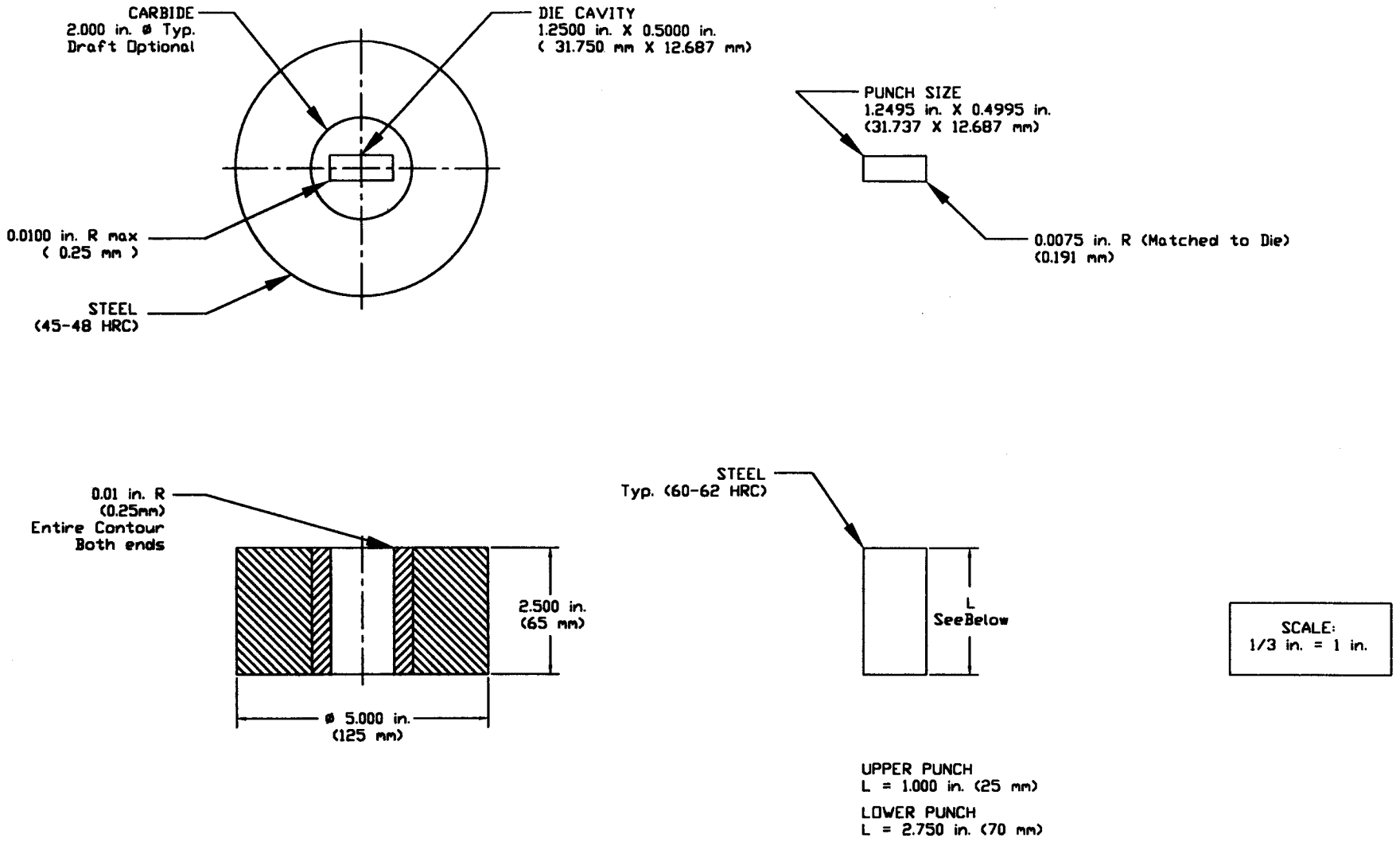
[2] *Annual Book of ASTM Standards*, Vol 02.05.



NOTE 1—The dimensions for the cavity shall be 0.500 ± 0.004 in. wide (12.70 ± 0.10 mm) by 1.250 ± 0.004 in. long (31.75 ± 0.10 mm). The mating parts shall fit freely and should be finished to a 4-µin. (N3) or better, to dimensions of 0.0005 in. (0.013 mm) to 0.0010 in. (0.025 mm) smaller than the die cavity in each dimension. The dimensions given in the drawing typify the die cavity and punch within the stated tolerance at the normal width and length.

FIG. 1 Example of Tooling to Produce the Test Specimen

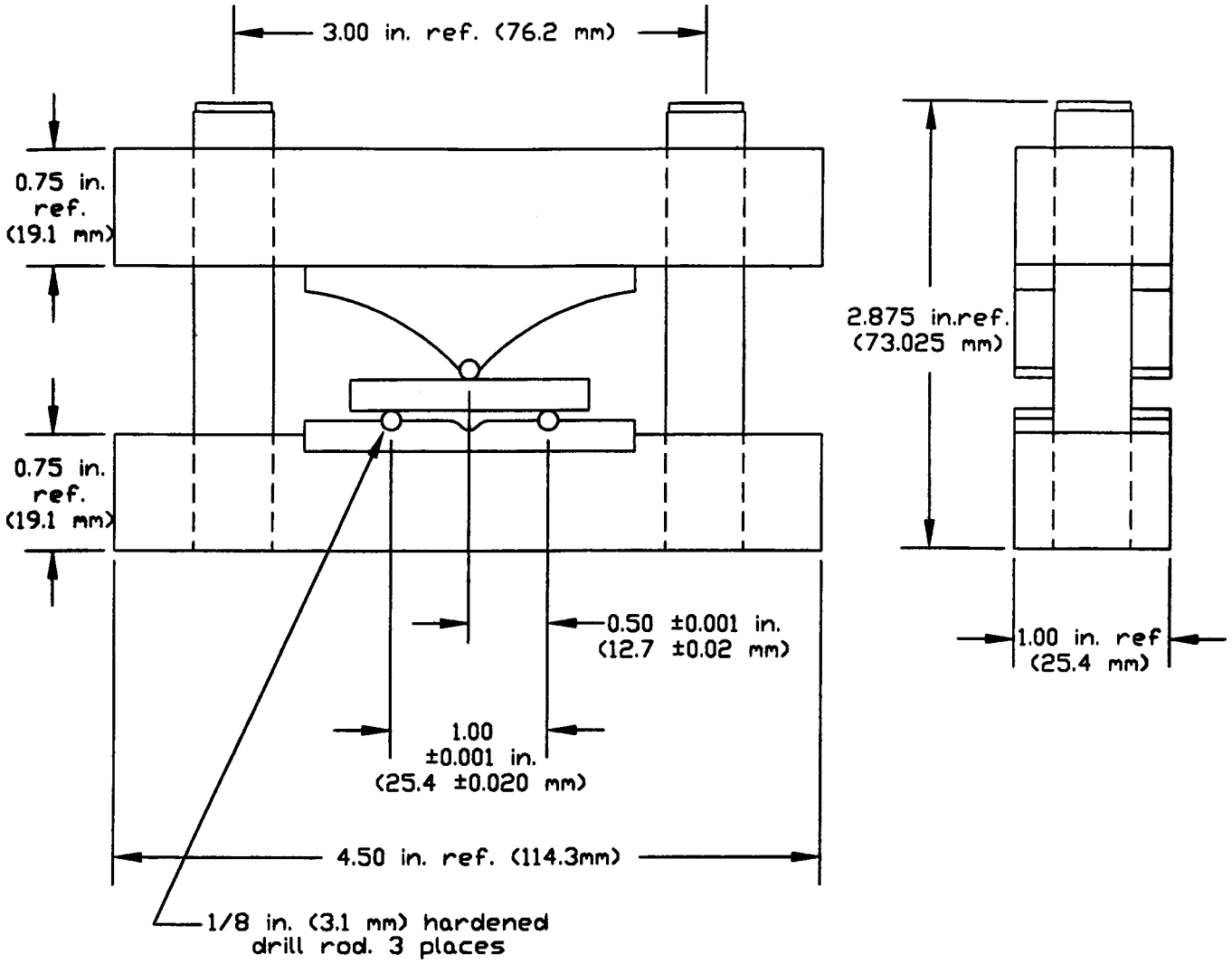


FIG. 2 Transverse Rupture Test Fixture

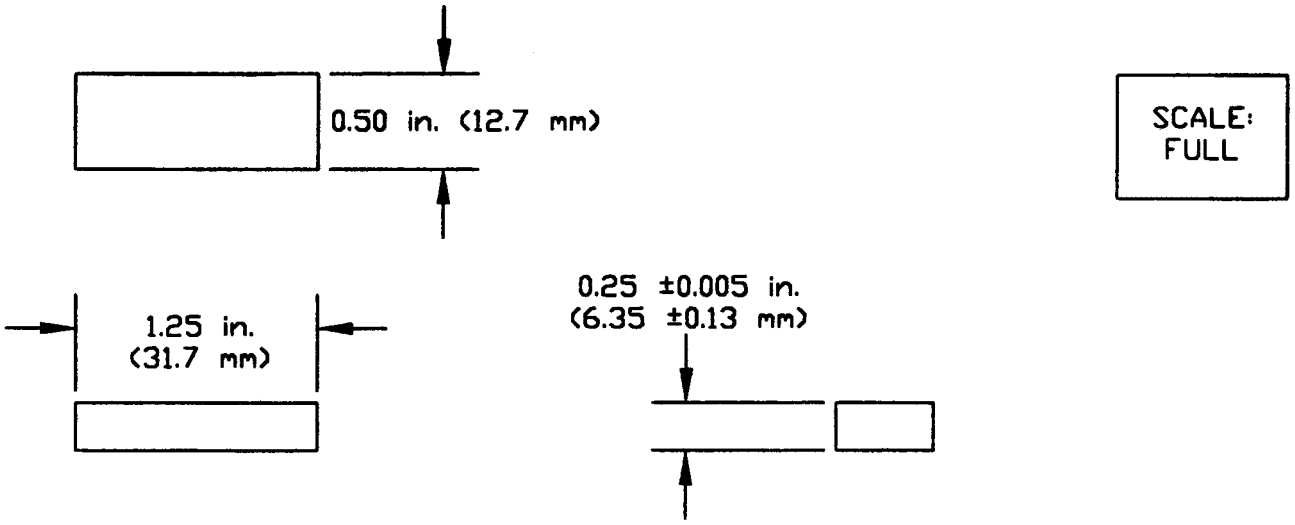


FIG. 3 Typical Transverse Rupture Test Specimen

8. Calculation

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

$$TRS = (3 \times P \times L) / (2 \times t^2 \times w) \quad (1)$$

where:

TRS = transverse rupture strength of the compact, psi (MPa),
P = force required to rupture the specimen, lbf (N),
L = length of specimen span relative to fixture 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 in pounds-force per square inch (megapascals) 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

10.1 On the basis of test error alone, the difference in the absolute value of two test results, x_1 and x_2. obtained in the same laboratory on the same material, will be expected to exceed *r*, (the repeatability interval) only about 5 % of the time. If such a difference is found to be larger than *r* there is reason to question one or both results. The value of *r* varies proportionally with the magnitude of the transverse rupture strength and is calculated from the following equation:

$$r = 6700 + (0.064)\,(x - 41000) \quad (2)$$

where the units of *r* and *x* are psi. This applies over the range from x from 41 500 to 145 000 psi. The unit *x* is the average of the two points being checked.

$$\frac{x_1 + x_2}{2} = x \quad (3)$$

10.2 On the basis of test error alone, the difference in absolute value of two test results, x_1 and x_2, obtained in different laboratories on the same material, will be expected to exceed *R*, the reproducibility interval, only about 5 % of the time. If such a difference is found to be larger than *R* there is reason to question one or both results. The value of *R* varies proportionally with the magnitude of the transverse rupture strength and is calculated from the following equation:

$$R = 8900 + (0.122\,)\,(x - 41000) \quad (4)$$

where units of *R* and *x* are psi.

10.3 The value of *r* and *R* are assumed to vary linearly over the transverse rupture strength range from 41 500 to 145 000 psi. Transverse rupture strength was measured only at the two end points.

11. Keywords

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