



Standard Test Method for Compressibility of Metal Powders in Uniaxial Compaction¹

This standard is issued under the fixed designation B 331; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This test method covers determination of compressibility of metal powders as measured by the extent to which they can be densified in a specified die under controlled conditions.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI equivalents 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 215 Practices for Sampling Finished Lots of Metal Powders²

B 243 Terminology of Powder Metallurgy²

B 328 Test Method for Density, Oil Content, and Interconnected Porosity of Sintered Powder Metal Structural Parts and Oil-Impregnated Bearings²

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method refer to Terminology B 243.

4. Summary of Test Method

4.1 The test method consists of compacting a sample of metal powder in a confining die, ejecting it from the die, and measuring its green density. The powder is subjected to uniaxial loading in a standardized die of rectangular or of round cross section.

5. Significance and Use

5.1 The compressibility obtained is a measure of a material characteristic inherent in the powder. The test method is useful as a quality control test in the evaluation and manufacturing control of metal powder production, and as an acceptance test for shipment of metal powder lots.

5.2 Results may be affected by test conditions such as the type amount, and method of lubrication, dwell time, and die material. They may not necessarily agree with results obtained under production conditions.

6. Apparatus

6.1 *Die and Two Steel Punches*—The die should be made of cemented carbide, or alternatively of tool steel. The set may be designed either for rectangular compacts or round compacts. Fig. 1 illustrates typical rectangular tooling and Fig. 2 illustrates typical round tooling.

6.2 *Compression Testing Machine or Hydraulic Powder Compacting Press*, capable of applying an adequate load with an accuracy of at least $\pm 1.0\%$.

6.3 *Balance*, suitable for weighing at least 100 g to the nearest 0.01 g.

6.4 *Micrometer*, or other suitable measuring device for measuring the dimensions of the compacts to the nearest 0.0002 in. (0.005 mm).

7. Sampling

7.1 A quantity of powder capable of producing the required number of test specimens (see 9.1 and Section 11) shall be obtained in accordance with Practices B 215.

8. Preparation of Apparatus

8.1 Lubrication is necessary to assist the ejection of the compacted test specimen from the die. Either die wall lubrication or powder lubrication may be used.

8.1.1 *Unlubricated Powder* may be tested in a die with lubricated walls. Apply to the die walls a mixture of a lubricant in a volatile organic liquid. After any excess liquid has drained away, allow the solution adhering to the walls to evaporate leaving a thin layer of lubricant.

NOTE 1—An example of such a mixture is 100 g of zinc stearate in 1 L of methyl alcohol.

8.1.2 An alternative way of testing powder not containing a lubricant is to use an otherwise unlubricated die after thoroughly mixing into the powder a sufficient amount of a suitable lubricant.

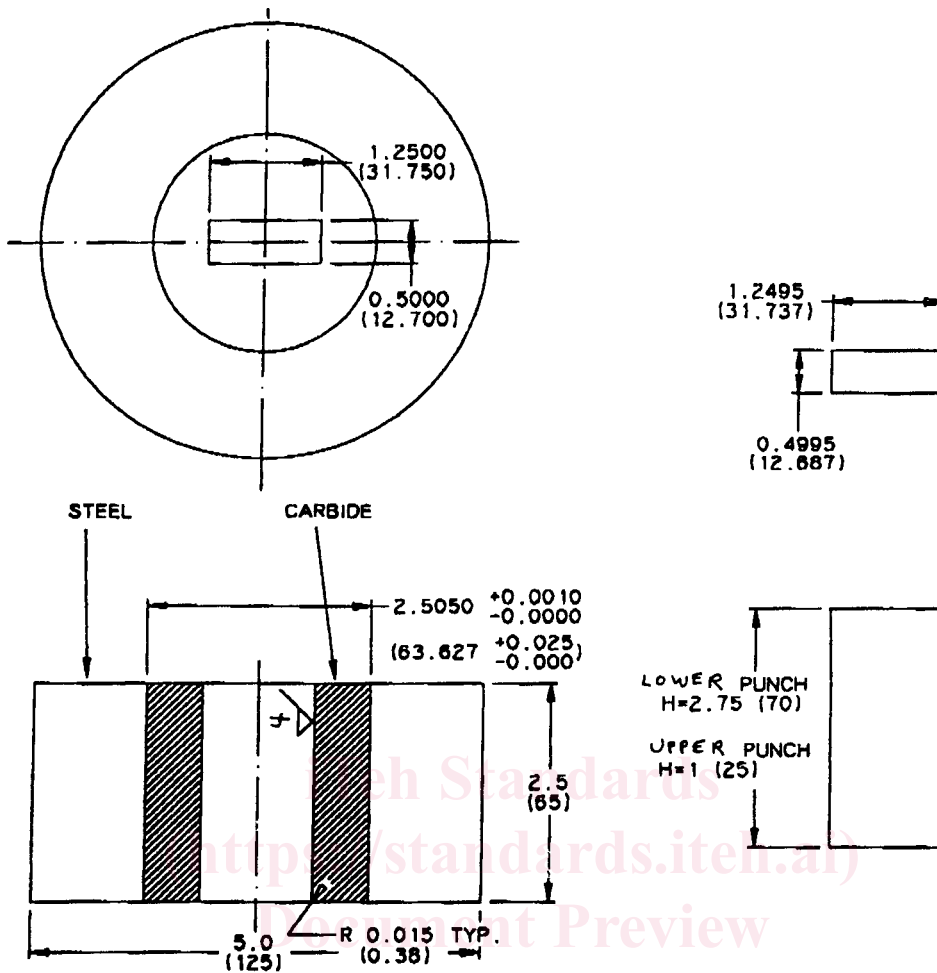
8.1.3 *Lubricated Powder*, received already mixed with sufficient lubricant should be tested in an otherwise unlubricated die.

8.2 Compressibility may vary according to the method of lubrication, type, and amount of lubricant.

¹ This test method is under the jurisdiction of ASTM Committee B-9 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.02 on Base Metal Powders.

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



NOTE:
 SHRINK RING ID 2.5000 ± 0.0000 (63.500 ± 0.000)
 -0.0010 (63.500 -0.025)
 DIE BORE TAPERED 1.5° over 0.1 (2.5) at top entrance and
 radiused 0.03 (0.8) to aid ejection

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 4 RMS, or better, to dimensions of 0.0005 in. (0.013 mm) to 0.001 in. (0.025 mm) smaller than the bottom of the die cavity, in each dimension. The dimensions given in the drawing typify the die cavity and punch within the stated tolerance, at the nominal width and length dimensions, permitting die wall to punch clearances of 0.00025 to 0.0005 in. (0.006 mm to 0.013 mm) at each of the four sides of the die, at the bottom of the die. The outer ring may be AISI H-11 steel hardened to 45 to 48 HRC. The punches may be AISI A-7 steel hardened to 60 to 62 HRC. The die insert should be die grade tungsten carbide.

FIG. 1 Example of Tooling to Produce Rectangular Test Piece

8.3 The parties shall agree on the method, amount, and type of lubricant.

9. Procedure

9.1 *Powder Sample Mass*—The powder sample mass shall be such as to result in a rectangular compact 0.240 to 0.260 in. thick (6.1 to 6.6 mm) or a round compact 0.27 to 0.29 in. (6.9 to 7.4 mm) thick. For a powder whose compressibility is not known, it may be necessary to adjust the powder mass based on the specimen thickness obtained in an initial test.

9.2 *Compaction*—The specimen shall be made using a double action pressing process. One example of this type of compaction is as follows:

9.2.1 Insert the lower punch into the die cavity. Position the

die cavity to the desired filling height using supporting spacers between the die and the lower press platen. Pour the powder sample into the die cavity taking care to ensure that the powder is uniformly distributed. Insert the upper punch and then apply and release a preliminary pressure of approximately 5000 psi (35 MPa). Remove the spacers supporting the die. If the die is supported by springs, or in some similar way, it is unnecessary to apply the preliminary pressure. Apply the final pressure. In special cases where the results may be affected by the rate of pressure application, a rate not exceeding 60 000 psi/min (415 MPa/min) is recommended.

9.2.2 Release the pressure as soon as the maximum pressure is attained, because pressure dwells of as little as 10 s can