Designation: B 610 – 00ε1

Standard Test Method for Measuring Dimensional Changes of Metal Powder Specimens[1]

This standard is issued under the fixed designation B 610; 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—Editorial corrections were made in Sections 5, 8.6, 9, and 10.4 and Fig. 2.

1. Scope

1.1 This test method primarily covers a procedure for determining the change in dimensions that occurs as a result of pressing and sintering a metal powder specimen. The size change referred to is the difference between the die size and the size of the sintered specimen after it has cooled to room temperature, expressed as a percentage. This size change is a basic characteristic of the metal powder.

1.2 The general procedure of measuring a test specimen and die, then calculating the dimensional change, as described in this test method, also may be used to determine green expansion, heat treat changes, or other dimensional changes of test specimens that result from processing steps.

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

1.4 *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:*

B 215 Practices for Sampling Finished Lots of Metal Powders[2]

B 243 Terminology of Powder Metallurgy[2]

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

3. Terminology

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

4. Summary of Test Method

4.1 Test specimens are made from the metal powder lot under consideration by pressing and sintering or other processing (see 1.2). The absolute dimensional change as a result of pressing and sintering is calculated from measurements taken on the sintered test specimens and from the die cavity.

4.2 When this method is used to compare metal powder lots, specimens from a reference metal powder lot agreed upon by the parties concerned are made and processed at the same time. The dimensional change of the test specimen is calculated and mathematically compared with the dimensional change of the reference specimen.

5. Significance and Use

5.1 The dimensional change obtained under specified conditions of pressing and sintering is a material characteristic inherent in the powder. It is useful to the production, testing, and use of metal powders.

5.2 The absolute dimensional change may be used to classify powders or differentiate one type or grade from another, to evaluate additions to the powder mix or measure process changes, and to guide in the design of tooling.

5.3 The comparative dimensional change is mainly used as a quality control test to measure variations between lots of metal powders of the same material composition.

5.4 Factors known to affect size change are the test specimen process conditions of green density, sinter time, sinter temperature, sinter atmosphere, level of additions to the base metal powder, lubricant type, powder grade, powder type, and powder lot.

6. Apparatus

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

6.2 *Mixer*, capable of thorough and controlled mixing of metal powders and lubricants.

6.3 *Compression-Testing Machine or Powder Press*, capable of applying the required pressure to produce the test specimen.

6.4 *Punches and Die*, for producing a test specimen, are shown in Fig. 1.

6.5 *Micrometers*, capable of measuring the necessary dimensions to 0.0001 in. (0.0025 mm).

6.6 *Sintering Furnace*, capable of maintaining a specified work temperature and having controlled atmosphere and a

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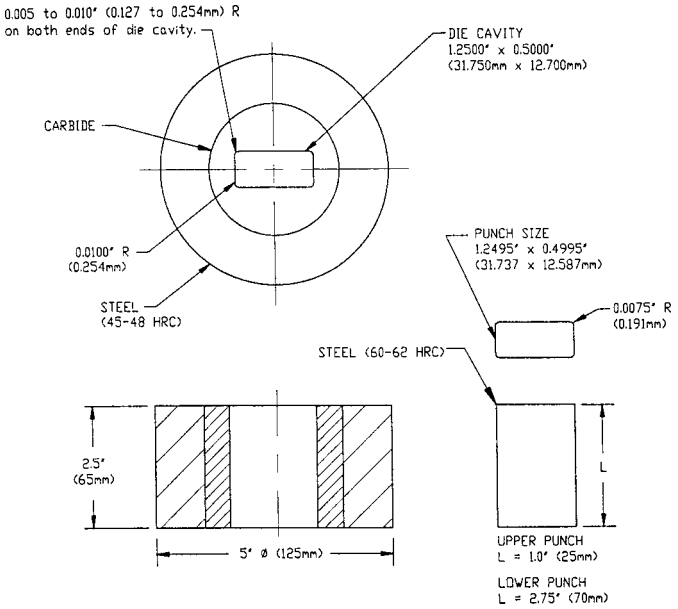
[2] *Annual Book of ASTM Standards*, Vol 02.05.



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 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

water-jacketed cooling zone. A vacuum furnace also is permitted.

6.7 When the dimensional change test is run to approve metal powders for production, it is preferable to use sintering conditions that approximate or simulate production conditions.

7. Test Specimen

7.1 The green test specimen, having nominal dimensions of 0.500 in. (12.70 mm) wide by 1.250 in. (31.75 mm) long by 0.250 in. (6.35 mm) thick, as shown in Fig. 2, is the recommended test specimen.

8. Procedure

8.1 Measure the long dimension of the die cavity to 0.0001 in. (0.0025 mm). Note this dimension, L_D, for future reference.

8.2 Obtain a test sample of the test metal powder (and reference metal powder, if used) in accordance with Practice B 215.

8.3 Compact three test specimens (and three reference specimens, if used) in accordance with Test Method B 312.

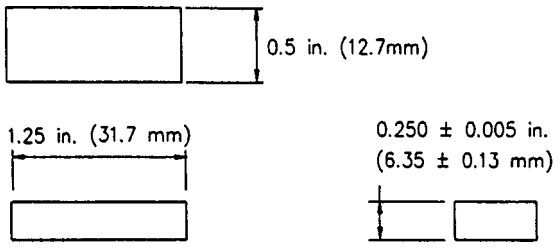


FIG. 2 Dimensional Change Test Specimen

8.4 Sinter the test specimens (with three reference specimens, if used) using a heating rate, sintering time and temperature, and cooling rate suitable for the material being tested.

8.5 When the dimensional change method is used to approve a metal powder lot, all powder and processing conditions shall be agreed upon by the parties concerned.

8.6 Measure the long dimension of the sintered specimens to 0.0001 in. (0.0025 mm). Note this dimension, L_T and L_R for reference specimens, if used, , for later calculation use.

9. Calculation

9.1 *Absolute Dimensional Change*:

9.1.1 Calculate the percent dimensional change (D_T) for the specimens from the test powder as follows:

$$D_T, \% = (L_T - L_D)/L_D \times 100 \quad (1)$$

where:

L_T = long dimension of sintered *test* specimen (see 8.6) and

L_D = long dimension of the die cavity (see 8.1).

9.1.2 Calculate the percent dimensional change (D_R) for the specimens from the reference powder as follows:

$$D_R, \% = (L_R - L_D)/L_D \times 100 \quad (2)$$

where:

L_R = long dimension of sintered *reference* specimen (see 8.6).

9.2 *Comparative Dimensional Change*—Calculate the comparative dimensional change (D) as follows:

$$D, \% = D_T - D_R \quad (3)$$

10. Report

10.1 Report the absolute dimensional change from die size for the specimens made from the test powder (D_T), and those from the reference powder (D_R), as the average of the three specimens, calculated to the nearest 0.01 %, including the sign of + for growth and – for shrinkage.

10.2 Report the comparative dimensional change (D), as the mathematical difference between the average absolute dimensional change from die size for the specimens made from the test powder and those from the reference powder as a percent to the nearest 0.01 %, including the sign of + or – to indicate direction of the difference.

NOTE 1—If the % dimensional change is divided by 100, the results then will be expressed in in./in. (mm/mm).

10.3 The following supplementary information should be reported for clarification:

10.3.1 Identification of powder, brand, grade, and lot number.

10.3.2 Chemistry of powder mix used if other than elemental powders are being tested.

10.3.3 Type, brand and percent of lubricant or the additives,

10.3.4 Compacting pressure,

10.3.5 Green density,

10.3.6 Sintering temperature,

10.3.7 Sintering time, as defined as the elapsed time for the heated specimen to be within ±15°F (±8°C) of the stated sintering temperature for iron and ±10°F (±5°C) for copper base, and

10.3.8 Furnace atmosphere.

10.4 The absolute dimensional change (D_R) of the specimens made from the reference metal powder shall be within the limits agreed upon between the parties concerned in order to have a valid test.

11. Precision and Bias

11.1 The precision and bias of this test method is currently under development in Subcommittee B09.02 on Base Metal Powders.

12. Keywords

12.1 die size; dimensional change; metal powders; sintering