



Standard Test Methods of Compression Testing of Metallic Materials at Room Temperature¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 These test methods cover the apparatus, specimens, and procedure for axial-load compression testing of metallic materials at room temperature (Note 1). For additional requirements pertaining to cemented carbides, see Annex A1.

NOTE 1—For compression tests at elevated temperatures, see Practice E 209.

1.2 The values stated in inch-pound units are to be regarded as the standard. The metric equivalent values cited in the standard 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 557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products²
- E 4 Practices for Force Verification of Testing Machines³
- E 6 Terminology Relating to Methods of Mechanical Testing³
- E 83 Practice for Verification and Classification of Extensometer³
- E 111 Test Method for Young's Modulus, Tangent Modulus, and Chord Modulus³
- E 171 Specification for Standard Atmospheres for Conditioning and Testing Flexible Barrier Materials⁴
- E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods⁵

¹ These test methods are under the jurisdiction of ASTM Committee E28 on Mechanical Testing and are the direct responsibility of Subcommittee E28.04 on Uniaxial Testing.

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² Annual Book of ASTM Standards, Vol 02.02.

³ Annual Book of ASTM Standards, Vol 03.01.

⁴ Annual Book of ASTM Standards, Vol 15.09.

⁵ Annual Book of ASTM Standards, Vol 14.02.

E 209 Practice for Compression Tests of Metallic Materials at Elevated Temperatures with Conventional or Rapid Heating Rates and Strain Rates³

E 251 Test Methods for Performance Characteristics of Metallic Bonded Resistance Strain Gages³

3. Terminology

3.1 **Definitions:** The definitions of terms relating to compression testing and room temperature in Terminology E 6 and Specification E 171, respectively, shall apply to these test methods.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 **buckling**—In addition to compressive failure by crushing of the material, compressive failure may occur by (1) elastic instability over the length of a column specimen due to nonaxiality of loading, (2) inelastic instability over the length of a column specimen, (3) a local instability, either elastic or inelastic, over a small portion of the gage length, or (4) a twisting or torsional failure in which cross sections rotate over each other about the longitudinal specimen axis. These types of failures are all termed *buckling*.

3.2.2 **column**—a compression member that is axially loaded and that may fail by buckling.

3.2.3 **radius of gyration**—the square root of the ratio of the moment of inertia of the cross section about the centroidal axis to the cross-sectional area:

$$\rho = (I/A)^{1/2} \quad (1)$$

where:

ρ = radius of gyration,

I = moment of inertia of the cross section about centroidal axis (for specimens without lateral support, the smaller value of I is the critical value), and

A = cross-sectional area.

3.2.4 **critical stress**—the axial uniform stress that causes a column to be on the verge of buckling. The critical load is calculated by multiplying the critical stress by the cross-section area.

3.2.5 **buckling equations**—If the buckling stress is less than or equal to the proportional limit of the material its value may be calculated using the Euler equation: