



Standard Practice for Compression Tests of Metallic Materials at Elevated Temperatures with Conventional or Rapid Heating Rates and Strain Rates¹

This standard is issued under the fixed designation E209; 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 practice covers compression test in which the specimen is heated to a constant and uniform temperature and held at temperature while an axial force is applied at a controlled rate of strain.

NOTE 1—In metals with extremely high elastic limit or low modulus of elasticity it is conceivable that 1.5 percent total strain under load could be reached before the 0.2 percent-offset yield strength is reached. In this event the 0.2 percent-offset yield strength will be the end point of the test unless rupture occurs before that point.

NOTE 2—For acceptable compression tests it is imperative that the specimens not buckle before the end point is reached. For this reason the equipment and procedures, as discussed in this recommended practice, must be designed to maintain uniform loading and axial alignment.

1.2 Preferred conditions of testing are recommended so that data from different sources conducting the tests will be comparable.

1.3 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.

1.4 *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:²

E4 Practices for Force Verification of Testing Machines

E9 Test Methods of Compression Testing of Metallic Materials at Room Temperature

E21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials

E83 Practice for Verification and Classification of Extensometer Systems

3. Apparatus

3.1 *Testing Machines*—Machines used for compression testing shall conform to the requirements of Practices E4.

3.2 *Bearing Blocks and Loading Adapters*—Load both ends of the compression specimens through bearing blocks or through pin-type adapters that are part of the compression-testing assembly. Bearing blocks may be designed with flat bearing faces for sheet- or bar-type specimens. Sheet specimens may also be loaded through pin-type adapters that are clamped rigidly to the grip sections of specimens designed for these adapters (1).³ The main requirement is that the method of applying the force be consistent with maintaining axial alignment and uniform loading on the specimen throughout the test. When bearing blocks with flat faces are used, the load-bearing surfaces should be smooth and parallel within very close limits. The tolerance for parallelism for these surfaces should be equal to or closer than that specified for the loaded ends of the specimens. The design of the equipment should provide adequate rigidity so that parallelism is maintained during heating and loading. The bearing blocks or pin-type adapters should be made of a material that is sufficiently hard at the testing temperature to resist plastic indentation at maximum force. They should also be of a material or coated with a material that is sufficiently oxidation resistant at the maximum testing temperature to prevent the formation of an oxide coating that would cause misalignment. In any compression test it is important that the specimen be carefully centered with respect to the bearing blocks, which in turn should be centered with respect to the testing machine heads.

NOTE 3—Bearing blocks with straight cylindrical or threaded holes depending on specimen design may be used for bar-type specimens providing the apparatus qualifies in accordance with Section 9.

NOTE 4—Bearing blocks of an adjustable type to provide parallel loading surfaces are discussed in Test Methods E9. Bearing blocks with a

¹ This practice is under the jurisdiction of ASTM Committee E28 on Mechanical Testing and is the direct responsibility of Subcommittee E28.04 on Uniaxial Testing.

Current edition approved Sept. 1, 2010. Published November 2010. Originally approved in 1963. Last previous edition, approved in 2005 as E209–05. DOI: 10.1520/E0209-00R10.

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.

³ Boldface numbers in parentheses refer to references at the end of this practice.