



Standard Test Methods for Bend Testing of Metallic Flat Materials for Spring Applications Involving Static Loading¹

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1. Scope

1.1 This standard describes three test methods² for determining the modulus of elasticity in bending and the bending strength of metallic strips or sheets intended for the use in flat springs:

1.1.1 *Test Method A*—a cantilever beam,

1.1.2 *Test Method B*—a three-point loaded beam (that is, a beam resting on two supports and centrally loaded), and

1.1.3 *Test Method C*—a four-point loaded beam (that is, a beam resting on two supports and loaded at two points equally spaced from each support).

1.2 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.

1.3 *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 The following documents of the issue in effect on date of use of these test methods form a part of these test methods to the extent referenced herein:

2.2 *ASTM Standards*:³

E4 Practices for Force Verification of Testing Machines

E6 Terminology Relating to Methods of Mechanical Testing

E111 Test Method for Young's Modulus, Tangent Modulus, and Chord Modulus

¹ These test methods are under the jurisdiction of ASTM Committee E28 on Mechanical Testing and are the direct responsibility of Subcommittee E28.02 on Ductility and Formability.

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² Method D, which appeared in the last previous edition, was dropped because of the unavailability of commercial testing equipment.

³ 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.

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 In addition to the terms in Terminology E6, the following descriptions of terms apply in connection with these test methods for determining bend properties:

3.1.2 *bend properties*—those properties of a material that are associated with elastic and inelastic behavior when a bending force is applied, or that involve the relationship between bending stress and strain.

3.1.3 *bending stress at outer fiber* (FL^{-2})—the nominal stress in the outer fibers of a beam resulting from application of a bending load.

3.1.4 *elastic limit in bending* (FL^{-2})—the greatest bending stress that a material is capable of sustaining without permanent strain remaining after complete release of the bending moment.

3.1.5 *modulus of elasticity in bending* (FL^{-2})—the ratio of bending stress to corresponding strain below the elastic limit in bending.

3.1.6 *span length* (L)—the distance between supports.

3.1.7 *uniform bending moment* (FL)—a bending moment that produces a uniform strain at the outer fibers throughout the gage length of the specimen.

3.1.8 *bending proof strength* (FL^{-2})—the nominal stress in the outer fibers of a beam that results in a specific permanent strain in the outer fibers upon unloading.

3.1.9 *cyclic bending yield strength* (FL^{-2})—the maximum nominal stress in uniform cyclic bending resulting from a given plastic deformation in the outer fibers of a beam.

3.1.10 *offset yield strength in bending* (FL^{-2})—the nominal stress in the outer fibers of a beam in bending at which a specified limiting deviation from proportionality of bending stress to bending strain is exhibited. The deviation is expressed in terms of strain.