



Standard Practice for Verification of Specimen Alignment Under Tensile Loading¹

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1. Scope

1.1 Included in this practice are methods covering the determination of the amount of bending that occurs during the loading of notched and unnotched tensile specimens in the elastic range and to plastic strains less than 0.002. These methods are particularly applicable to the force application rates normally used for tension testing, creep testing, and uniaxial fatigue testing.

2. Referenced Documents

2.1 ASTM Standards:

E 6 Terminology Relating to Methods of Mechanical Testing²

3. Terminology

3.1 The terms in Terminology E 6 apply. Other terms used in connection with specimen alignment are defined as follows:

3.2 Definitions:

3.2.1 *alignment*—the condition of a testing machine and load train (including the test specimen) which influences the introduction of bending moments into a specimen during tensile loading.

3.2.2 *apparatus*—the load-train, strain gages, and other details of the equipment to be used for testing, excluding the test specimen.

3.2.3 *axial strain*—the average of the longitudinal strains measured at the surface on opposite sides of the longitudinal axis of symmetry of the specimen by two strain-sensing devices located at the mid-length of the reduced section.

3.2.4 *bending strain*—the difference between the strain at the surface and the axial strain (see Fig. 1). In general, the bending strain varies from point to point around and along the reduced section of the specimen. Bending strain is calculated as shown in Section 11.

3.2.5 *eccentricity*—the distance between the line of action of the applied force and the axis of symmetry of the specimen in a plane perpendicular to the longitudinal axis of the specimen.

3.2.6 *maximum bending strain*—the largest value of bending strain at the position along the length of the reduced section of a straight unnotched specimen at which bending is measured. (For notched specimens, see 4.9.)

3.2.7 *notched section*—the section perpendicular to the longitudinal axis of symmetry of the specimen where the cross-sectional area is intentionally at a minimum value in order to serve as a stress raiser.

3.2.8 *nominal percent bending in notched specimens*—the percent bending in a hypothetical (unnotched) specimen of uniform cross section—equal to the minimum cross section of the notched specimen, the eccentricity of the applied force in the hypothetical, and the notched specimens being the same. (See 11.5.) (This definition is not intended to define strain at the root of the notch.)

3.2.9 *percent bending*—the bending strain times 100 divided by the axial strain.

3.2.10 *rated force*—a force at which the alignment is being measured.

3.2.11 *reduced section*—that part of the specimen length between the fillets.

4. Significance and Use

4.1 It has been shown that bending stresses that inadvertently occur due to misalignment between the applied force and the specimen axes during tensile forces can affect the test results. In recognition of this effect, some test methods include a statement limiting the misalignment which is permitted. The purpose of this practice is to provide a reference for test methods and practices that require tensile loading under conditions where alignment is important. The objective is to implement the use of common terminology and methods for verification of alignment of loading fixtures and test specimens.

4.2 Axiality requirements and verifications should be *optional* when testing is performed for acceptance of materials for minimum strength and ductility requirements. This is because the effects, if any, especially excessive bending, would be expected to reduce strength and ductility properties and give conservative results. There may be no benefit from improved axiality when testing high ductility materials to determine conformance with minimum properties. Whether or not to improve axiality, should be a matter of negotiation between the material producer and the user.

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² *Annual Book of ASTM Standards*, Vol. 03.01.

