



Standard Test Method for Determining the Superplastic Properties of Metallic Sheet Materials¹

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^{ε1} NOTE—Footnote 4 was editorially corrected in October 2015.

1. Scope

1.1 This test method describes the procedure for determining the superplastic forming properties (SPF) of a metallic sheet material. It includes tests both for the basic SPF properties and also for derived SPF properties. The test for basic properties encompasses effects due to strain hardening or softening.

1.2 This test method covers sheet materials with thicknesses of at least 0.5 mm but not greater than 6 mm. It characterizes the material under a uni-axial tensile stress condition.

NOTE 1—Most industrial applications of superplastic forming involve a multi-axial stress condition in a sheet; however it is more convenient to characterize a material under a uni-axial tensile stress condition. Tests should be performed in different orientations to the rolling direction of the sheet to ascertain initial anisotropy.

1.3 This method has been used successfully between strain rates of 10^{-5} to 10^{-1} per second.

1.4 This method has been used successfully on Aluminum and Titanium alloys. The use of the method with other metals should be verified.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *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.*

¹ This test method is under the jurisdiction of ASTM Committee E28 on Mechanical Testing and is the direct responsibility of Subcommittee E28.02 on Ductility and Formability.

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2. Referenced Documents

2.1 ASTM Standards:²

- E4 Practices for Force Verification of Testing Machines
- E6 Terminology Relating to Methods of Mechanical Testing
- E21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials
- E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
- E646 Test Method for Tensile Strain-Hardening Exponents (n -Values) of Metallic Sheet Materials
- E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 **Definitions**—Definitions such as gage length (L and L_0), true stress (σ), true strain (ϵ), normal engineering stress (S), and engineering strain (e) are defined in Terminology E6. Thus,

$$\epsilon = \ln(L/L_0)$$

$$\sigma = S(1 + e)$$

NOTE 2—Engineering stress S and strain e are only valid up to the point of necking or instability of cross section. For superplastic deformation, the coupon undergoes an essentially uniform and constant neck along its length, and S and e are assumed in this standard to be valid. However at the junction to the clamp sections of the coupon the cross section reduces from the original value to the final value, over a length of approximately 4 % at each end. Also, there are local small instabilities of cross section over the gauge length. These contribute to an error in the calculated values of ϵ and σ . In the absence of currently available extensometers that could operate in the high temperature environment of an SPF test, ϵ and σ are to be inferred from crosshead extension and force.

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.