



Standard Practice for Reporting Uniaxial Strength Data and Estimating Weibull Distribution Parameters for Advanced Ceramics¹

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1. Scope

1.1 This practice covers the evaluation and reporting of uniaxial strength data and the estimation of Weibull probability distribution parameters for advanced ceramics that fail in a brittle fashion (see Fig. 1). The estimated Weibull distribution parameters are used for statistical comparison of the relative quality of two or more test data sets and for the prediction of the probability of failure (or, alternatively, the fracture strength) for a structure of interest. In addition, this practice encourages the integration of mechanical property data and fractographic analysis.

1.2 The failure strength of advanced ceramics is treated as a continuous random variable determined by the flaw population. Typically, a number of test specimens with well-defined geometry are failed under isothermal, well-defined displacement and/or force-application conditions. The force at which each test specimen fails is recorded. The resulting failure stress data are used to obtain Weibull parameter estimates associated with the underlying flaw population distribution.

1.3 This practice is restricted to the assumption that the distribution underlying the failure strengths is the two-parameter Weibull distribution with size scaling. Furthermore, this practice is restricted to test specimens (tensile, flexural, pressurized ring, etc.) that are primarily subjected to uniaxial stress states. The practice also assumes that the flaw population is stable with time and that no slow crack growth is occurring.

1.4 The practice outlines methods to correct for bias errors in the estimated Weibull parameters and to calculate confidence bounds on those estimates from data sets where all failures originate from a single flaw population (that is, a single failure mode). In samples where failures originate from multiple independent flaw populations (for example, competing failure modes), the methods outlined in Section 9 for bias correction and confidence bounds are not applicable.

1.5 This practice includes the following:

¹ This practice is under the jurisdiction of ASTM Committee C28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.01 on Mechanical Properties and Performance.

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1.6 The values stated in SI units are to be regarded as the standard per [IEEE/ASTM SI 10](#).

2. Referenced Documents

2.1 ASTM Standards:²

- [C1145 Terminology of Advanced Ceramics](#)
- [C1322 Practice for Fractography and Characterization of Fracture Origins in Advanced Ceramics](#)
- [E6 Terminology Relating to Methods of Mechanical Testing](#)
- [E178 Practice for Dealing With Outlying Observations](#)
- [E456 Terminology Relating to Quality and Statistics](#)
- [IEEE/ASTM SI 10 American National Standard for Use of the International System of Units \(SI\): The Modern Metric System](#)

3. Terminology

3.1 Proper use of the following terms and equations will alleviate misunderstanding in the presentation of data and in the calculation of strength distribution parameters.

3.1.1 *censored strength data*—strength measurements (that is, a sample) containing suspended observations such as that produced by multiple competing or concurrent flaw populations.

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.