



Standard Practice for Conducting Ruggedness Tests¹

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1. Scope

1.1 This practice covers conducting ruggedness tests. The purpose of a ruggedness test is to identify those factors that strongly influence the measurements provided by a specific test method and to estimate how closely those factors need to be controlled.

1.2 This practice restricts itself to designs with two levels per factor. The designs require the simultaneous change of the levels of all of the factors, thus permitting the determination of the effects of each of the factors on the measured results.

1.3 The system of units for this practice is not specified. Dimensional quantities in the practice are presented only as illustrations of calculation methods. The examples are not binding on products or test methods treated.

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

E456 Terminology Relating to Quality and Statistics

E1325 Terminology Relating to Design of Experiments

E1488 Guide for Statistical Procedures to Use in Developing and Applying Test Methods

F2082 Test Method for Determination of Transformation Temperature of Nickel-Titanium Shape Memory Alloys by Bend and Free Recovery

3. Terminology

3.1 **Definitions**—The terminology defined in Terminology E456 applies to this practice unless modified herein.

¹ This practice is under the jurisdiction of ASTM Committee E11 on Quality and Statistics and is the direct responsibility of Subcommittee E11.20 on Test Method Evaluation and Quality Control.

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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.

3.1.1 *fractional factorial design, n*—a factorial experiment in which only an adequately chosen fraction of the treatments required for the complete factorial experiment is selected to be run. **E1325**

3.1.2 *level (of a factor), n*—a given value, a specification of procedure or a specific setting of a factor. **E1325**

3.1.3 *Plackett-Burman designs, n*—a set of screening designs using orthogonal arrays that permit evaluation of the linear effects of up to $n=t-1$ factors in a study of t treatment combinations. **E1325**

3.1.4 *ruggedness, n*—insensitivity of a test method to departures from specified test or environmental conditions.

3.1.4.1 *Discussion*—An evaluation of the “ruggedness” of a test method or an empirical model derived from an experiment is useful in determining whether the results or decisions will be relatively invariant over some range of environmental variability under which the test method or the model is likely to be applied.

3.1.5 *ruggedness test, n*—a planned experiment in which environmental factors or test conditions are deliberately varied in order to evaluate the effects of such variation.

3.1.5.1 *Discussion*—Since there usually are many environmental factors that might be considered in a ruggedness test, it is customary to use a “screening” type of experiment design which concentrates on examining many first order effects and generally assumes that second order effects such as interactions and curvature are relatively negligible. Often in evaluating the ruggedness of a test method, if there is an indication that the results of a test method are highly dependent on the levels of the environmental factors, there is a sufficient indication that certain levels of environmental factors must be included in the specifications for the test method, or even that the test method itself will need further revision.

3.1.6 *screening design, n*—a balanced design, requiring relatively minimal amount of experimentation, to evaluate the lower order effects of a relatively large number of factors in terms of contributions to variability or in terms of estimates of parameters for a model. **E1325**

3.1.7 *test result, n*—the value of a characteristic obtained by carrying out a specified test method.

3.2 *Definitions of Terms Specific to This Standard:*