Designation: E1856 – 13 (Reapproved 2021)

Standard Guide for Evaluating Computerized Data Acquisition Systems Used to Acquire Data from Universal Testing Machines[1]

This standard is issued under the fixed designation E1856; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This guide is intended to assist the user in the evaluation and documentation of computerized data acquisition systems used to acquire data from quasi-static tests, performed on universal testing machines. The report produced will aid in the correct use and calibration of the computerized universal testing machine.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E4 Practices for Force Calibration and Verification of Testing Machines

E6 Terminology Relating to Methods of Mechanical Testing

E8/E8M Test Methods for Tension Testing of Metallic Materials

E74 Practices for Calibration and Verification for Force-Measuring Instruments

E83 Practice for Verification and Classification of Extensometer Systems

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

E1012 Practice for Verification of Testing Frame and Specimen Alignment Under Tensile and Compressive Axial Force Application

3. Terminology

3.1 The definitions of mechanical testing terms that appear in Terminology E6 apply to this guide.

3.2 *Definitions:*

3.2.1 *resolution, n*—for a particular measurement device, the smallest change in the quantity being measured that causes a perceptible change in the corresponding indication.

3.2.1.1 *Discussion*—Resolution may depend on the value (magnitude) of the quantity being measured.

3.2.1.2 *Discussion*—For paper charts or analog indicators, the resolution should not be assumed to be better (smaller) than 1/10 of the spacing between graduations. For digital devices, the best resolution potentially achievable is the smallest difference between two different readings given by the display.

3.2.1.3 *Discussion*—For both analog and digital devices, the actual resolution can be significantly poorer than described above, due to factors such as noise, friction, etc.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *basic data, n*—the digital equivalents of analog counterparts, such as force and displacement measurements, which under static conditions are traceable to national standards (see Fig. 1).

3.3.2 *computerized data acquisition system*—a device that collects basic data from a universal testing machine during a test and calculates and presents derived data based on the basic data collected.

3.3.3 *derived data, n*—additional numbers derived from the basic data through computation using software algorithms, such as a peak force or a modulus value.

3.3.4 *data acquisition rate, n*—the rate at which digital samples of each wave-form (that is, force, strain, displacement, and so forth) are acquired, expressed in samples/second.

3.3.5 *transducer-channel bandwidth*—the frequency at which the amplitude response of a transducer channel has

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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.

***A Summary of Changes section appears at the end of this standard**

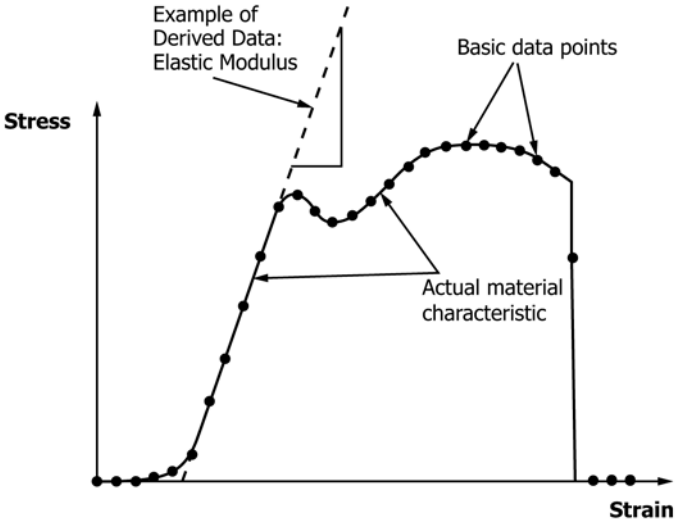

FIG. 1 Basic Data and Derived Data

fallen by 3 dB; that is, the measured signal is in error by about 30 % and the phase shift is 45° or greater.

3.3.5.1 *Discussion*—The precise amplitude and phase responses vary with the electrical design of the computerized data acquisition system, but the 3 dB bandwidth (expressed in hertz) is a simple single measure of responsiveness (see Fig. 2).

4. Summary of Guide

4.1 Comparative tests are performed to determine if the derived data acquired with a computerized universal testing machine agree with results acquired on the same machine from graphical records or with results acquired on other testing machines to ensure that the materials being tested are correctly characterized.

5. Significance and Use

5.1 This guide is recommended to be used by anyone acquiring data from a universal testing machine using a computerized data acquisition system.

6. Procedure

6.1 Choose at least five different test specimen types that are representative of the specimens commonly tested on the universal testing machine. If the universal testing machine is used to test fewer than five different specimen types, choose all those tested. Specimen types may be differentiated by material (strength level), size, shape, or test performed.

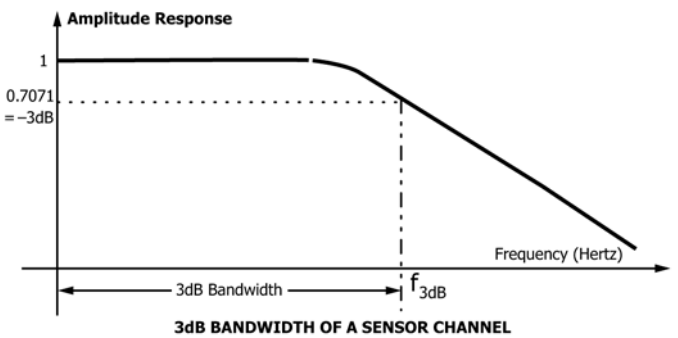

FIG. 2 Bandwidth

6.2 Use one of the following procedures to evaluate and document the conformity of the derived data.

6.2.1 *Round Robin Procedure:*

6.2.1.1 Perform a round robin involving at least two other universal testing machines. The other testing machines need not necessarily be computerized.

NOTE 1—It is preferable to use universal testing machines of varying types so that systemic problems are not masked.

6.2.1.2 If possible, configure the universal testing machines in such a way as to be able to obtain a graphic record of the tests. The graphic record may be generated by analog signal sources, the computerized data acquisition system, or may be generated manually from digital data recorded by the computerized data acquisition system.

6.2.1.3 Ascertain that all readout and recording devices have been calibrated in accordance with Practices E4, E83, or other applicable standards.

6.2.1.4 Test at least five specimens of each specimen type on each machine in conformance with the applicable test methods or established procedures.

NOTE 2—It may be desirable to test many more specimens after an initial screening, particularly if high standard deviations are observed on all machines.

6.2.1.5 Obtain the derived data from the computerized data acquisition system or graphic records of the tests from each machine, or both.

6.2.1.6 From the graphic records obtained, manually calculate the same test results obtained by the computerized data acquisition system.

6.2.1.7 Calculate the average and standard deviation of both the manually calculated results and the derived data obtained by the computerized data acquisition system(s) within each group of five or more specimens.

6.2.1.8 Investigate, identify, and correct, if necessary, the cause of any average results obtained by the computer that differ from the manually obtained average results, or the average results obtained by other testing machines, by more than 2.0 % of the average or more than one standard deviation, whichever is greater. In all cases, use the smallest non-zero standard deviation for evaluations.

6.2.1.9 Investigate, identify, and correct, if necessary, the cause of any standard deviations of the derived data obtained by the computerized data acquisition system that are more than two times the standard deviation obtained manually or by the other machines.

NOTE 3—Differences in averages and standard deviations of these magnitudes are quite often due to variations in the material being tested, and a complete statistical evaluation of the data using methods such as Practice E691 may be necessary.

6.2.2 *Single Machine Procedure:*

6.2.2.1 This procedure may be used for universal testing machines with the capability of producing graphic records from which derived data can be manually calculated.

6.2.2.2 Configure the testing machine in such a way as to be able to obtain a graphic record of the tests. The graphic record