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# 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 E 1856; 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 *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:*

E 4 Practices for Force Verification of Testing Machines[2]

E 8 Test Methods for Tension Testing of Metallic Materials[2]

E 74 Practice for Calibration of Force Measuring Instruments for Verifying the Force Indication of Testing Machines[2]

E 83 Practice for Verification and Classification of Extensometers Systems[2]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[3]

E 1012 Practice for Verification of Specimen Alignment Under Tensile Loading[2]

## 3. Terminology

3.1 *Definitions:*

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

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

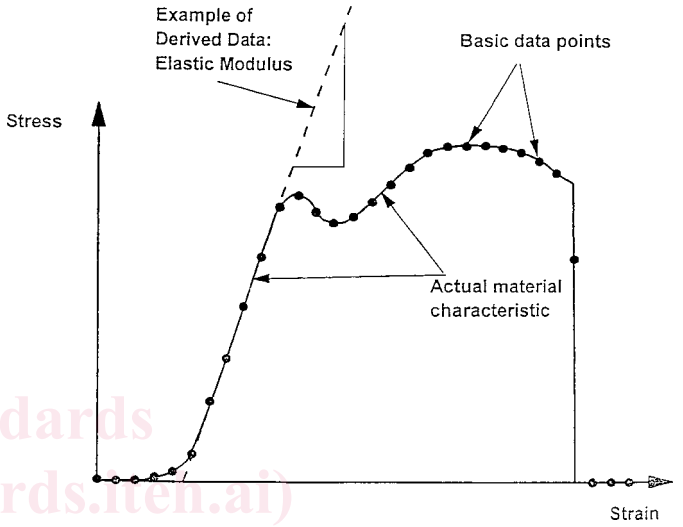


FIG. 1 Basic Data and Derived Data

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

3.1.4 *resolution*—the resolution is the smallest change in force, strain, or displacement, or both, that can be displayed or obtained, or both, from the computerized testing system at any applied force, strain, or position, or both (for force resolution see Practice E 4).

3.1.5 *transducer-channel bandwidth*—the bandwidth of a transducer-measurement channel which is measuring a force, strain, or displacement in a testing machine is the frequency at which the amplitude response of the measurement system has fallen by 3 dB, that is, the measured signal is in error by about 30 % and the phase shift has become 45° or greater. The precise amplitude and phase responses vary with the electrical design of the system, but the 3 dB bandwidth (expressed in Hertz) is a simple single measure of responsiveness (see Fig. 2).

3.1.6 *computerized data acquisition system—for the purpose of this guide*, a computerized data acquisition system is a device which collects basic data from a universal testing machine during a test and calculates and presents derived data based on the basic data collected.

[1] This guide is under the jurisdiction of ASTM Committee E28 on Mechanical Testing and is the direct responsibility of Subcommittee E28.15 on Automated Testing.

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

[3] *Annual Book of ASTM Standards*, Vol 14.02.

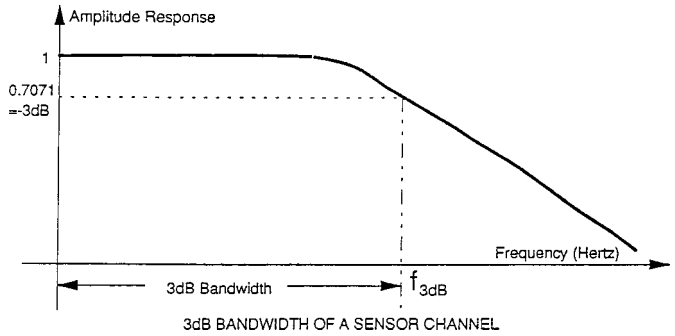


**FIG. 2 Bandwidth**

## 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 which are representative of the specimens commonly tested on the testing machine.

NOTE 1—If the testing machine is used to test less than five different specimen types, choose all those tested.

NOTE 2—Specimen types can be differentiated by material (strength level), size, shape, or test performed, or both.

6.2 Use one of the following procedures to evaluate and document the conformity of the computerized test results.

6.2.1 *Round Robin Procedure*:

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

NOTE 3—It is preferable to use testing machines of varying types so that systemic problems are not masked.

6.2.1.2 If possible, configure the 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 computer system, or may be generated manually from digital data recorded by the data system.

6.2.1.3 Ascertain that all readout and recording devices have been calibrated in accordance with Practices E 4, E 83, 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 4—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 results from the computer 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 computer system.

6.2.1.7 Calculate the average and standard deviation of both the manually calculated results and the results obtained by the computer system(s) (derived data) 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 which 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.

NOTE 5—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 results obtained by the computer which are more than two times the standard deviation obtained manually or by the other machines.

NOTE 6—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 E 691 may be necessary.

6.2.2 *Single Machine Procedure*:

6.2.2.1 This procedure may be used for testing machines with the capability of producing graphic records from which test results (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 may be generated by analog signal sources, the computer system, or may be generated manually from digital data recorded by the data system.

6.2.2.3 Ascertain that all readout and recording devices used (analog or digital, or both) have been calibrated in accordance with Practices E 4, E 83, or other applicable standards.

6.2.2.4 Ascertain that all transducers with their readout or recording devices, or both, including the devices producing the graphic record, have the required bandwidth for the tests performed with the machine (see Appendix X2).

6.2.2.5 Test at least five specimens of each specimen type in conformance with the applicable test methods or established procedures, obtaining both a graphic record and results from the computer system at the same time.

6.2.2.6 From the graphic record, determine the same test results as are calculated by the computer system.

6.2.2.7 Calculate the average and standard deviation of both the manually calculated results and the results obtained by the computer system (derived data) within each group of five specimens.

6.2.2.8 Investigate, identify, and correct, if necessary, the cause of any average results obtained by the computer which differ from the manually obtained average results by more than 2.0 % of the average or more than one standard deviation, whichever is greater.

NOTE 7—In all cases, use the smallest non-zero standard deviation for evaluations.