Designation: E1106 – 12

Standard Test Method for Primary Calibration of Acoustic Emission Sensors[1]

This standard is issued under the fixed designation E1106; 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 test method covers the requirements for the absolute calibration of acoustic emission (AE) sensors. The calibration yields the frequency response of a transducer to waves, at a surface, of the type normally encountered in acoustic emission work. The transducer voltage response is determined at discrete frequency intervals of approximately 10 kHz up to 1 MHz. The input is a given well-established dynamic displacement normal to the mounting surface. The units of the calibration are output voltage per unit mechanical input (displacement, velocity, or acceleration).

1.2 *Units*—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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E114 Practice for Ultrasonic Pulse-Echo Straight-Beam Contact Testing

E494 Practice for Measuring Ultrasonic Velocity in Materials

E650 Guide for Mounting Piezoelectric Acoustic Emission Sensors

E1316 Terminology for Nondestructive Examinations

3. Terminology

3.1 Refer to Terminology E1316 for terminology used in this test method.

4. Significance and Use

4.1 *Transfer Standards*—One purpose of this test method is for the direct calibration of displacement transducers for use as secondary standards for the calibration of AE sensors for use in nondestructive evaluation. For this purpose, the transfer standard should be high fidelity and very well behaved and understood. If this can be established, the stated accuracy should apply over the full frequency range up to 1 MHz.

NOTE 1—The stated accuracy applies only if the transfer standard returns to quiescence, following the transient input, before any wave reflected from the boundary of the calibration block returns to the transfer standard (~100 μs). For low frequencies with periods on the order of the time window, this condition is problematical to prove.

4.2 *Applications Sensors*—This test method may also be used for the calibration of AE sensors for use in nondestructive evaluation. Some of these sensors are less well behaved than devices suitable for a transfer standard. The stated accuracy for such devices applies in the range of 100 kHz to 1 MHz and with less accuracy below 100 kHz.

5. General Requirements

5.1 A primary difficulty in any calibration of a mechanical/electrical transduction device is the determination of the mechanical-motion input to the device. To address this difficulty, this calibration procedure uses *(i)* a standard transducer whose absolute sensitivity is known from its design and physical characteristics; and also *(ii)* a source that produces motion that approximates a waveform calculable from theory. The use of two independent sources of information confers a degree of redundancy that is employed to confirm the validity of the measurements and quantify the experimental errors. Briefly stated, the sensitivity of the transfer standard (or other sensor under test) is determined by comparison with the standard transducer, while knowledge of a part of the theoretical waveform is used as a check.

5.2 *Test Block and Mechanical Input*—The mechanical input to the sensors is obtained by pressing a glass capillary down onto the surface of a large test block until it breaks. The reasons for selecting this approach are: *(a)* capillary breaks are localized and short in duration, like natural acoustic emission events; and *(b)* use of a large block simplifies wave propagation and makes sensor output less dependent on arbitrary features of block geometry.

[1] This test method is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.04 on Acoustic Emission Method.

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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**

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