



Standard Practice for Secondary Calibration of Acoustic Emission Sensors¹

This standard is issued under the fixed designation E1781/E1781M; 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 practice covers requirements for the secondary calibration of acoustic emission (AE) sensors. The secondary calibration yields the frequency response of a sensor to waves of the type normally encountered in acoustic emission work. The source producing the signal used for the calibration is mounted on the same surface of the test block as the sensor under testing (SUT). Rayleigh waves are dominant under these conditions; the calibration results represent primarily the sensor's sensitivity to Rayleigh waves. The sensitivity of the sensor is determined for excitation within the range of 100 kHz to 1 MHz. Sensitivity values are usually determined at frequencies approximately 10 kHz apart. The units of the calibration are volts per unit of mechanical input (displacement, velocity, or acceleration).

1.2 *Units*—The values stated in either SI units or inch-pound units are to be regarded as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standards.

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

E1106 Test Method for Primary Calibration of Acoustic Emission Sensors

E1316 Terminology for Nondestructive Examinations

3. Terminology

3.1 *Definitions*—Refer to Terminology E1316, Section B, for terms used in this practice.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *reference sensor (RS)*—a sensor that has had its response established by primary calibration (also called secondary standard transducer) (see Method E1106).

3.2.2 *secondary calibration*—a procedure for measuring the frequency or transient response of an AE sensor by comparison with an RS.

3.2.3 *test block*—a block of homogeneous, isotropic, elastic material on which a source, an RS, and a SUT are placed for conducting secondary calibration.

4. Significance and Use

4.1 The purpose of this practice is to enable the transfer of calibration from sensors that have been calibrated by primary calibration to other sensors.

5. General Requirements

5.1 *Units for Calibration*—Secondary calibration produces the same type of information regarding a sensor as does primary calibration (Method E1106). An AE sensor responds to motion at its front face. The actual stress and strain at the front face of a mounted sensor depends on the interaction between the mechanical impedance of the sensor (load) and that of the mounting block (driver); neither the stress nor the strain is amenable to direct measurement at this location. However, the free displacement that would occur at the surface of the block in the absence of the sensor can be inferred from measurements made elsewhere on the surface. Since AE sensors are used to monitor motion at a free surface of a structure and interactive effects between the sensor and the structure are generally of no interest, the free motion is the appropriate input variable. It is therefore required that the units of calibration shall be volts per unit of free displacement or free velocity, that is, volts per unit or volt seconds per unit.

5.2 The calibration results may be expressed, in the frequency domain, as the steady-state magnitude and phase

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

Current edition approved June 1, 2013. Published June 2013. Originally approved in 1996. Last previous edition approved in 2008 as E1781 - 08. DOI: 10.1520/E1781_E1781M-13.

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.