Designation: E 569 – 02

Standard Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation[1]

This standard is issued under the fixed designation E 569; 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 provides guidelines for acoustic emission (AE) examination or monitoring of structures, such as pressure vessels, piping systems, or other structures that can be stressed by mechanical or thermal means.

1.2 The basic functions of an AE monitoring system are to detect, locate, and classify emission sources. Other methods of nondestructive testing (NDT) may be used to further evaluate the significance of acoustic emission sources.

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:*

E 543 Practice for Agencies Performing Nondestructive Testing[2]

E 650 Guide for Mounting Piezoelectric Acoustic Emission Sensors[2]

E 750 Practice for Characterizing Acoustic Emission Instrumentation[2]

E 1316 Terminology for Nondestructive Examinations[2]

2.2 *Other Documents:*

SNT-TC-1A Recommended Practice for Nondestructive Testing Personnel Qualification and Certification[3]

ANSI/ASNT CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel[3]

3. Terminology

3.1 *Definitions*—Definitions of terms relating to acoustic emission may be found in Section B of Terminology E 1316.

3.2 *Definitions of Terms Specific to this Standard:*

3.2.1 *AE activity*—the presence of acoustic emission during an examination.

3.2.2 *active source*—one which exhibits increasing cumulative AE activity with increasing or constant stimulus.

3.2.3 *critically active source*—one which exhibits an increasing rate of change of cumulative AE activity with increasing or constant stimulus.

3.2.4 *AE source intensity*—average energy, counts or amplitude per hit.

3.2.5 *intense source*—one in which the AE source intensity of an active source consistently exceeds, by a specified amount, the average AE source intensity of active sources.

3.2.6 *critically intense source*—one in which the AE source intensity consistently increases with increasing stimulus or with time under constant stimulus.

4. Summary of Practice

4.1 Acoustic emission examination of a structure usually requires application of a mechanical or thermal stimulus. Such stimulation produces changes in the stresses in the structure. During stimulation of a structure, AE from discontinuities (such as cracks and inclusions) and from other areas of stress concentration, or from other acoustic sources (such as leaks, loose parts, and structural motion) can be detected by an instrumentation system, using sensors which, when stimulated by stress waves, generate electrical signals.

4.2 In addition to immediate evaluation of the emissions detected during the application of the stimulus, a permanent record of the number and location of emitting sources and the

[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.

Current edition approved June 10, 2002. Published August 2002. Originally published as E 569 – 76. Last previous edition E 569 – 97.

[2] *Annual Book of ASTM Standards*, Vol 03.03.

[3] Available from American Society for Nondestructive Testing, 1711 Arlingate Plaza, PO Box 28518, Columbus, Ohio 43228-0518.

relative amount of AE detected from each source provides a basis for comparison with sources detected during the examination and during subsequent stimulation.

5. Order Information

5.1 If AE monitoring in accordance with this practice is performed as a service, the following items are subject to agreement between the purchaser and supplier:

5.1.1 *Examination Area*—Many applications will require an arrangement of sensors such that all areas of the structure are monitored. In other applications, only a portion of the structure may require monitoring.

5.1.2 Previous maximum vessel stresses or loads; vessel relaxation period, if any; the planned stimulation schedule, stimulation parameters, and AE monitoring period(s) (see 10.1).

5.1.3 The person(s) responsible for resuming the examination if unexpected or unusual AE activity response patterns are detected.

5.1.4 The date and location of the intended examination and the expected ambient conditions.

5.1.5 The criteria to be used for interpreting, classifying, and evaluating AE indications and response patterns, if different from that described in this practice.

5.1.6 Disposition of records or other examination data and contents of the examination report.

5.1.7 Survey of the structure for extraneous background noise that could preclude an effective examination.

6. Basis of Application

6.1 *Personnel Qualification*

6.1.1 If specified in the contractual agreement, personnel performing examinations to this standard shall be qualified in accordance with a nationally recognized NDT personnel qualification practice or standard such as ANSI/ASNT-CP-189, SNT-TC-1A, NAS-410 or a similar document and certified by the employer or certifying agency, as applicable. The practice or standard used and its applicable revision shall be identified in the contractual agreement between the using parties.

6.2 *Qualification of Nondestructive Testing Agencies*

6.2.1 If specified in the contractual agreement, NDT agencies shall be qualified and evaluated as described in Practice E 543. The applicable edition of Practice E 543 shall be specified in the contractual agreement.

6.3 *Timing of Examination*

6.3.1 The timing of the examination shall be in accordance with a contractual agreement or with an established internal procedure.

6.4 *Extent of Examination*

6.4.1 The extent of the examination shall be in accordance with 5.1.1 unless otherwise specified.

6.5 *Reporting Criteria/Acceptance*

6.5.1 Reporting criteria for the examination results shall be in accordance with Sections 12 and 13.

6.6 *Reexamination of Repaired/Reworked Items*

6.6.1 Reexamination of repaired/reworked items is not addressed in this standard and if required shall be specified in a contractual agreement.

7. Examination Preparation

7.1 Before the examination begins, make the following preparations for AE monitoring:

7.1.1 Determine the type, number, and placement of sensors. This requires knowledge of both material and physical characteristics of the structure and the features of the instrumentation. This determination is also dependent upon the required precision and accuracy of the examination.

7.1.2 Establish communications between the control point for the application of the stimulus and the AE examination control center.

7.1.3 Provide a means for continuously recording a measure of the stimulus.

7.1.4 Identify potential sources of extraneous acoustic noise, such as vibration, friction, and fluid flow. Such sources may require acoustic isolation or control, in order not to mask valid acoustic emissions.

7.1.5 Attach the sensors; both the couplant and sensing device must be compatible with the surface conditions and the composition of the structural material being examined (see Guide E 650).

7.1.6 Verify the AE monitoring system in accordance with Section 9.

8. Safety Precautions

8.1 When examining vessels, ambient temperature should not be below the ductile-brittle transition temperature of the pressure vessel construction material.

9. Calibration and Standardization

9.1 Annual calibration and verification of pressure transducer, AE sensors, preamplifiers (if applicable), signal processor (particularly the signal processor time reference), and AE electronic waveform generator should be performed. Equipment should be adjusted so that it conforms to equipment manufacturer's specifications. Instruments used for calibrations must have current accuracy certification that is traceable to the National Institute for Standards and Technology (NIST).

9.2 Routine electronic evaluations (verification) must be performed any time there is concern about signal processor performance. A waveform generator should be used in making evaluations. Each signal processor channel must respond with peak amplitude reading within ±2 dBV of the electronic waveform generator output.

9.3 A system performance verification must be conducted immediately before, and immediately after, each examination. A performance verification uses a mechanical device to induce stress waves into the structure at a specified distance from each sensor. Induced stress waves stimulate a sensor in a manner similar to emission from a flaw. Performance verifications verify performance of the entire system (including couplant).

9.3.1 The preferred technique for conducting a performance verification is a pencil lead break. Lead should be broken on the structure at a distance of 4 in. (100 to 102 mm) from the sensor centerline. 2H lead, 0.3 mm diameter, 0.1 in. (2 to 3 mm) long should be used (see Fig. 4 of Guide E 976). If circumstances require different values to be used, the values used shall be documented in the examination report.