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.

Designation: E749/E749M – 17 (Reapproved 2021)

Standard Practice for Acoustic Emission Monitoring During Continuous Welding[1]

This standard is issued under the fixed designation E749/E749M; 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 recommendations for acoustic emission (AE) monitoring of weldments during and immediately following their fabrication by continuous welding processes.

1.2 The procedure described in this practice is applicable to the detection and location of AE sources in weldments and in their heat-affected zone during fabrication, particularly in those cases where the time duration of welding is such that fusion and solidification take place while welding is still in progress.

1.3 The effectiveness of acoustic emission to detect discontinuities in the weldment and the heat-affected zone is dependent on the design of the AE system, the AE system verification procedure, the weld process, and the material type. Materials that have been monitored include low-carbon steels, low-alloy steels, stainless steels, and some aluminum alloys. The system performance must be verified for each application by demonstrating that the defects of concern can be detected with the desired reliability.

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately 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 nonconformance with the standard.

1.5 *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.*

1.6 *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]

E543 Specification for Agencies Performing Nondestructive Testing

E569 Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation

E650 Guide for Mounting Piezoelectric Acoustic Emission Sensors

E1316 Terminology for Nondestructive Examinations

2.2 *ASNT Standards:*[3]

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

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

2.3 *AIA Standard:*[4]

NAS-410 Certification and Qualification of Nondestructive Personnel (Quality Assurance Committee)

2.4 *ISO Standard:*[5]

ISO 9712 Non-Destructive Testing: Qualification and Certification of NDT Personnel

3. Terminology

3.1 *Definitions*—For definitions of terms relating to acoustic emission testing, see Section B of Terminology E1316.

4. Significance and Use

4.1 Detection and location of AE sources in weldments during fabrication may provide information related to the integrity of the weld. Such information may be used to direct repair procedures on the weld or as a guide for application of other nondestructive evaluation (NDE) methods. A major attribute of applying AE for in-process monitoring of welds is

[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.

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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.

[3] Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, http://www.asnt.org.

[4] Available from Aerospace Industries Association of America, Inc. (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209-3928, http://www.aia-aerospace.org.

[5] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

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

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the ability of the method to provide immediate real-time information on weld integrity. This feature makes the method useful to lower weld costs by repairing defects at the most convenient point in the production process. The AE activity from discontinuities in the weldment is stimulated by the thermal stresses from the welding process. The AE activity resulting from this stimulation is detected by AE sensors in the vicinity of the weldment, which convert the acoustic waves into electronic signals. The AE instrumentation processes signals and provides means for immediate display or indication of AE activity and for permanent recordings of the data.

4.2 Items to be considered in preparation and planning for monitoring should include but not be limited to the following:

4.2.1 Description of the system or object to be monitored or examined,

4.2.2 Extent of monitoring, that is, entire weld, cover passes only, and so forth,

4.2.3 Limitations or restrictions on the sensor mounting procedures, if applicable,

4.2.4 Performance parameters to be established and maintained during the AE system verification procedure (sensitivity, location accuracy, and so forth),

4.2.5 Maximum time interval between AE system verification checks,

4.2.6 Performance criteria for purchased equipment,

4.2.7 Requirements for permanent records of the AE response, if applicable,

4.2.8 Content and format of test report, if required, and

4.2.9 Operator qualification and certification, if required.

5. Basis of Application

5.1 The following items are subject to contractual agreement between the parties using or referencing this practice.

5.2 *Personnel Qualification:*

5.2.1 If specified in the contractual agreement, personnel performing examinations to this standard shall be qualified in accordance with a nationally or internationally recognized NDT personnel qualification practice or standard such as ANSI/ASNT CP-189, SNT-TC-1A, NAS-410, ISO 9712, 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.

5.3 *Qualification of Nondestructive Agencies*—If specified in the contractual agreement, NDT agencies shall be qualified and evaluated as described in Practice E543. The applicable edition of Practice E543 shall be specified in the contractual agreement.

5.4 *Procedures and Techniques*—The procedures and techniques to be utilized shall be as specified in the contractual agreement.

6. Examination Preparation

6.1 The following preparatory procedures should be completed before initiating AE monitoring:

6.1.1 Select the location(s) where the sensor(s) will be acoustically coupled. The sensor(s) should be centrally located near the weldment to provide for optimal AE response from all portions of the weld. If the sensor(s) are piezoelectric, this location should be such that the maximum temperature stays below manufacturers' specifications of the sensor(s). Take care in selecting the sensor mounting locations to avoid contact or disturbance, or both, of the sensor by any of the welding or structural positioning equipment. Typical distances from 150 to 300 mm [6 to 12 in.] from the heat-affected zone of the weld are usually satisfactory. Typical fixed sensor placement patterns that have been successfully used are shown in Figs. 1-3.

6.1.1.1 If a fixed contact sensor(s) is used, clean the area(s) where attachment will be made to eliminate loose scale, welding flux, or other debris, and attach the sensor in accordance with Guide E650.

6.1.1.2 If moving sensors are used, clean the coupling path so that uniform sensitivity is maintained as the sensor moves. Fig. 4 shows side and top views of a typical configuration for moving sensors.

6.1.2 Position and route the signal cables connecting the sensor(s) to the AE instrumentation to avoid contacting the hot weld bead or entangling the welding and positioning equipment.

6.1.3 *Adjustment of Apparatus:*

6.1.3.1 After all sensors are mounted, connected, and operational (without objectionable background noise), the AE monitoring system can then be adjusted using an AE simulator.

6.1.3.2 *Gain Adjustment*—To set or select the overall gain for a channel (if necessary), locate the acoustic emission simulator at a selected distance adjacent to the sensor. Monitor the response to the simulated emission, and adjust the overall channel gain to a specified amplitude level. Repeat this procedure two times, placing the simulator at the same distance from the sensor but at different azimuthal positions relative to the original simulator positions (see Fig. 5). Record the average gain for the three simulator positions. Repeat the entire procedure for each AE sensor on the structure, and adjust the gains. The average gains for all channels should give responses to the simulator that have peak voltages identical to within ±3 dB.

6.1.4 *Determination of Source-Location Accuracy*—Check the operation of the AE source-location function by analyzing simulated AE signals from several random locations in the weld and on the structure, as well as from any specific critical locations. For each placement of the simulator, determine and record the precision and accuracy of the AE location function. It should be noted that the accuracy of locating the simulator source will not necessarily be the same as for locating a real AE source. During trial welding in multi-pass configurations, it should be verified that location accuracy is maintained during

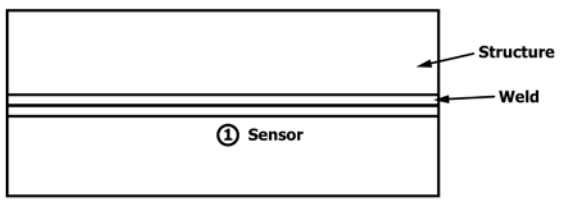

FIG. 1 Typical Sensor Placement for Single Channel AE Monitoring of a Linear Weld