



Standard Practice for Verifying the Consistency of AE-Sensor Response Using an Acrylic Rod¹

This standard is issued under the fixed designation E2075/E2075M; 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 is used for routinely checking the sensitivity of acoustic emission (AE) sensors. It is intended to provide a reliable, precisely specified way of comparing a set of sensors, or telling whether an individual sensor's sensitivity has degraded during its service life, or both.

1.2 This practice is not a “calibration” nor does it give frequency response information.

1.3 *Units*—The values stated in 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 non-conformance with the standard.

1.4 *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

[E650 Guide for Mounting Piezoelectric Acoustic Emission Sensors](#)

[E750 Practice for Characterizing Acoustic Emission Instrumentation](#)

[E976 Guide for Determining the Reproducibility of Acoustic Emission Sensor Response](#)

[E2374 Guide for Acoustic Emission System Performance Verification](#)

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, 2015. Published June 2015. Originally approved in 2000. Last previous edition approved in 2010 as E2075 - 10. DOI: 10.1520/E2075_E2075M-15.

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. Significance and Use

3.1 Degradation in sensor performance can occur due to dropping, mechanical shock while mounted on the test structure, temperature cycles, and so forth. It is necessary and desirable to have a simple measurement procedure that will check the consistency of sensor response, while holding all other variables constant.

3.2 While test blocks of many different kinds have been used for this purpose for many years, an acrylic polymer rod offers the best all-around combination of suitable acoustic properties, practical convenience, ease of procurement and low cost.

3.3 Because the acoustic properties of the acrylic rod are known to depend on temperature, this practice requires that the rod, sensors, and couplant be stabilized at the same working temperature, prior to verifying the sensors.

3.4 Attention should be paid to storage conditions for the acrylic polymer rod. For example, it should not be left in a freezing or hot environment overnight, unless it is given time for temperature stabilization before use.

3.5 Properly applied and with proper record keeping, this practice can be used in many ways. The user organization must determine the context for its use, the acceptance standards and the actions to be taken based on the lead break results. The following uses are suggested:

3.5.1 To determine when a sensor is no longer suitable for use.

3.5.2 To check sensors that have been exposed to high-risk conditions, such as dropping, overheating, and so forth.

3.5.3 To get an early warning of sensor degradation over time. This can lead to identifying conditions of use, which are damaging sensors, and thus, to better equipment care and lower replacement costs.

3.5.4 To obtain matched sets of sensors, preamplifiers, instrumentation channels, or a combination thereof, for more uniform performance of the total system.

3.5.5 To save time and money, by eliminating the installation of bad sensors.

3.5.6 To verify sensors quickly but consistently in the field and to assist trouble-shooting when a channel does not pass a performance check.

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

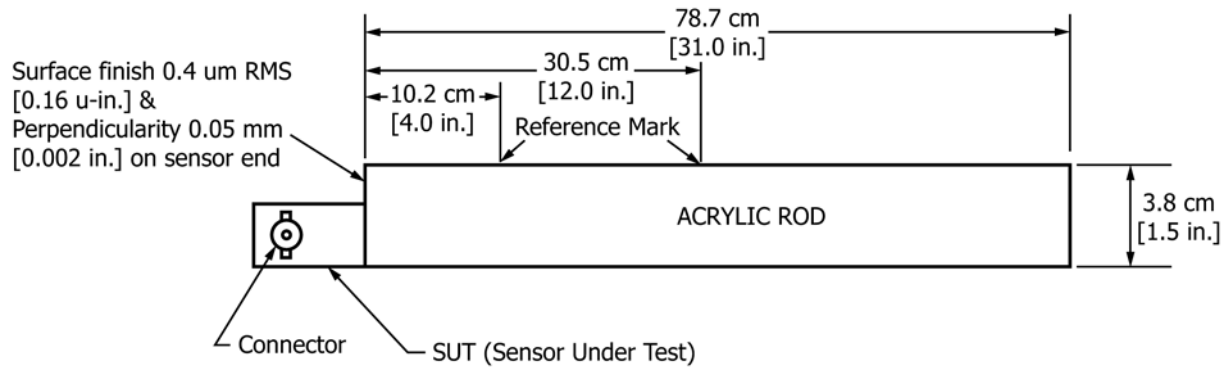


FIG. 1 Acrylic Rod Description

3.6 All the above uses are recommended for consideration. The purpose of this practice is not to call out how these uses are to be implemented, but only to state how the test itself is to be performed so that the results obtained will be accurate and reliable.

4. Apparatus

4.1 *Acrylic Polymer Cylindrical Rod* (Fig. 1), should be used. The actual material of the acrylic polymer rod is polymethylmethacrylate.³

4.1.1 The rod shall be cast, not extruded.

4.1.2 Dimensions of the rod should be 78.7 cm [31 in.] long by 3.8 cm [1.5 in.] in diameter, sensors end cut true and smooth with a surface finish of 0.4 μm RMS [0.16 $\mu\text{in.}$].

4.1.3 Other lengths of rod are acceptable, provided that there is sufficient distance to attenuate and prevent reflected signals from the nonsensor end of the rod reaching the sensor.

4.1.4 A permanent reference mark, for example an “X”, is placed on the rod at a distance of 10.2 cm [4 in.], or 30.5 cm [12 in.], or both, from one end; marking the spots where the pencil lead is to be broken. It is convenient to provide a very small spotface, for example, 0.8 mm [0.03 in.] diameter and 0.1 mm [0.004 in.] deep at these reference mark points, to rest the tip of the pencil lead to avoid slippage during the lead break process.

NOTE 1—The surface finish of the cylindrical rod section could produce reflections that affect AE response. The surface finish should be maintained in a clean, undamaged condition.

4.2 *Hsu-Nielsen Pencil Lead Break Source*, with 2H pencil lead, as described in 4.3.3 of Guide E976.

4.3 *Sensor(s)*, to be tested.

4.4 *Acoustic Emission Equipment*, with amplitude measurement capability, for recording sensor response. (Operating familiarity with the apparatus is assumed.)

4.5 *Couplant*, to be standardized and documented by the user of this practice.

³ Some of the generic brand names of this material include, but are not limited to: Lucite, PMMA, plexiglass, perspex, and so forth.

5. Procedure

5.1 Ensure that the acrylic rod, sensors and couplant have been allowed to stabilize to the ambient temperature of the examination environment.

5.2 Place the prepared acrylic rod horizontally on a suitable hard, flat surface, such as a benchtop, with the reference mark(s) facing vertically up (12 o'clock). The rod may be secured with tape or other means no closer than 30.5 cm [12 in.] from the reference mark.

5.3 Prepare and power-up the AE measurement system including preamplifier (if used) and connecting cables; allow warm up time as necessary. Verify the system's performance. Verification may be accomplished on the rod using a reference sensor that is dedicated to this purpose and not exposed to the hazards of field use; or, it may be accomplished by electronic procedures such as those described in Practice E750 or Guide E2374.

5.4 Mount the sensor to be tested on the flat end of the rod using the prescribed couplant and normal good application techniques (refer to Guide E650). Wipe off old couplant before mounting. Mount the sensor in the six o'clock position so that it is resting on the same surface supporting the acrylic rod. This will prevent slipping of the sensor during sensor verification. If the sensor is a side connector type, have the connector pointing in the 3 o'clock direction as shown in Fig. 1.

5.5 Using the pencil lead source, break lead with the end of the lead in the center of the reference mark, within 0.5 mm [0.020 in.] with a lead extension of 2.5 ± 0.5 mm [0.1 ± 0.02 in.]. A Nielsen shoe may be used to obtain a consistent 30° angle between the lead and the surface. Hold the pencil pointing towards the sensor but with its axis approximately 22° (a quarter of a right angle) off from the axis of the rod, so that the lead flies off to one side and does not hit the sensor. Fingers may be rested on the rod on the side away from the sensor to steady the pencil, but there must be no finger contact or other materials in contact with the rod between pencil and sensor, except for the hard surface on which the acrylic rod is resting. As a general guide, use the 10.2 cm [4 in.] reference mark when breaking 0.3 mm [0.012 in.] pencil lead and the 30.5 cm [12.0 in.] reference mark when using 0.5 mm [0.02 in.] pencil

lead. If using the 10.2 cm [4.0 in.] reference mark and the sensor amplitude response is 90 dB or greater, move to the 30.5 cm [12 in.] reference mark instead to avoid possible saturation effects, which might compromise the test results.

5.6 Make three consistent lead breaks for each sensor, recording amplitude responses on a sensor performance verification form, similar to that shown in **Appendix X1**. As a general rule, determine the average sensor amplitude response and proceed to the next sensor.

5.7 Acceptance criteria, which should be assigned prior to conducting this practice by the testing organization, should be documented, for example as shown in **Appendix X1**, and applied to the sensor data recorded. Sensors failing the criteria should not be used during the examination, and should be returned for a more comprehensive analysis, repaired or discarded.

6. Precision and Bias

6.1 Temperature variations are known to affect the acoustic absorption properties of the acrylic rod. However, since this is

a comparative technique rather than an absolute one, this practice can be carried out with good results if all component parts used in the practice have been allowed to stabilize to the examination (environmental) temperature prior to application.

6.2 Person-to-person variations can be reduced to a range of 1 dB by proper technique and training.

6.3 Variations in fracture performance within a lead and between leads are possible. With experience, occasional bad breaks often can be identified by the operator, even without reference to the results of the measurement.

6.4 Bad breaks are relatively common as the pencil is about to run out of lead.

6.5 While uniformity of material is a major quality goal of the lead manufacturer, runs of bad lead can occur due to manufacturing variations.

7. Keywords

7.1 acoustic emission sensors; AE; sensor check; sensor consistency check; sensor response; sensor test; sensor verification

APPENDIX

(Nonmandatory Information)

X1. Sensor Performance Verification Form

See **Fig. X1.1**.

DATE: _____ Start/End Times: _____ Job ID: _____

OPERATOR(S): _____ AMBIENT TEMPERATURE: _____

PENCIL LEAD DIA: _____ LEAD HARDNESS: _____ SHOE: Y/N _____

SYSTEM MANUFACTURER MODEL: _____

SYSTEM SERIAL#: _____ CHANNEL # _____

ROD ID: _____

SENSOR COUPLANT: _____ SENSOR CABLE LENGTH: _____

Sensor Model, SN#	Amplitudes (dB _{AE})	Avg.	Sensor Model, SN#	Amplitudes (dB _{AE})	Avg.

AVG. AMPL. OF ALL SENSORS: _____ dB ACCEPTANCE CRITERIA: +/- 2 dB of Average Amplitude

COMMENTS/NOTES: _____

FIG. X1.1 Example of Sensor Performance Verification Form

SUMMARY OF CHANGES

Committee E07 has identified the location of selected changes to this standard since the last issue (E2075/E2075M-10) that may impact the use of this standard.

- (1) Added a new section, 4.1.1, to describe that the rod was a “cast” part, not extruded.
- (3) Added inch-pound units conversions to Section 5.
- (2) Rearranged paragraph 4.2.
- (4) Updated Fig. X1.1.
- (5) Added “Summary of Changes.”

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>