



Designation: E2076/E2076M – 15 (Reapproved 2022)

Standard Practice for Examination of Fiberglass Reinforced Plastic Fan Blades Using Acoustic Emission¹

This standard is issued under the fixed designation E2076/E2076M; 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) examinations of fiberglass reinforced plastic (FRP) fan blades of the type used in industrial cooling towers and heat exchangers.

1.2 This practice uses simulated service loading to determine structural integrity.

1.3 This practice will detect sources of acoustic emission in areas of sensor coverage that are stressed during the course of the examination.

1.4 This practice applies to examinations of new and in-service fan blades.

1.5 This practice is limited to fan blades of FRP construction, with length (hub centerline to tip) of less than 3 m [10 ft], and with fiberglass content greater than 15 % by weight.

1.6 AE measurements are used to detect emission sources. Other nondestructive examination (NDE) methods may be used to evaluate the significance of AE sources. Procedures for other NDE methods are beyond the scope of this practice.

1.7 *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 non-conformance with the standard.

1.8 *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.*

1.9 *This international standard was developed in accordance with internationally recognized principles on standard-*

ization 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

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

E1067 Practice for Acoustic Emission Examination of Fiberglass Reinforced Plastic Resin (FRP) Tanks/Vessels

E1106 Test Method for Primary Calibration of Acoustic Emission Sensors

E1316 Terminology for Nondestructive Examinations

E2374 Guide for Acoustic Emission System Performance Verification

2.2 ASNT Documents: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 Aerospace Industries Association Document:⁴

NAS 410 Certification and Qualification of Nondestructive Testing Personnel

2.4 ISO Standard:⁵

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

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 Arlington 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>.

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, see Terminology E1316.

4. Summary of Practice

4.1 This practice consists of subjecting individual FRP fan blades to increasing load while monitoring with sensors that are sensitive to acoustic emission (transient stress waves) caused by growing flaws.

4.2 This practice provides guidelines to determine the zonal location of structural flaws in FRP fan blades.

4.3 The test load, applied at the blade tip is calculated to provide 100 % of the maximum allowable operating (bending) load at the blade-hub interface.

4.4 This practice is intended to simulate the bending load. Torsional and centrifugal loads are not simulated by this practice.

4.5 Structurally insignificant flaws may produce acoustic emission.

5. Significance and Use

5.1 The AE examination method detects structurally significant flaws in FRP structures via test loading. The damage mechanisms that are detected in FRP include resin cracking, fiber debonding, fiber pullout, fiber breakage, delamination, and secondary bond failure.

5.2 Flaws in unstressed areas will not generate detectable AE.

5.3 Flaws located with AE may be examined by other methods.

6. Basis of Application

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

6.2 Personnel Qualification

6.2.1 If specified in the contractual agreement, personnel performing examinations to this practice 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 specified in the contractual agreement between the using parties.

6.3 *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.

6.4 *Extent of Examination*—The extent of examination shall be in accordance with 10.2 unless otherwise specified.

6.5 *Reporting Criteria/Acceptance Criteria*—Reporting criteria for the examination results shall be in accordance with Section 12 unless otherwise specified. Since acceptance criteria, for example, for reference radiographs, are not specified in this practice, they shall be specified in the contractual agreement.

6.6 *Reexamination of Repaired/Reworked Items*—Reexamination of repaired/reworked items is not addressed in this practice, and if required, shall be specified in the contractual agreement.

6.7 *Personnel Training*—It is recommended that personnel performing the examination have additional training on the following topics:

- 6.7.1 Basic technology of AE from FRP;
- 6.7.2 Failure mechanisms of FRP;
- 6.7.3 AE instrument and sensor checkout on FRP;
- 6.7.4 Loading of FRP components for AE testing;
- 6.7.5 Data collection and interpretation; and
- 6.7.6 Examination report preparation.

7. Apparatus

7.1 Essential features of the apparatus required for this practice are shown in Fig. 1. Specifications are provided on Annex A1.

7.2 Couplant must be used to acoustically couple sensors to the blade surface. Adhesives that have acceptable acoustic properties and ultrasonic couplants are acceptable.

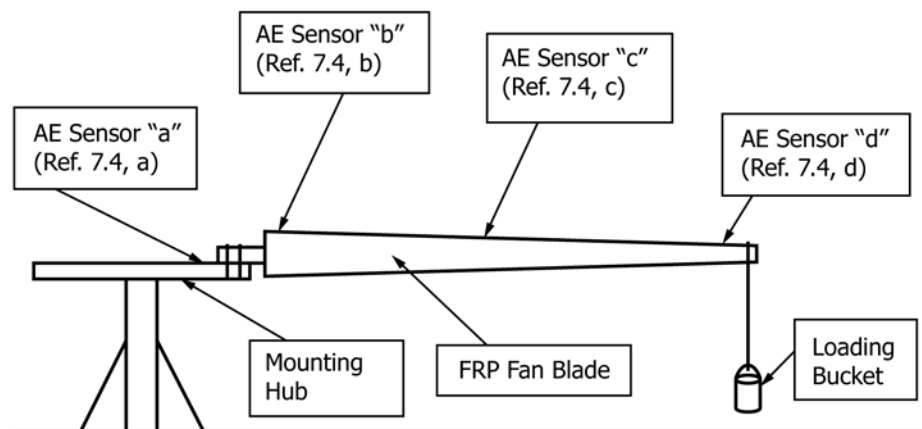


FIG. 1 Apparatus