



Standard Practice for Determining Damage-Based Design Stress for Glass Fiber Reinforced Plastic (GFRP) Materials Using Acoustic Emission¹

This standard is issued under the fixed designation E2478; 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 details procedures for establishing the direct stress and shear stress damage-based design values for use in the damage-based design criterion for materials to be used in GFRP vessels and other GFRP structures. The practice uses data derived from acoustic emission examination of four-point beam bending tests and in-plane shear tests (see ASME Section X, Article RT-8).

1.2 The onset of lamina damage is indicated by the presence of significant acoustic emission during the reload portion of load/reload cycles. “Significant emission” is defined with historic index.

1.3 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units which are provided for information only and are not considered 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

- D790** Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D4255/D4255M** Test Method for In-Plane Shear Properties of Polymer Matrix Composite Materials by the Rail Shear Method

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, 2016. Published June 29, 2016. Originally approved in 2006. Last previous edition approved in 2011 as E2478 - 11. DOI: 10.1520/E2478-11R16.

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.

- D3846** Test Method for In-Plane Shear Strength of Reinforced Plastics
- E543** Specification for Agencies Performing Nondestructive Testing
- E976** Guide for Determining the Reproducibility of Acoustic Emission Sensor Response
- E1316** Terminology for Nondestructive Examinations
- E2374** Guide for Acoustic Emission System Performance Verification

2.2 ASME Documents:³

- ASME Section X, Article RT-8** Test Method for Determining Damage-Based Design Criterion
- ASME Section V, Article 11** Acoustic Emission Examination of Fiber-Reinforced Plastic Vessels

2.3 Other Standards:

- ANSI/ASNT-CP-189** Qualification and Certification of Nondestructive Testing Personnel⁴
- SNT-TC-1A** Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing⁴
- NAS-410** Certification and Qualification of Nondestructive Test Personnel⁵

3. Terminology

3.1 Definitions of terms related to conventional acoustic emission are in Terminology E1316, Section B.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *historic index*—a measure of the change in MARSE (or other AE feature parameter such as AE Signal Strength) throughout an examination.

3.2.2 *knee in the curve*—a dramatic change in the slope of the cumulative AE (MARSE or Signal Strength) versus time curve.

³ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁴ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlington Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

⁵ Available from Aerospace Industries Association of America, Inc. (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209-3928, <http://www.aia-aerospace.org>.