Designation: E2907/E2907M – 13 (Reapproved 2019)

Standard Practice for Examination of Paper Machine Rolls Using Acoustic Emission from Crack Face Rubbing[1]

This standard is issued under the fixed designation E2907/E2907M; 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 non-pressure, paper machine rolls.

1.2 This practice utilizes a slow rotation of the roll to produce a full load cycle where load is provided by the weight of the roll suspended from its bearings or other journal support mechanism(s).

1.3 This practice is used for detection of cracks and other discontinuities in rolls that produce frictional acoustic emission during rotation.

1.4 The AE measurements are used to detect or locate emission sources, or both. Other nondestructive test (NDT) methods must be used to evaluate the significance of AE sources. Procedures for other NDT techniques are beyond the scope of this practice. See Note 1.

NOTE 1—Traditional AE examination, magnetic particle examination, shear wave ultrasonic examination, and radiography are commonly used to establish the exact position and dimensions of flaws that produce AE.

1.5 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.

1.6 *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. Specific precautionary statements are given in Section 8.*

1.7 *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

E650 Guide for Mounting Piezoelectric Acoustic Emission Sensors

E976 Guide for Determining the Reproducibility of Acoustic Emission Sensor Response

E1316 Terminology for Nondestructive Examinations

E2075 Practice for Verifying the Consistency of AE-Sensor Response Using an Acrylic Rod

E2374 Guide for Acoustic Emission System Performance Verification

E2598 Practice for Acoustic Emission Examination of Cast Iron Yankee and Steam Heated Paper Dryers

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 Document*[4]

NAS-410 Certification and Qualification of Nondestructive Testing Personnel

3. Terminology

3.1 *Definitions*—See Terminology E1316 for general terminology applicable to this practice.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *crack face rubbing*—physical displacement of existing crack surfaces as load is changed.

[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 May 1, 2019. Published June 2019. Originally approved in 2013. Last previous edition approved in 2013 as E2907/E2907M – 13. DOI: 10.1520/E2907_E2907M-13R19.

[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.

3.2.2 *crack face rubbing emission*—acoustic emission produced by (frictional mechanisms) within existing cracks that are subjected to a change in load.

3.2.3 *crack-face-rubbing emission*—is one form of tribo-acoustic emission.

3.2.4 *tribo-acoustic emission*—stress waves produced by rubbing of surfaces.

4. Summary of Practice

4.1 The type of paper machine roll that has been most commonly examined using this technique is known as a "felt" roll.

4.2 The felt must be removed or loosened such that a felt roll can be rotated without causing background noise. Electromagnetically "jogging" the roll may be a possibility, depending on the availability of electricity in the mill.

4.3 The roll is slowly rotated through 360 degrees, then rotated back to the original 0 degrees orientation. (Test time is approximately 60 seconds.)

4.4 This examination procedure describes a technique whereby AE is detected from the rubbing of existing crack surfaces. Excessive loading to induce crack propagation is not required.

4.5 The AE sensors are mounted on each end of the roll (bearing journal or shell, or both).

4.6 Sensors are connected to an acoustic emission signal processor. The signal processor uses single channel data for zone location and measured times of arrival to determine linear location of emissions sources.

4.7 If measured emission exceeds a prescribed level (that is, specific areas produce enough AE activity), then such locations are considered NDT indications and should receive secondary NDT examination to determine the severity of the indication.

4.8 Secondary examination confirms presence of flaws and measures flaw dimensions.

4.9 If one dimension of the flaw aspect ratio exceeds a prescribed limit (that is, a conservative limit that is based on construction material, wall thickness, fatigue crack growth estimates, and fracture critical flaw depth calculations), then the roll must be removed from service.

5. Significance and Use

5.1 Paper machine rolls can range in size from 2.4 to 9 m [8 to 30 ft] long, with a shell thickness of from 12.5 to 75 mm [0.5 to 3 in.,] and 300 to 1200 mm [12 to 48 in.] diameter. Depending on purpose, paper machine rolls can weigh as little as 60 000 kg [13 000 lb] to as much as 27 500 kg [60 000 lb].

5.2 If indications are found during this procedure it can be repeated, with additional sensors to refine source location accuracy.

5.3 Removal of rolls for traditional NDT examination may be impractical and may not be sensitive enough to locate small defects.

5.4 Traditional AE examination, whereby the roll is subjected to load greater than service load to detect crack extension, risks damage to the roll and is best employed as a follow-up NDT examination.

5.5 Manual rotation through a full revolution subjects existing cracks to tensile and compressive forces which can open and close existing cracks, and cause friction at the crack surfaces.

5.6 Excess background noise (overhead cranes, nearby maintenance activities) may distort AE data or render it useless. Users must be aware of the following common sources of background noise: bearing noise (lack of lubrication, spalling, and so forth), mechanical contact with the roll by other objects, electromagnetic interference (EMI) and radio frequency interference (RFI) from nearby broadcasting facilities and from other sources. This practice should not be used if background noise cannot be eliminated or controlled.

5.7 Other Non-destructive test methods may be used to evaluate the significance of AE indications. Traditional AE has been used to confirm the existence of the AE indication and fine tune the location. Magnetic particle, ultrasonic and radiographic examinations have been used to establish the position, depth and dimensions of the indication. Procedures for using other NDT methods are beyond the scope of this practice.

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*—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, 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.

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

6.4 *Extent of Examination*—The extent of examination includes the entire roll unless otherwise specified.

6.5 *Reporting Criteria/Acceptance Criteria*—Reporting criteria for the examination results shall be in accordance with Section 11 unless otherwise specified. Since acceptance criteria (for example, 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.

7. Apparatus

7.1 Essential features of the apparatus required for this practice are provided in Fig. 1. Full specifications are in Annex A1.

7.2 Couplant must be used to acoustically connect sensors to the (bare metal) vessel surface. Adhesives that have acceptable acoustic properties, and adhesives used in combination with traditional couplants, are acceptable.

7.3 Sensors may be held in place with magnets, elastic strips, adhesive tape, or other mechanical means.

7.4 The AE sensors are used to detect frictionally induced stress waves emanating from the crack surface. Sensors must be held in contact with the roll to ensure adequate acoustic coupling.

7.5 A preamplifier may be enclosed in the sensor housing or in a separate enclosure. If a separate preamplifier is used, cable length, between sensor and preamp, must not exceed 2 m [6 ft].

7.6 Power/signal cable length (that is, cable between preamp and signal processor) shall not exceed 150 m [500 ft]. See A1.5.

7.7 Signal processors are computerized instruments with independent channels that filter, measure, and convert analog information into digital form for display and permanent storage. A signal processor must have sufficient speed and capacity to independently process data from all sensors simultaneously. The signal processor should provide capability to filter data for replay. A printer should be used to provide hard copies of examination results.

7.7.1 A video monitor should display processed examination data in various formats. Display format may be selected by the equipment operator.

7.7.2 A data storage device, such as a hard drive, may be used to provide data for replay or for archives.

7.7.3 Hard copy capability should be available from a printer or equivalent device.

8. Safety Precautions

8.1 If the roll has been allowed to cool to a very low level, the operator should be aware of the ductile-brittle transition temperature of the roll's construction material.

9. Calibration and Verification

9.1 Annual calibration and verification of 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 the 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) or equivalent.

9.2 Routine electronic evaluation of the signal processor should be performed monthly and any time there is concern about signal processor performance. An AE electronic 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.

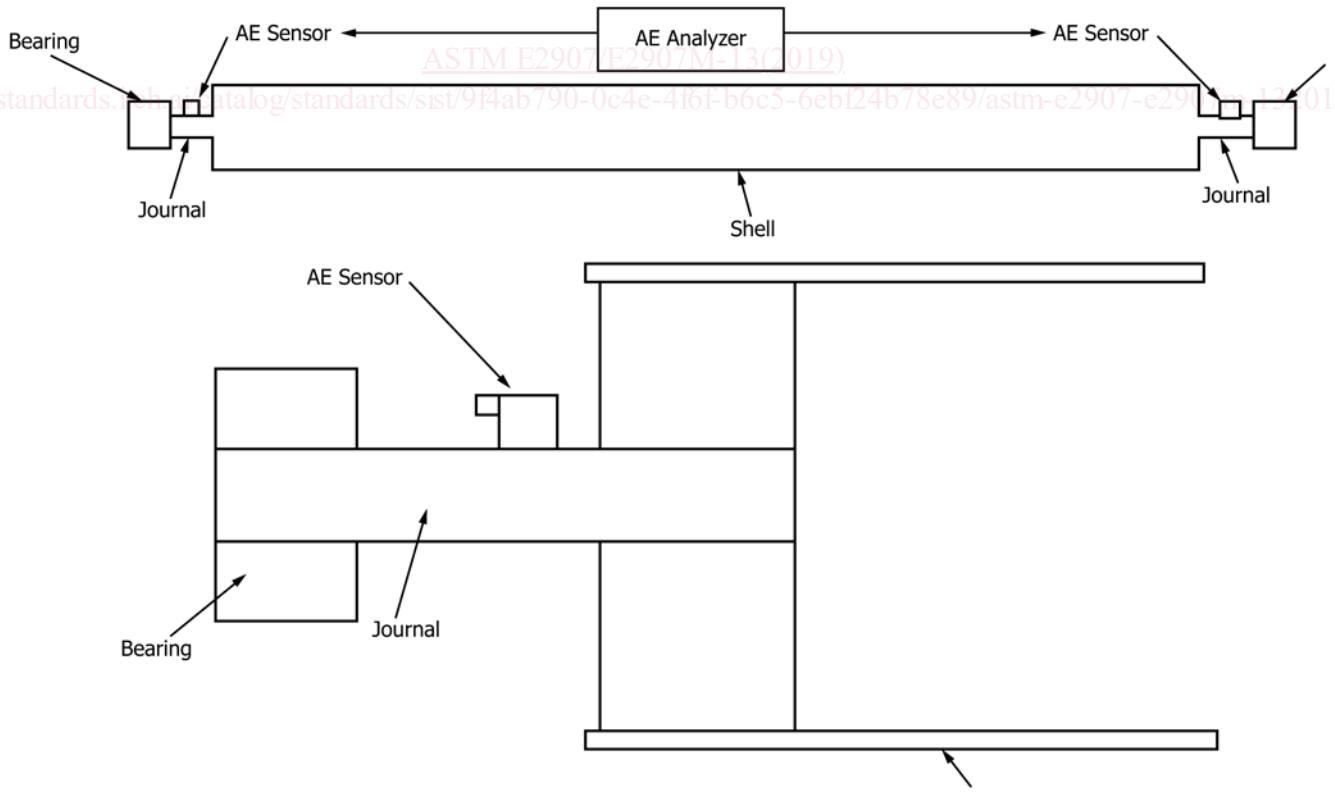

FIG. 1 Essential Features of the Apparatus