Designation: E2928/E2928M – 23

Standard Practice for Examination of Drillstring Threads Using the Alternating Current Field Measurement Technique[1]

This standard is issued under the fixed designation E2928/E2928M; 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 describes procedures to be followed during alternating current field measurement examination of drillstring threads on tubulars used for oil and gas exploration and production for detection and, if required, sizing of service-induced surface breaking discontinuities transverse to the pipe.

1.2 This practice is intended for use on threads in any metallic material.

1.3 This practice does not establish acceptance criteria. Typical industry practice is to reject these connections on detection of a confirmed crack.

1.4 While the alternating current field measurement technique is capable of detecting discontinuities in these connections, supplemental surface NDT methods such as magnetic particle testing for ferrous metals and penetrant testing for non-ferrous metals may detect additional discontinuities.

1.5 *Units*—The values stated in either inch-pound units or SI units are to be regarded separately as standard. The values stated in each system might not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from both systems may result in nonconformance 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.*

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

E1316 Terminology for Nondestructive Examinations

E2261 Practice for Examination of Welds Using the Alternating Current Field Measurement Technique

3. Terminology

3.1 For definitions of terms relating to this practice refer to Terminology E1316, Section A, Common NDT terms, and Section C, Electromagnetic testing. The following definitions are specific to the alternating current field measurement technique:

3.2 *Definitions:*

3.2.1 *detector, n*—one or more coils or elements used to sense or measure a magnetic field; also known as a receiver.

3.2.2 *exciter, n*—a device that generates a time varying electromagnetic field, usually a coil energized with alternating current (AC); also known as a transmitter.

3.2.3 *uniform field, n*—as applied to nondestructive testing with magnetic fields, the area of uniform magnetic field over the surface of the material under examination produced by a parallel induced alternating current, which has been passed through the test piece and is observable beyond the direct coupling of the exciting coil.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *alternating current field measurement system, n*—the electronic instrumentation, software, probes, and all associated components and cables required for performing an examination using the alternating current field measurement technique.

3.3.2 *box, n*—the female thread in a drillstring connection.

3.3.3 *Bx, n*—the x component of the magnetic field, parallel to the thread root, the magnitude of which is proportional to the current density set up by the electric field.

[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.07 on Electromagnetic Method.

Current edition approved Feb. 1, 2023. Published March 2023. Originally approved in 2013. Last previous edition approved in 2017 as E2928/E2928M – 17. DOI: 10.1520/E2928_E2928M-23.

[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.

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

3.3.4 *Bz, n*—the z component of the magnetic field normal to the examined pipe surface, the magnitude of which is proportional to the lateral deflection of the induced currents in the plane of that surface.

3.3.5 *configuration data, n*—standardization data and instrumentation settings for a particular probe stored in a computer file or device memory.

3.3.6 *data sample rate, n*—the rate at which data is digitized for display and recording, in data points per second.

3.3.7 *longitudinal, adj*—following from the above definition, a longitudinal discontinuity is parallel to the pipe axis and therefore perpendicular to the scan direction.

3.3.8 *operational standardization block, n*—a reference standard with specified artificial notches, used to confirm the operation of the system.

3.3.9 *pin, n*—the male thread in a drillstring connection.

3.3.10 *satellite signals, n—Bx* and *Bz* signals observed when the probe passes a discontinuity in an adjacent thread root.

3.3.11 *surface plot, n*—for use with array probes. This type of plot has one component of the magnetic field plotted over an area, typically as a color contour plot or 3-D wire frame plot.

3.3.12 *time base plots, n*—these plot the relationship between *Bx* or *Bz* values with time.

3.3.13 *transverse, adj*—as is normal in drilling, the terms transverse and longitudinal are defined in reference to the pipe axis. Therefore, a transverse discontinuity is parallel to the thread and hence to the scan direction. This is different to the situation for weld inspection, covered in Guide E2261.

3.3.14 *X-Y Plot, n*—an X-Y graph with two orthogonal components of magnetic field plotted against each other.

NOTE 1—Different equipment manufacturers may use slightly different terminology. Reference should be made to the equipment manufacturer's documentation for clarification.

4. Summary of Practice

4.1 In a basic alternating current field measurement system, a small probe is moved around the thread root. The probe contains an exciter coil, which induces an AC magnetic field in the material surface aligned to the direction of the thread root. This, in turn, causes alternating current to flow across the threads. The depth of penetration of this current varies with material type and frequency but is typically 0.004 in. [0.1 mm] deep in ferromagnetic materials and 0.08 to 0.3 in. [2 to 7 mm] deep in non-ferromagnetic materials. Any surface breaking discontinuities within a short distance of either side of the scan line at this location will interrupt or disturb the flow of the alternating current. Measurement of the absolute quantities of the two major components of the surface magnetic fields (*Bx* and *Bz*) determines the severity of the disturbance (see Fig. 1) and thus the severity of the discontinuity. Discontinuity sizes, such as crack length and depth, can be estimated from the values of these quantities or the physical locations of key points, or both, selected from the *Bx* and *Bz* traces along with the standardization data and instrument settings from each individual probe. This discontinuity sizing can be performed automatically using system software. Discontinuities essentially perpendicular to the thread may be detected (in ferritic metals only) by the flux leakage effect.

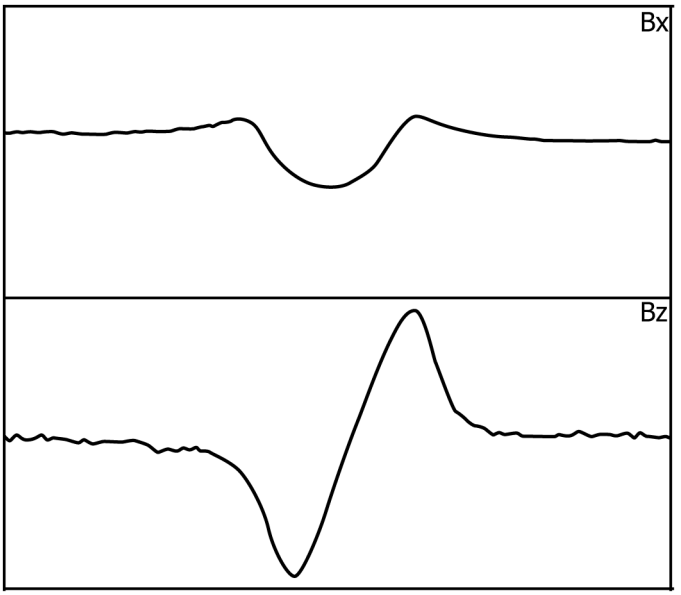

FIG. 1 Example *Bx* and *Bz* Traces as a Probe Passes Over a Crack (The orientation of the traces may differ depending upon the instrumentation.)

4.2 Configuration data is loaded at the start of the examination. System sensitivity and operation is verified using an operation standardization block. System operation is checked and recorded prior to and at regular intervals during the examination. This can be accomplished using discontinuity-sizing tables in the system software. Data is recorded in a manner that allows archiving and subsequent recall for each thread. Evaluation of examination results may be conducted at the time of examination or at a later date. The examiner generates an examination report detailing complete results of the examination.

5. Significance and Use

5.1 The purpose of the alternating current field measurement method is to evaluate threads for surface breaking discontinuities such as fatigue cracks running along the thread root. The examination results may then be used to determine the fate of the test piece. This may involve re-examination by an alternative technique, immediate scrapping of the test piece, or reworking to remove discontinuities (beyond the scope of this practice). This practice is not intended for the examination of threads for non-surface breaking discontinuities.

6. Basis of Application

6.1 *Personnel Qualification*—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 and certified by the employer or certifying agent, as applicable. The practice or standard used and its applicable revision shall be identified in the contractual agreement between the using parties