Designation: E1571 – 21

Standard Practice for Electromagnetic Examination of Ferromagnetic Steel Wire Rope[1]

This standard is issued under the fixed designation E1571; 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 covers the application and standardization of instruments that use the electromagnetic, the magnetic flux, and the magnetic flux leakage examination method to detect flaws and changes in metallic cross-sectional areas in ferromagnetic wire rope products.

1.1.1 This practice includes rope diameters up to 2.5 in. (63.5 mm). Larger diameters may be included, subject to agreement by the users of this practice.

1.2 *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 are provided for information only and are not considered standard.

1.3 *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.*

1.4 *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

2.2 *Other Documents:*

ANSI/ASNT-CP-189 ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel[3]

SNT-TC-1A Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing[3]

NAS-410 Certification and Qualification of Nondestructive Personnel (Quality Assurance Committee)[4]

ISO 9712 Nondestructive Testing—Qualification and Certification of NDT Personnel[5]

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *dual-function instrument, n*—a wire rope NDT instrument designed to simultaneously detect and display changes of metallic cross-sectional area on one channel and local flaws on another channel of a dual-channel strip chart recorder or another appropriate device.

3.2.2 *local flaw (LF), n*—a discontinuity in a rope, such as a broken or damaged wire, a corrosion pit on a wire, a groove worn into a wire, or any other physical condition that degrades the integrity of the rope in a localized manner.

3.2.3 *loss of metallic cross-sectional area (LMA), n*—a relative measure of the amount of material (mass) missing from a location along the wire rope and is measured by comparing a point with a reference point on the rope that represents maximum metallic cross-sectional area, as measured with an instrument.

3.2.4 *single-function instrument, n*—a wire rope NDT instrument designed to detect and display either changes in metallic cross-sectional area or local flaws, but not both, on a strip chart recorder or another appropriate device.

[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.

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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 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.

[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.

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

4. Summary of Practice

4.1 The principle of operation of a wire rope nondestructive examination instrument is as follows:

4.1.1 *Direct Current and Permanent Magnet (Magnetic Flux) Instruments*—Direct current (dc) and permanent magnet instruments (Figs. 1 and 2) supply a constant flux that magnetizes a length of rope as it passes through the sensor head (magnetizing circuit). The total axial magnetic flux in the rope can be measured either by Hall effect sensors, an encircling (sense) coil, or by any other appropriate device that can measure absolute magnetic fields or variations in a steady magnetic field. The signal from the sensors is electronically processed, and the output voltage is proportional to the volume of steel or the change in metallic cross-sectional area, within the region of influence of the magnetizing circuit. This type of instrument measures changes in metallic cross-sectional area.

4.1.2 *Magnetic Flux Leakage Instrument*—A direct current or permanent magnet instrument (Fig. 3) is used to supply a constant flux that magnetizes a length of rope as it passes through the sensor head (magnetizing circuit). The magnetic flux leakage created by a discontinuity in the rope, such as a broken wire, can be detected with a differential sensor, such as a Hall effect sensor, sensor coils, or by any other appropriate device. The signal from the sensor is electronically processed and recorded. This type of instrument measures LFs. While the information is not quantitative as to the exact nature and magnitude of the causal flaws, valuable conclusions can be drawn as to the presence of broken wires, internal corrosion, and fretting of wires in the rope.

4.2 The examination is conducted using one or more techniques discussed in 4.1. Loss of metallic cross-sectional area can be determined by using an instrument operating according to the principle discussed in 4.1.1. Broken wires and internal (or external) corrosion can be detected by using a magnetic flux leakage instrument as described in 4.1.2. The examination procedure must conform to Section 9. One instrument may incorporate both magnetic flux and magnetic flux leakage principles.

5. Significance and Use

5.1 This practice outlines a procedure to standardize an instrument and to use the instrument to examine ferromagnetic wire rope products in which the magnetic flux and magnetic flux leakage methods are used. If properly applied, the magnetic flux method is capable of detecting the presence, location, and magnitude of metal loss from wear, broken wires, and corrosion, and the magnetic flux leakage method is capable of detecting the presence and location of flaws such as broken wires and corrosion pits.

5.2 The instrument's response to the rope's fabrication, installation, and in-service-induced flaws can be significantly different from the instrument's response to artificial flaws such as wire gaps or added wires. For this reason, it is preferable to detect and mark (using set-up standards that represent) real in-service-induced flaws whose characteristics will adversely affect the serviceability of the wire rope.

6. Basis of Application

6.1 The following items require agreement by the users of this practice and should be included in the rope examination contract:

6.1.1 Acceptance criteria.

6.1.2 Determination of LMA, or the display of LFs, or both.

6.1.3 Extent of rope examination (that is, full length that may require several setups or partial length with one setup).

6.1.4 Standardization method to be used: wire rope reference standard, rod reference standards, or a combination thereof.

6.1.5 Maximum time interval between equipment standardizations.

6.2 *Personnel Qualification*—If specified in the contractual agreement, personnel performing examinations in accordance with this test method 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

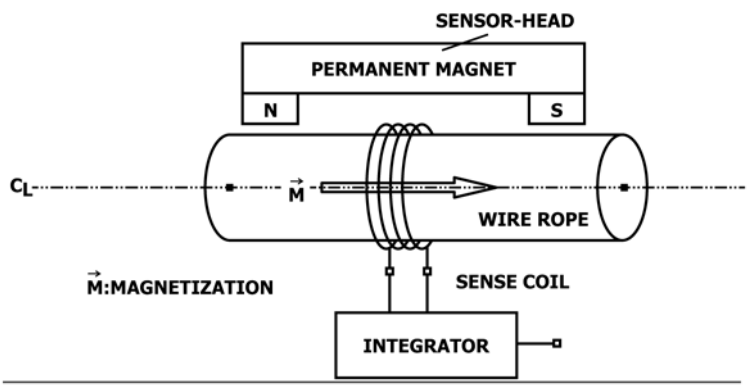

FIG. 1 Schematic Representation of a Permanent Magnet Equipped Sensor-Head Using a Sense Coil to Measure the Loss of Metallic Cross-Sectional Area