Designation: E2905/E2905M − 20

Standard Practice for Examination of Mill and Kiln Girth Gear Teeth—Electromagnetic Methods[1]

This standard is issued under the fixed designation E2905/E2905M; 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*

NOTE 1—Throughout the standard, "gear" means gear or pinion unless the gear is specifically identified.

1.1 This practice describes a two-part procedure for electromagnetic evaluation on gear teeth on mill and kiln gear drives and pinions. The first part of this practice details the ability to detect 100 % of surface-breaking discontinuities in the flank and root area on both the drive side and non-drive (coast) side of the gear tooth using an eddy current array. The second part of the examination is to size or measure accurately the length and depth of any cracks found in these areas using electromagnetic methods. No other practice addresses the use of electromagnetic methods for the detection and sizing of surface-breaking discontinuities on mill and kiln ring gear teeth. For reference, Fig. 1 contains a schematic diagram labeling the areas of the gear teeth.

1.2 This practice is used only for the detection of surface breaking discontinuities including cracking, macropitting, and certain scuffing and wear patterns. It will not provide a full gear tooth analysis. Visual examination by an experienced gear specialist is the best way to characterize fully the failure modes present. It is imperative that the analysis of the gear teeth is completed at the time of examination. Sending data offsite for analysis later is not recommended, as potential failure modes could be missed from lack of in-situ visual examination.

1.3 Two technicians, one lead technician, and a gear technician, are typically required for this practice. One technician guides the probe and the other technician operates the computer/software and analyzes the gear teeth condition.

1.4 It is important that the appropriate method standards, such as Practice E3024 and Practice E2261, accompany the technician when performing the examination. If crack sizing is performed, then it shall be performed using an electromagnetic testing method such as the alternating current field measurement approach of Practice E2261.

1.5 It is recommended that the technician review the appendixes in this practice in advance of starting the job.

1.6 A clean gear is recommended for a complete gear analysis. Depending on the lubrication used, the technician, in discussion with the client, shall determine the appropriate cleaning procedure. If an oil bath lubrication system is used, ensure the gear teeth surfaces are clean. If an asphaltic-based or synthetic-based lubricant is used, refer to the annexes and appendices in 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 are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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 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]

E709 Guide for Magnetic Particle Testing
E1316 Terminology for Nondestructive Examinations
E2261 Practice for Examination of Welds Using the Alternating Current Field Measurement Technique
E2884 Guide for Eddy Current Testing of Electrically Conducting Materials Using Conformable Sensor Arrays
E3024 Practice for Magnetic Particle Testing for General Industry

[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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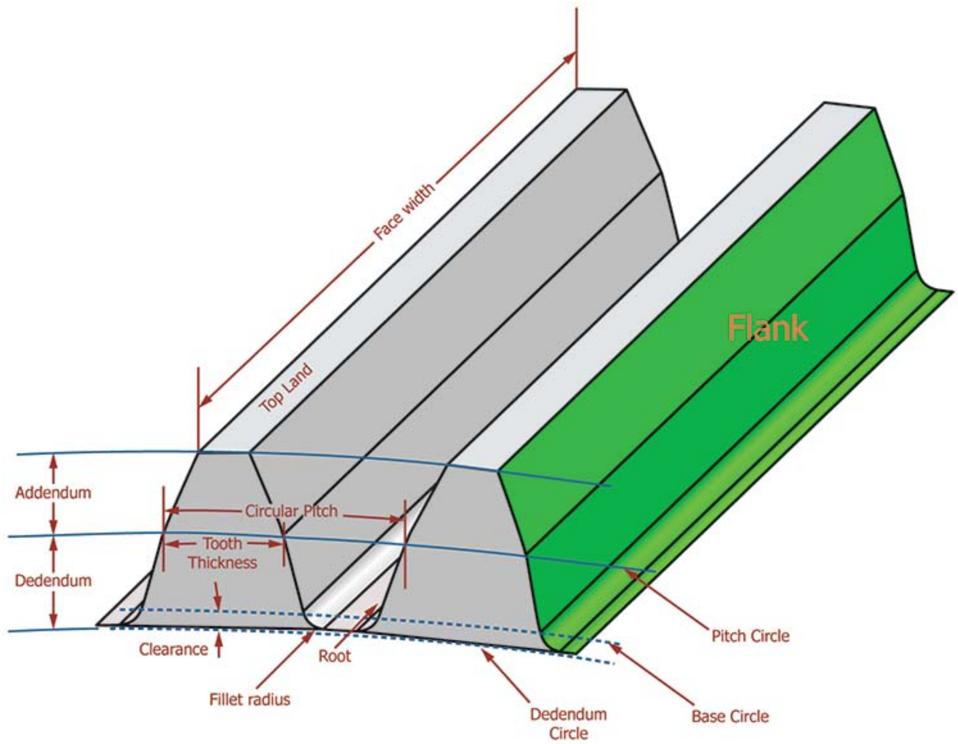
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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



Green shaded region showing scanned area in one pass.

FIG. 1 Schematic Image Labeling the Regions of the Gear Teeth and the Area (Shown in Green Shading) That is Scanned in One Pass With the Eddy Current Array Probe

2.2 *AIA Standard:*[3]

NAS 410 Certification and Qualification of Nondestructive Test Personnel

2.3 *ANSI/AGMA Standards:*[4]

AGMA 912-A04 Mechanisms of Gear Tooth Failures—Information Sheet

AGMA 919-1-A14 Condition Monitoring and Diagnostics of Gear Units and Open Gears

ASNI/AGMA 1010-F14 Standard for Appearance of Gear Teeth—Terminology of Wear and Failure

ANSI/AGMA 1012 G-05 Gear Nomenclature, Definition of Terms

ANSI+AGMA+6014-B15 Annex G

2.4 *ANSI/ASNT Standards:*

ANSI/ASNT-CP-189 Qualification and Certification of Nondestructive Testing Personnel[4]

ISO 9712 Qualification and Certification of NDT Personnel[4]

SNT-TC-1A Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing[5]

3. Terminology

3.1 *Definitions*—For definitions of terms relating to this practice, refer to Terminology E1316, Practice E2261, and Guide E2884. For definitions of general terms relating to gear examinations, refer to Guide E709, ANSI/AGMA 1012 G-05, ANSI/AGMA 1010-F14, AGMA 919-1-A14, and ANSI+AGMA+6014-B15.

NOTE 2—Different equipment manufacturers may use slightly different terminology. Reference should be made to the equipment manufacturer's documentation for clarification.

3.2 *Eddy Current Array Method:*

3.2.1 *eddy current array, ECA, n*—a sensor configuration with multiple sensing coils that respond to a local magnetic field created by at least one proximate drive coil.

3.2.1.1 *Discussion*—The eddy current array technology provides the ability to measure electronically multiple eddy current sensing coils placed side by side in the same probe assembly. Example eddy current arrays have distinct drive coils associated with each sense coil or a drive coil with a linear conductor that is parallel to a linear array of sense coils. Depending upon the instrumentation, the response for each sense element can be measured in parallel or a multiplexer can be used to switch between one or more of the sense coils. Typically, a multiplexer is used when the number of sense coils is greater than the number of data acquisition channels for impedance measurement. When using eddy current sensor arrays with multiple drive coils and multiple sensing coils, undesired coupling between the individual coils is likely to take place. It may be necessary to use a multiplexer with a special multiplexing pattern to avoid such undesired coupling. Most conventional eddy current flaw detection techniques can be reproduced with an ECA examination. With the benefits of

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

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[5] Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, http://www.asnt.org.

single-pass coverage, and enhanced imaging capabilities, ECA technology provides a remarkably powerful tool and significant time savings during examinations compared to raster scanning with a single coil probe. (See Fig. 2.)

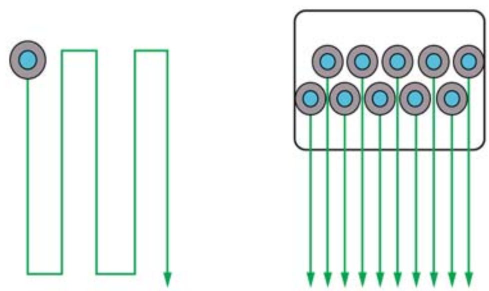


FIG. 2 Eddy Current Single Coil Probe Compared to Eddy Current Array Probe Coils

3.2.1.2 *Discussion*—In this practice, the eddy current array is used for the detection of surface breaking discontinuities including cracking, macro-pitting, and certain scuffing and wear patterns. Although ECA will show the effects of certain types of wear patterns, the proper method for interpreting contact and wear patterns should be used. Refer to ANSI/AGMA 1010-F14. It describes the appearance of gear tooth failure modes and discusses their mechanisms, with the sole intent of facilitating identification of gear wear and failure.

3.2.2 *eddy current array probes, n*—mechanical fixtures designed to detect a specific type of discontinuity with an eddy current array and to conform to the shape of the part under examination (see Fig. 3).

3.2.2.1 *Discussion*—Probes can be designed to detect a specific type of discontinuity and conform to the shape of the gear tooth under examination. Also notice that the center of the root would actually be scanned twice. In this examination, there is no saturation performed. Surface probes are made with coils designed to be driven at relatively high frequencies (typically 50 to 500 kHz). Using higher frequencies results in less penetration of the eddy current field into the test part allowing full coverage of any surface-breaking discontinuities of the component to be examined. In addition, the higher frequencies provide a higher resolution for the detection of smaller defects. For this practice, a surface array probe, with the ability of detecting all surface discontinuities—including cracks—is required for a successful examination.

3.2.2.2 *Discussion—Probe Quality*—Probe operational life varies depending on the environmental conditions within the work area. Some of these environmental factors are temperature, moisture, cleanliness, and the main factor being surface roughness.

3.2.3 *reference standard, n*—shall contain at least one long reference indicator to standardize all the channels of the array at once and also representative defects for flaw characterization during the examination.

3.2.4 *set screws, n*—conformable and substantially nonconducting set screws on the probe that are used to allow small lift-off adjustments or excursions on surface response.

3.2.5 *system performance verification, n*—use of a measurement of one or more response values, typically physical property values for a reference standard to confirm that the response values are within specified tolerances to validate the system standardization and verify proper instrument operation.

4. Summary of Practice

4.1 *Gear-Cleaning Procedure*—Typically, mill operations performs the gear tooth cleaning. However, in some cases, the technicians performing the examination may be required to clean the gear as per Appendix X2. Mill maintenance personnel are responsible for removing the guards for access to the gear teeth. Nondestructive examination (NDE) for mill and kiln girth gear teeth are provided for maintenance and as a part of an overall predictive maintenance plan. Visual interpretation is the common method used by gear specialists to analyze gear tooth condition in-situ, such as contact patterns, scuffing, and wear patterns. However, visual examination is not recommended for crack detection. For a thorough visual examination, proper cleaning of the gear teeth is considered mandatory. Other reasons for a cleaned gear tooth are to prevent lift-off and that it is very hard for the ECA probe to maintain the geometry of a gear tooth that has lubricant present, especially if the lubricant is asphaltic-based or synthetic. If asphaltic or synthetic lubrication is used, refer to Appendix X2 for cleaning procedures.

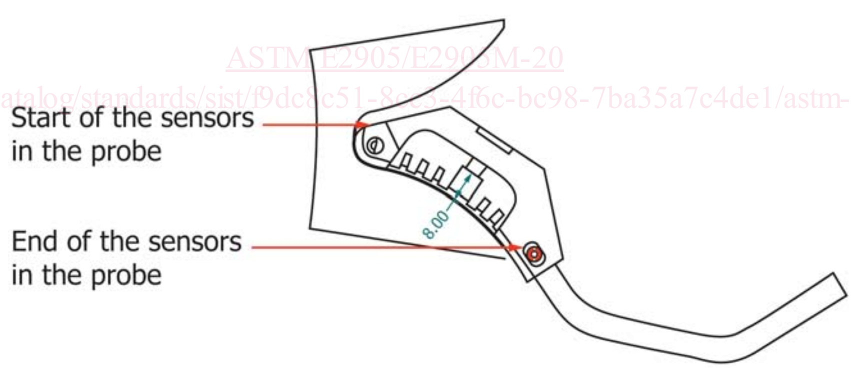


FIG. 3 Coverage of a Flexible Probe—Root, Dedendum, and Addendum

FIG. 4 Two Cracks on a Tooth Just Above the Root That Were Only Observed Visually After Being Revealed by the ECA Examination; In This Example, the Cracks Were Not Apparent Visually Until MT Was Performed

4.1.1 *ECA*—ECA is used for nondestructively locating and characterizing surface-breaking discontinuities in conducting materials to electrically conductive materials. For use in this practice, the properly designed ECA probe has proven to detect all surface-breaking discontinuities from 0.76 mm [0.03 in.] and larger on the flank and root of girth gear teeth. The examination is performed by scanning a conformable eddy current sensor array over the surface of the flank and root of the gear tooth being examined in one pass. The drive side of the tooth is referred to as the A side and the non-drive side of the tooth is referred to as the B side of the tooth. The measured responses and location information are then used, typically in the form of a displayed image (C-scan), to determine the presence and characteristics of discontinuities.

4.1.2 *Alternating Current Field Measurement Method*—Alternating current field measurement is used if a crack is found. Alternative electromagnetic methods can also be used for sizing cracks.

4.1.3 *Alternating Current Field Measurement for Nondestructive Testing Detection and Sizing of Surface-Breaking Cracks*—It works on all metals, ferrous or nonferrous. A sensor probe is placed on the surface to be examined and an alternating current is induced into the surface. When no defects are present, the alternating current produces a uniform magnetic field above the surface. Any defect present will perturb the current, forcing it to flow around and underneath the defect; this causes the magnetic field to become non-uniform and sensors in the alternating current field measurement probe measure these field variations. Two components of this magnetic field are measured—one provides information about the depth or aspect ratio of the defect(s) and the other shows the positions of the defects' ends. The two signals are used to confirm the presence of a defect and, together with a sizing algorithm, measure its length and depth. The main advantages of alternating current field measurement for this practice are the speed of sizing cracks and that it provides both depth and length information. Defects up to 25 mm [1 in.] in depth can be sized accurately. See Practice E2261 for additional information regarding the alternating current field measurement method.

4.1.4 *Magnetic Particle Examination*—The magnetic particle method produces a direct visual indication which can assist the technician/inspector in further analyzing and identifying the discontinuity for documentation in the report. (See Fig. 4.) It is also used when excessive lift-off prevents the ECA probe from receiving a signal.

5. Significance and Use

5.1 Visual interpretation of gear teeth condition is different from examining for cracks or early signs of macro-pitting. Visual interpretation is referred to ASNI/AGMA 1010-F14.

5.1.1 The purpose of using an eddy current array for mill girth gear tooth examination is it drastically reduces the examination time; covers a large area in one single pass; provides real-time cartography of the examined region, facilitating data interpretation; and improves reliability and probability of detection (POD). One tooth can be examined in less than 30 seconds.

NOTE 3—In this practice, ECA is used as a discontinuity finding tool (see Fig. 4) and a presentation aid as support once problems are discovered and photographed. Colors and three-dimensional (3D) images (see Fig. 5) that help with visualization are invaluable in such circumstances.

5.1.2 The purpose of using alternating current field measurement is to size surface-breaking cracks electronically.

5.1.3 This practice is a useful tool for a condition-based monitoring program.

5.2 The examination results may then be used by qualified personnel or organizations to assess the severity and potential consequences of the failure modes identified. This practice is not intended for the examination of non-surface-breaking discontinuities. Other methods should be considered to address examination for non-surface-breaking discontinuities.

6. Basis of Application

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

6.1.1 *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 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 identified in the contractual agreement between the using parties.

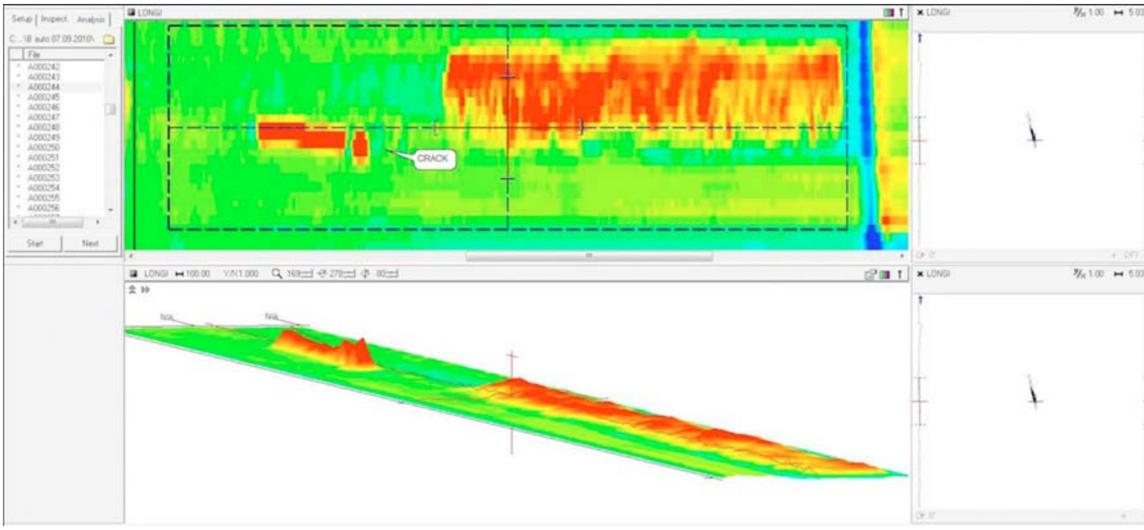


FIG. 5 Two- and Three-Dimensional View

7. Interferences

7.1 *Curvature of Examination Surface*—For the examination of gears or pinions with pronounced profiles, a flexible probe is required that can adjust its curvature to the various profiles. System performance verification tests should be run to verify lift-off sensitivity by adjusting the set screws in the face of the array probe.

7.2 *Surface Conditions*—The gear tooth flanks and roots can be readily scanned with the ECA probe by adjusting the set screws to set a proper lift-off. Gear tooth surfaces shall be clean and free of any asphaltic or synthetic lubricant that could interfere with proper lift-off of the ECA probe against the gear tooth surface.

7.3 *Pressure of the Probe Against Surface Under Examination*—Sliding the probe across the gear tooth is all the pressure that is required.

NOTE 4—The array probe has two set screws that allow for adjusting lift-off.

7.4 *Temperature*—Eddy current measurements are generally affected by temperature variations of the material under examination. For this practice, once the gear has been cleaned, the temperature of the gear teeth is ready for examination.

7.5 *Scanning Speed*—The length of the C-scan image may depend upon how fast a gear tooth is scanned if a position encoder is not used. This means that the number of acquisition points in the images may vary with the scan speed. As the technician applies a filter with a given number of points on the C-scan, this filter could cut or modify some indications. Scanning speed should be at the same speed that is set in the scan parameters.

7.6 *Residual Magnetism*—In magnetic materials, residual magnetism may affect the measurement and appear as a local property change. In this application, eddy current is induced in the material by the applied alternating magnetic field. With a probe configuration as in this application, the magnetism is very weak. Residual magnetism would be detected if the gear was previously examined using magnetic particle. Gears of this nature are usually examined every year or two, so any residual magnetism would be minimal. This application reduces the noise level by an optimal probe configuration.

7.7 *Limitations*—The eddy current array will not detect all scuffing conditions, wear patterns, backlash problems, lubrication issues, tip to root interference, and similar conditions. Visual interpretation by an expert is the typical method used to analyze these conditions. It is advised that the technician also be a girth gear specialist who understands how to properly identify and characterize gear tooth failure modes. Basic eddy current experience does not provide the knowledge required to interpret gear tooth issues or the understanding of ECA. The knowledge of the defect type helps in determining the root causes and the potential solutions, resulting in a higher standard of examination.

8. Apparatus

8.1 *Instrumentation*—The electronic instrumentation shall be capable of energizing the eddy current surface array with alternating current of one or more suitable frequencies and shall be capable of measuring the impedance or variations in the impedance of each element in the surface array. The equipment shall include a capability to correlate the impedance variations, or property values derived from the impedance values, with physical property changes for the material under examination.

8.2 *Eddy Current Surface Array*—The eddy current surface array shall be capable of inducing currents in the material under examination and sensing variations in the physical characteristics of the material under examination. Eddy current array (ECA) technology provides the ability to measure electronically multiple eddy current coils placed side by side in the same probe assembly. The surface probe array shall have sense coils that cover the entire length of the surface to be examined. This could include two rows of coils offset by one half between the two rows. Such coils configuration, whichever the exciting mode (absolute, transmit-receive, differential, and so forth), will allow good coverage all along the array and also avoid dead zones. The ECA data responses can be displayed as an image spanning the surface of the examined region of the gear or as individual coil channels for analysis after examination.

8.2.1 Depending upon the instrumentation, the response for each sense element can be measured in parallel or a multiplexer can be used to switch between one or more of the sensing coils. Typically, a multiplexer is used when the number of sense elements is greater than the number of data acquisition channels for impedance measurement. When using eddy current sensor arrays with multiple drive coils and multiple sensing coils, undesired coupling between the individual coils is likely to take place. It may be necessary to use a multiplexer with a special multiplexing pattern to avoid such undesired coupling. Similarly, the undesirable effect of mutual inductance (magnetic coupling between coils in close proximity) can be minimized with the use of an internal multiplexing system to program carefully the exact time that each coil is excited to transmit its eddy current signal. The signals are then reassembled before being displayed.

8.2.2 To achieve the best results for examination performance, there are several important parameters to consider when designing an effective ECA probe. Key factors include examination coverage, sensitivity, frequency, and, of course, cost. To optimize performance, it is important to balance the various probe parameters carefully. For example, high-sensitivity probes require small, high-frequency coils (providing less coverage); probes capable of greater coverage require larger, lower-frequency coils (resulting in decreased sensitivity to small defects). As is the case with conventional eddy current examinations, choosing the correct probe characteristics is essential to a successful examination. The array can be in contact with the material being tested or offset by an intended lift-off distance (for noncontact scanning) with two set screws in the face of the array probe.

8.3 An important consideration affecting the choice of instrumentation, eddy current array, and operational parameters is the depth of penetration of the sensor fields into the material under examination. The eddy current density does not remain constant with depth into the material. The eddy current density is greatest at the surface and decreases exponentially with depth (that is, the "skin effect"). The standard depth of penetration decreases with increasing frequency, electrical conductivity, or magnetic permeability of the material. For a material that is both thick and uniform, the standard depth of penetration is the depth at which the eddy current density is 37 % of the material surface value. To detect shallow defects in a material, relatively high frequencies are used. Refer to Guide E2884 for additional information.

9. Standardization

9.1 The eddy current unit is a precision instrument and should be calibrated annually or at periodic intervals after a repair or when a malfunction is suspected.

9.1.1 *Standardization*—Standardization is performed to adjust the sensitivity for an ECA probe. To do this, the operator scans a reference standard containing a reference notch to generate the same eddy current signal for each channel. To do this, the operator needs to adjust signal amplitude and phase for each channel to achieve it. After the standardization, other defects can be scanned, such as three different long transversal notches at depths from 1 to 3 to 5 mm [0.04 to 0.1 to 0.2 in.] long to 30 mm [1.2 in.] long. Also six holes ranging from 0.76 to 6 mm [0.03 to 0.24 in.] in diameter can be used for characterization purposes. Using the reference standard, the operator adjusts the gain and rotation of each channel so that the same phase and amplitude response is obtained for all channels. To validate the standardization, a system performance verification should be performed.

9.1.2 *System Performance Verification*—System performance verification refers to measurements on a reference standard to confirm that the measured responses are within specified tolerances for the application. This serves to validate the standardization and verify proper instrument operation.

9.1.3 *Discontinuity System Performance Verification*—This system performance verification uses measurements on a discontinuity containing reference standard to verify instrument operation. The reference standard should contain one or more reference indicators that are representative of the discontinuities to be found in the examination. The response variation as a result of the discontinuity as well as the background variation associated with discontinuity-free regions of the reference standard is to be within specified tolerances. When possible, the discontinuity reference standard should have the same shape as the part being examined.

10. Procedure

10.1 *Preparing the Gear Before Examination*—Ensure the addendum, dedendum, and root on both the drive side and the non-drive side of the gear teeth are clean and free from any tacky deposits. If the lubrication used is of sufficiently low viscosity, then the probe will glide along the gear tooth surface with ease and additional cleaning may not be required. If an asphaltic-based or synthetic lubricant is used, refer to Appendix X2.

NOTE 5—The gear tooth surfaces do not have to be wiped clean to remove residues from the cleaning chemical as in magnetic particle or liquid penetrant examination techniques.

NOTE 6—If the teeth are not already pre-stamped with numbers, use a stamp to mark every 25^{th} tooth on the top land. Confirmation with the technical assistant should be made every 25 teeth to ensure accuracy.

10.2 *ECA Method*—Operate and setup the instrument and software in accordance with the manufacturer's instructions.

10.2.1 Ensure that the ECA probe is compatible with the eddy current instrument.

10.2.2 The instrument shall be assembled, turned on, and allowed sufficient time to stabilize in accordance with the manufacturer's instructions before use. The instrument should be standardized on a reference standard. Standardization should be repeated at intervals established based on experience for a given application, including performance verification.

10.2.3 Once the equipment is set up and secured, the technical assistant will position himself or herself safely close to the girth gear so access to the gear teeth is unobstructed. The technician will position himself or herself safely where they have complete access to the notebook computer or whatever device the technician is using to store the acquisition software.

10.2.4 Once both people are in position, the technician will give the command for the assistant to run the probe across the gear tooth face (A side) of the tooth on the girth gear. The assistant will run the probe partially off the edge of the tooth from the farthest side of the gear tooth and pull it towards him until the probe has passed over the entire surface of the tooth face and off the edge. The technician will then give the command to start on the B side tooth face. This process will continue until all the gear tooth surfaces are scanned.

10.2.5 During the scanning, discontinuities may present themselves (see Fig. 5). If discontinuities are present, the technician will decide if further investigation is required. If so, the technician will take a picture of this with the tooth number marked on the gear tooth. If the discontinuity is a crack, the technician will use alternating current field measurement technique to size the crack accurately. The crack will be identified with the tooth number marked on the tooth and using magnetic particle method allowing the crack to present itself for a picture. If the discontinuity warrants contacting the maintenance supervisor to inform him of the discontinuity, the maintenance supervisor is responsible for making a decision, if any, on the repair procedure to remedy the situation.

10.2.6 Once the girth gear examination is completed, the team will then move themselves into position to examine the pinion. This part of the examination process will use the ECA flexible probe. The same process as A1.1-A1.4 will apply here.

10.2.7 Once all the data are collected, the technicians will gather all the equipment, clean up their work area, and clear the area. The technician and maintenance supervisor responsible for the examination will discuss the best course of action for presentation of the findings from the gear examination.

10.2.8 Finally, a formal hard copy of the report will be sent to the client.

11. Report

11.1 An examination report should contain the following information:

11.1.1 Date of examination, name of asset examined, and name of owner/operator;

11.1.2 Instrument, probe, and sensor identification;

11.1.3 Identification of components or location, or both, of examination;

11.1.4 Lubrication currently used;

11.1.5 Material(s) of the component;

11.1.6 Date of last instrument calibration and type and frequency of standardization;

11.1.7 Frequencies used;

11.1.8 A scope of work; and

11.1.9 A summary of work performed identifying critical areas of concern.

11.2 *Recommendations:*

11.2.1 An analysis report of the gear teeth examined;

11.2.2 Pictures of the critical areas of concern, including cracks highlighted by magnetic particle;

11.2.3 Pictures of gear teeth that show no surface breaking discontinuities. This would illustrate how the average scan would look on unaffected areas of the gear teeth; and

11.2.4 For performance verification and standardization, either the reference standard identification or a description of the discontinuity-free regions of the component should be provided.

11.3 All information should be archived whether or not it is required in the report.

12. Keywords

12.1 alternating current field measurement; crack; eddy current; eddy current array; electromagnetic examination; gear; gear examination; gear teeth; girth gear; kiln gear; macro-pitting; micro-pitting; mill gear; nondestructive examination; open gear; pitting

ANNEX

(Mandatory Information)

A1. PREPARATION OF THE GEAR BEFORE EXAMINATION

A1.1 It is critical to confirm with the client if cleaning is necessary and who will be cleaning the gear before examination. Will the client clean the gear before examination or will gear examination technicians do it? Ensure only approved gear-cleaning products are used. When cleaning a mill gear, no more than a 30 % charge or load of ore should be in the mill before starting the cleaning procedure to reduce stresses on the gear teeth.

A1.2 If the gear is lubricated with asphaltic or synthetic-based lubricants, acceptable cleaning methods include spraying the gear and manual scraping. A description of the spray method is found in Appendix X2. Manual scraping of the gear tooth flank and root can be performed with a stiff putty knife. Care must be taken to ensure that the scraping does not damage the gear tooth. Eddy current array probes are designed to scan through coatings; however, to accurately detect small discontinuities that can initiate cracks, the probe liftoff from the surface must be accurately maintained. This cannot be done properly when scanning through high viscosity open gear