

ASNT QUESTIONS & ANSWERS BOOK

Third Edition

Electromagnetic Testing Method

Levels I, II and III Review Questions
Book E

Alternating Current Field Measurement
Eddy Current Testing
Remote Field Testing



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The American Society for
Nondestructive Testing, Inc.



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ASNT exists to create a safer world by promoting the profession and technologies of nondestructive testing.

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INTRODUCTION

This book was previously published as *Supplement to Recommended Practice No. SNT-TC-1A (Q&A Book): Electromagnetic Testing*. The third edition of this publication builds on work that was coordinated by Jim Cox of JECNDT, LLC. As with other books in the ASNT Questions & Answers series, this book is intended to provide candidates studying for qualifying examinations with sample Level I, II, and III questions. Unlike other Questions & Answers books, this book is divided into three sections based on technique: alternating current field measurement, eddy current, and remote field.

The main change between the second and third editions is that the magnetic flux leakage (MFL) questions have been removed. Per *Recommended Practice No. SNT-TC-1A: Personnel Qualification and Certification in Nondestructive Testing* (2011), MFL is recognized as a method in its own right and not as a technique of electromagnetic testing (ET).

Every question has at least one reference that is listed in *ANSI/ASNT CP-105: ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel* (2011) as a recommended reference for qualification and certification in electromagnetic testing.

SECTION |

ALTERNATING CURRENT FIELD MEASUREMENT

LEVEL I

Alternating Current Field Measurement Review Questions

1. Which of the following frequencies has the least depth of penetration?
 - a. 5 kHz
 - b. 50 kHz
 - c. 5 Hz
 - d. 5 MHz

C.2.23; F.318; G.71
2. Which of the following wires, assuming all are the same length and same material, will have the greatest resistance?
 - a. 1.58 mm (0.062 in.) diameter
 - b. 3.18 mm (0.125 in.) diameter
 - c. 6.35 mm (0.250 in.) diameter
 - d. 12.7 mm (0.500 in.) diameter

G.15
3. Given cables with equal diameters made of the same material, which of the following cable lengths will have the greatest resistance?
 - a. 152 mm (6 in.)
 - b. 457 mm (18 in.)
 - c. 610 mm (24 in.)
 - d. 1422 mm (56 in.)

G.15
4. Which of the following materials has the greatest depth of penetration when excited with the same frequency?
 - a. Aluminum.
 - b. Copper.
 - c. Stainless steel.
 - d. Steel.

C.2.24; F.318; G.86 (Fig. 10.2)
5. When the permeability of a material is increased, the depth of penetration does which of the following?
 - a. Increases.
 - b. Decreases.
 - c. Remains constant.
 - d. Increases the conductivity.

F.319; G.84
6. What is required in one circuit to change the current in an adjacent circuit?
 - a. A continuous current must flow.
 - b. The resistance in both circuits must increase.
 - c. There must be a change in the current in the original circuit.
 - d. The magnetic field remains constant.

C.2.4; F.315; G.15
7. What is the effect of increasing the number of turns of wire in a coil?
 - a. The magnetic field produced will increase.
 - b. The magnetic field produced will decrease.
 - c. The magnetic field will remain constant.
 - d. There will be a change in the electric current.

D.331-332; G.14
8. What is the symbol for conductivity?
 - a. ν
 - b. Ω
 - c. μ
 - d. σ

G.57
9. What is the symbol for permeability?
 - a. H
 - b. B
 - c. μ
 - d. I

G.47

10. Materials with which of the following relative permeability values will be the most easily magnetized?
 - a. 60
 - b. 240
 - c. 800
 - d. 1000

G.47, 62
11. When an electric current flows through a conductor, in which direction is the magnetic field oriented?
 - a. Parallel to the conductor.
 - b. At 90° to the current flow.
 - c. In the opposite direction to the current flow.
 - d. In the same direction as the current flow.

G.43
12. If the current passing through a fixed number of turns is increased, what will be the effect on the magnetic field?
 - a. The magnetic field will increase.
 - b. The magnetic field will decrease.
 - c. The magnetic field will remain constant.
 - d. The magnetic field will change direction.

F.315; G.13
13. Which of the following has no effect on the inductance of a coil?
 - a. Increasing the number of turns.
 - b. Increasing the coil diameter.
 - c. Increasing the current.
 - d. Decreasing the number of turns.

G.13, 17
14. The depth of penetration in a material will be increased by:
 - a. increasing the permeability.
 - b. increasing the conductivity.
 - c. increasing the frequency of the test.
 - d. decreasing permeability.

C.2.22-23; G.84
15. When a primary coil is brought close to a conductive material, what is the effect on the secondary magnetic field?
 - a. It will be opposite to the primary magnetic field.
 - b. It will be opposite to the primary electric field.
 - c. It will be smaller but in the same direction.
 - d. It will be larger but in the same direction.

C.2.2; F.319; G.5
16. What couples an alternating current field measurement probe and a metal surface when operating in air?
 - a. An electric current.
 - b. A magnetic field.
 - c. No coupling.
 - d. Air.

H.250 (Fig. 1)
17. What generates a magnetic field in the B_z direction?
 - a. Uniform surface currents.
 - b. Increasing surface currents.
 - c. Curvature in the X and Y surface currents.
 - d. Decreasing surface currents.

B.1
18. What is the predominant electromagnetic property of a ferromagnetic material?
 - a. Resistance.
 - b. Conductance.
 - c. High permeability.
 - d. A high-frequency constant.

G.44, 47
19. If a current is flowing in a surface, then the magnetic flux density in the X direction is proportional to:
 - a. the current in the X direction.
 - b. the current in the Y direction.
 - c. the curvature of the current in the X-Y plane.
 - d. the magnetic flux direction in the Z direction.

H.251

20. In what way does the magnetic field used for magnetic particle inspection differ from the one produced during alternating current field measurement inspection?
- It is equal and opposite.
 - There is no difference; it is in the same direction.
 - It is at 90° to the magnetic field associated with the alternating current field measurement technique.
 - It is at 90° to the surface of the material.
- H.230, 251
21. What is the symbol for resistance?
- H
 - V
 - I
 - R
- G.15
22. Which of the following materials has the smallest depth of penetration for the same applied AC magnetic field?
- Mild steel.
 - Stainless steel.
 - Aluminum.
 - Copper.
- C.2.22-24; F.318; G.86(Fig. 10.2)
23. Which of the following best describes stainless steel?
- High permeability — low conductivity.
 - Low conductivity — low permeability.
 - High conductivity — low permeability.
 - High permeability — high conductivity.
- A.5, 28 (Table 1); C.2.19, 24
24. Which of the following statements is correct?
- The conductivity of a metal is proportional to the applied magnetic field.
 - The resistance in a circuit does not affect the current through the circuit.
 - A varying electric current cannot produce a current in an adjacent circuit.
 - The magnetic field produced by a current is proportional to the magnitude of the current.
- G.13
25. If it is required to generate a uniform electric field parallel to the weld, what direction will the magnetic field have to be to generate this electric field?
- At 90° to the weld and parallel to the surface.
 - Parallel to the surface and parallel to the weld.
 - A circular coil above the surface parallel to the weld.
 - A circular coil above the surface perpendicular to the weld.
- H.251
26. If a current flows in a surface and the magnetic flux density is in the Y direction, what change would produce an effect?
- A change in the current in the X direction.
 - A change in the magnetic flux density in the X direction.
 - A nonmetallic coating.
 - A change in the current in the Z direction.
- H.251
27. Which of the following NDT methods or techniques can be used to estimate crack depth?
- Magnetic particle testing.
 - Alternating current field measurement.
 - Dye penetrant inspection.
 - Ultrasonic creep wave inspection.
- H.253
28. During an alternating current field measurement weld inspection, the measurement of crack depth requires the following information:
- the coil frequency.
 - the length of the crack.
 - the depth of penetration of the AC field.
 - instrument type.
- B.8

29. What indication in the magnetic field component represents crack depth and shows that a crack is present?
- The magnetic field is uniform.
 - The magnetic field is zero.
 - The magnetic field value is greater than the background field value.
 - The magnetic field value is lower than the background value.
- B.6
30. For accurate depth sizing when using electrical or electromagnetic inspection methods, what must the relationship between the crack length and depth be?
- They must be equal.
 - The length must be equal to or greater than twice the depth of the crack.
 - The crack depth must be more than 13 mm (0.5 in.).
 - The crack length must be less than 51 mm (2.0 in.).
- H.258
31. When a crack is detected in a ferromagnetic material in an applied uniform magnetic field parallel to the weld and the crack is angled toward the toe of the weld, a magnetic field perpendicular to the surface is produced at the crack ends. What form does the field take?
- A -ve peak at both ends.
 - A +ve peak at both ends.
 - A large +ve peak at one end and a small -ve peak at the other end.
 - Large +ve peaks at each end and a -ve peak in the center.
- B.3
32. For accurate depth sizing, why must the length of a crack always be greater than twice the depth during alternating current field measurement inspection?
- To give sufficient current flow under the crack center.
 - The depth of the crack depends on the length.
 - No current will flow if the crack is too short.
 - To give sufficient current flow around the crack ends.
- H.258
33. What effect would you expect if the coils in an alternating current field measurement probe were smaller and closer together?
- No effect.
 - Improved detection of smaller discontinuities.
 - Improved sizing on larger discontinuities.
 - Smaller B_x signals.
- H.255
34. When using the alternating current field measurement inspection technique, what is the most important value that is measured?
- Phase angle.
 - Amplitude of the B_x magnetic field.
 - Amplitude of the B_z magnetic field.
 - Depth of the crack.
- H.251
35. If a hysteresis loop were produced for a conductive material and the loop was wide, it could be said that the material has:
- low permeability and would be difficult to magnetize.
 - high permeability and would be easy to magnetize.
 - high permeability and would be difficult to magnetize.
 - low residual magnetism and be easy to magnetize.
- G.47
36. The alternating current field measurement technique differs from other crack detection technologies in that it measures:
- the through thickness dimension.
 - the length only of a crack.
 - the length of the crack beneath the surface.
 - detection only.
- H.253
37. The alternating current field measurement test technique is most effective for locating which of the following cracks?
- Cracks in nonmagnetic materials.
 - Cracks in magnetic materials.
 - Cracks in coated materials.
 - Cracks in composite materials.
- F.314; H.253-254

38. In which of the following situations is alternating current field measurement least likely to be used?
- Testing under water.
 - Testing in air.
 - Testing of objects with elevated temperatures.
 - Testing of objects with many geometrical changes.
- E.214; H.253 G.15, 18
39. If a transverse discontinuity is detected in a longitudinal ferritic steel weld, the B_x indication:
- produces an increase in the magnetic field.
 - produces a reduction in the magnetic field.
 - has no effect on the magnetic field.
 - reduces the magnetic field to zero.
- B.2 H.8-9, 253
40. When an electric current flows down a wire, what is associated with it?
- An electric current flowing in the opposite direction.
 - A cooling effect.
 - A magnetic field at right angles to the current.
 - A magnetic field parallel to the electric current.
- C.2.2; G.4 B.7
41. Which of the following definitions most closely defines Ohm's law?
- The potential differences in a circuit =1.
 - The current in a circuit is proportional to the potential difference across it.
 - The magnetic field produced by a current is proportional to the magnitude of the current.
 - The frequency of an AC system is determined by its inductance.
- G.15 H.248, 252-258
42. What is the symbol for electric current?
- I
 - C
 - L
 - F
- G.14 C.2.15; G.57
43. The resistance of a direct current circuit is equivalent to which quantity in an alternating current circuit?
- Inductive reactance.
 - Impedance.
 - Reluctance.
 - Conductivity.
44. Which NDT method or technique below *cannot* be used to estimate crack depth?
- Alternating current potential drop (ACPD).
 - Time-of-flight ultrasonics.
 - Alternating current field measurement.
 - Dye penetrant inspection.
45. Variations in scanning speed:
- could influence the detection of small discontinuities.
 - will not change the amplitude of small discontinuities.
 - will have no direct effect on test results.
 - will affect instrument calibration and setup.
46. For which of the following applications could you *not* normally use alternating current field measurement for discontinuity detection?
- Fatigue cracks in welded joints of high strength steel.
 - Subsurface cracks in welded joints of mild steel.
 - Cracks in a weld of high-strength steel under an epoxy paint coating.
 - Surface fatigue cracks in mild steel welds.
47. IACS is the recognized abbreviation for:
- International Annealed Copper Standard.
 - Induced Alternating Current System.
 - Inductively Activated Comparison System.
 - Internal Applied Current System.

48. When alternating current field measurement test coils are wound to form small diameter coils, what would they normally be used to detect?
- Gradual changes in crack length.
 - Gradual changes in crack depth.
 - Small surface discontinuities.
 - Changes in permeability.
49. What term is used to describe the variation in the B_x display as the distance from the surface being tested to the coil varies?
- Phase change.
 - Fill factor.
 - Edge effect.
 - Liftoff.
50. Alternating current field measurement *cannot* be used to inspect:
- steel.
 - aluminum.
 - wood.
 - copper.

H.255

H.248-249

H.252

Answers

1d	2a	3d	4c	5b	6c	7a	8d	9c	10d	11b	12a	13c	14d
15a	16b	17c	18c	19b	20c	21d	22a	23b	24d	25a	26a	27b	28b
29d	30b	31c	32a	33b	34b	35a	36c	37c	38d	39a	40c	41b	42a
43b	44d	45a	46b	47a	48c	49d	50c						

LEVEL II

Alternating Current Field Measurement Review Questions

1. The B_z magnetic field can best be described as:
 - a. magnetism parallel to the plate surface.
 - b. perpendicular to the current flow.
 - c. parallel to the current flow.
 - d. equal to one (1) in a uniform field.

H.251
2. The B_x magnetic field is best described as:
 - a. magnetism parallel to the plate surface.
 - b. 90° to the longitudinal weld.
 - c. parallel to the electrical current.
 - d. zero.

H.251
3. If the B_x chart recorder trace is low on the graph:
 - a. there is a high current density.
 - b. there is a low current density.
 - c. the electric current is high.
 - d. the B_x flux density is high.

H.251
4. If a current is flowing in a surface (called the x-y plane), then:
 - a. the magnetic flux density in the x direction is equal to the current in the y direction.
 - b. the magnetic flux density in the y direction is equal to the current in the x direction.
 - c. the magnetic flux density in the z direction (out of the x-y plane) is proportional to the curvature of the current in the x-y plane.
 - d. the magnetic flux density in the z direction (out of the x-y plane) is equal to the curvature of the current in the x-y plane.

H.251
5. When measuring the length of a crack with alternating current field measurement, how is the length between the B_z positive and B_z negative positions related to the true crack length?
 - a. This is the true length of the crack.
 - b. This length is slightly less than the true length.
 - c. This length is half the true length.
 - d. This length is slightly more than the true length.

B.8
6. For accurate sizing, why must the length-to-depth ratio of a crack being measured be at least 2:1?
 - a. Below this ratio more current would flow to the bottom of the crack than around the ends.
 - b. Below this ratio more current would flow around the ends of the crack than to the bottom.
 - c. Electricity will follow the path of greatest resistance.
 - d. No current will flow.

H.257-258
7. What magnetic property has the greatest effect on the depth of penetration?
 - a. Permeability.
 - b. Resistance.
 - c. Voltage.
 - d. Conductivity.

A.5; F.319
8. What is a main advantage of using alternating current potential drop testing?
 - a. It is very effective when used on paint.
 - b. It does not require a very clean surface for the injection prods to make contact.
 - c. It is highly effective under water.
 - d. It allows estimation of crack depth without the need for calibration.

H.248

9. The axes of the coils used to measure the magnetic fields at the surface of a plate are mounted:
 - a. perpendicular to the B_x and B_z fields.
 - b. parallel to the B_x and B_z fields.
 - c. in the same direction.
 - d. transverse to the direction of the crack.

H.251
10. If alternating current field measurement is to be used to inspect through a nonconductive coating, what is the recommended maximum thickness of the coating to still ensure detection of a 2 mm (0.08 in.) deep discontinuity?
 - a. 0.1 mm (0.004 in.)
 - b. 1 mm (0.04 in.)
 - c. 5 mm (0.196 in.)
 - d. 25 mm (0.98 in.)

H.254
11. If corrosion is present on the surface to be inspected, producing heavy pitting, what effect could it have on the inspection results?
 - a. None.
 - b. There will be reduced sensitivity to small cracks and accuracy of sizing.
 - c. A small amount of surface noise could be produced.
 - d. The depth of the corrosion pits could be measured.

H.266
12. What is the effect of liftoff on a differential probe?
 - a. One coil is affected and the other is not.
 - b. None of the coils is affected.
 - c. One coil changes positive and the other changes negative, thus cancelling each other.
 - d. A large signal is produced.

F.316; G.34, 89
13. What will happen if an absolute coil is brought close to the edge of a plate?
 - a. There will be a significant effect on the display.
 - b. There will be no effect.
 - c. The current will change direction.
 - d. The magnetic field will change direction.

A.29; F.319
14. What effect will reduce the accuracy of depth sizing of a crack when using alternating current field measurement?
 - a. A paint coating.
 - b. A corroded surface.
 - c. Cracks that are not semielliptical in shape.
 - d. A material of varying thickness.

H.265-266
15. If an indication has been produced by excessive grinding, how can it be differentiated from a crack?
 - a. Carry out a transverse scan.
 - b. Increase the speed of the scan.
 - c. Increase the gain.
 - d. Carry out parallel scans away from the weld.

B.3
16. Which of the following has no effect on crack sizing when using the alternating current field measurement technique?
 - a. Size of the slots in the test block.
 - b. Multiple cracking.
 - c. An inclined crack.
 - d. Line contacts.

B.5
17. A large transverse crack in a ferritic steel weld may be indicated during longitudinal scanning by:
 - a. a positive and negative B_z signal with no change in B_x .
 - b. a drop in the value of the B_x signal with no change in the B_z signal.
 - c. no response, as a longitudinal scan will not detect a transverse discontinuity.
 - d. a rise in the B_x with a peak and a trough in the B_z .

B.2
18. The method of crack depth sizing used with alternating current field measurement corresponds most closely to which of the following?
 - a. Calibration against test blocks containing slots.
 - b. Comparison with predetermined mathematical models.
 - c. Calibration against liftoff.
 - d. Multiplication of crack length values.

H.250

19. A signal is suspected to have come from a weld repair in the toe of the weld. What procedure should be carried out?
- Scan over the repair at a different liftoff.
 - Scan over the repair in order to produce smaller B_z signals.
 - Scan over the repair in order to produce signals that will cover a wider area.
 - Scan over the repair in order to produce larger B_z signals.
- B.3
20. What is the value of the B_z magnetic field when a uniform field is applied to a flat surface of ferritic steel?
- Zero.
 - Less than the uniform field.
 - Greater than the uniform field.
 - Equal to the uniform field.
- H.251
21. Which of the following is a limitation of crack sizing by alternating current field measurement?
- Crack length is less than twice the depth.
 - Crack length is less than 10 mm (0.39 in.).
 - Crack depth is greater than 10 mm (0.39 in.).
 - Crack depth is greater than the depth of penetration.
- H.253, 258
22. When the permeability of a material is increased, the depth of penetration does which of the following?
- Decreases.
 - Remains constant.
 - Becomes less inductive.
 - Increases.
- F.318-319; G.84
23. What is the dominant electromagnetic property of a ferromagnetic material?
- Low conductivity.
 - Low electrical resistance.
 - Low frequency constant.
 - High permeability.
- F.319; G.44, 62
24. High and low current density results in a different distribution in the lines of flux. The number of lines per unit area is defined as:
- magnetic coupling.
 - magnetic density.
 - flux density.
 - hysteresis density.
- G.43
25. Which of the following frequencies will provide the greatest alternating current field measurement penetration in aluminum?
- 300 Hz
 - 10 kHz
 - 1 kHz
 - 3 kHz
- F.318; G.63
26. The coercive force of a permanent magnet would be _____ the coercive force of a soft iron electromagnetic core.
- less than
 - greater than
 - twice
 - equal to
- D.175
27. It is believed that an alternating current field measurement instrument is operating defectively. What is the proper course of action?
- All of the rejected material should be retested.
 - All of the accepted material should be retested.
 - All material should be retested from the time of the last function's test-block test.
 - The test instrument should be recalibrated.
- B.6
28. What is the coupling medium between a coated metal surface and an alternating current field measurement probe when operating under water?
- Magnetic field.
 - Water.
 - Electric current.
 - None.
- B.2

29. Which of the following statements is incorrect?
- The resistance in a circuit affects the current through the circuit.
 - The magnetic field produced by a current is proportional to the magnitude of the current.
 - A varying magnetic field can produce a current in a conductor.
 - The conductivity of a metal is proportional to the applied magnetic field.
- F.318; G.86 (Fig. 10.2)
30. An eddy current is a circulating electrical current induced in a conducting material by:
- an alternating magnetic field.
 - a piezoelectric force.
 - a uniform magnetic field.
 - direct current.
- A.27-28; C.2.16; G.74
31. Alternating current field measurement would have the deepest depth of penetration in which of the following materials?
- 90-10 Cu/Ni.
 - Mild steel.
 - Aluminum.
 - Stainless steel.
32. What generates a magnetic field perpendicular to the surface of a test object when using the alternating current field measurement technique??
- Uniform surface currents in the Y direction.
 - Increasing surface currents.
 - Circulation of currents around the ends of a discontinuity.
 - Decreasing surface currents.
- H.251
33. When scanning into tight geometry:
- the B_x signal will decrease.
 - the B_z signal will decrease.
 - the B_x signal will increase.
 - the B_z signal will increase.
- B.3

Answers

1b	2a	3b	4c	5b	6b	7a	8d	9b	10c	11b	12c	13a	14c
15d	16a	17d	18b	19c	20a	21a	22a	23d	24c	25a	26b	27c	28a
29d	30a	31d	32c	33c									

LEVEL III

Alternating Current Field Measurement Review Questions

1. In an alternating current field measurement system, a calibration standard may be used to:
 - a. ensure repeatability and reliability of the setup.
 - b. calibrate the precise length of detectable discontinuities.
 - c. determine the material type being tested.
 - d. measure the test frequency.

B.5
2. Skin effect causes eddy currents to tend to flow near the surface of the test piece. Which one of the following factors alters the skin effect?
 - a. Test frequency.
 - b. Size of discontinuity.
 - c. Orientation of the discontinuity.
 - d. Electric current strength.

H.211
3. Which of the following is an advantage of alternating current field measurement compared to magnetic particle or liquid penetrant inspection?
 - a. Sensitivity to coatings and material property changes.
 - b. Ability to provide information on depth and length of discontinuities.
 - c. Ability to provide information on length of discontinuities.
 - d. Ability to detect surface-breaking discontinuities.

A.68-69
4. Which of the following, testable with alternating current field measurement, are cracks resulting from a combination of internal and external chemical reactions?
 - a. Semielliptical fatigue cracks.
 - b. Stress-corrosion cracking.
 - c. Cracks in railroad car axles.
 - d. Hydrogen-induced cracking.

H.265-266
5. For alternating current field measurement discontinuity sizing techniques using standard theoretical models to produce the sizing tables, what is the common assumption?
 - a. The input current is unidirectional and of uniform density.
 - b. The input current is omnidirectional with varying density.
 - c. All discontinuities are axial surface cracks.
 - d. All discontinuities are subsurface cracks.

H.257-258
6. The reliability, as well as the ability, of alternating current field measurement to detect discontinuities has been specifically determined by:
 - a. railroad cars and tracks not failing for years after alternating current field measurement examinations.
 - b. extensive trials carried out on realistic discontinuities under controlled conditions.
 - c. the number of satisfied customers around the world.
 - d. repeated field use around the world.

H.260
7. A large, uniform input field in alternating current field measurement means:
 - a. an improved focal point for localized detection.
 - b. decreased ease of discontinuity sizing.
 - c. that the current perturbation from a discontinuity extends some distance away from the discontinuity.
 - d. an increased probability of detection.

H.262

8. It is reasonable to expect that a discontinuity will be detected by alternating current field measurement if the B_x signal amplitude is minimally:
- 1% or more.
 - 10% or more.
 - 80% or more.
 - 100%.
- H.263
9. For alternating current field measurement inspections, probe/solenoid size:
- has no effect on the examination results.
 - should be a consideration while developing a successful alternating current field measurement technique.
 - is important only for underwater examinations.
 - is the same for all alternating current field measurement probes/solenoids.
- H.263
10. The false call rate for alternating current field measurement is:
- normally high.
 - very dependent on the underwater depth.
 - generally low.
 - greater than all other NDT techniques.
- H.264
11. While performing alternating current field measurement, one material where particular care has to be used to avoid false calls is:
- A-214 CS.
 - A-179 CS.
 - 304 SS.
 - duplex steel.
- H.264
12. Alternating current field measurement was originally designed for the detection and sizing of:
- fatigue cracks.
 - weld bursts.
 - intergranular attack (IGA).
 - conductivity variations.
- H.265
13. Stress-corrosion cracking (SCC) can form a close series of cracks acting as a “colony” or clusters of cracks. In these cases, as the signal response from alternating current field measurement can “superimpose” individual discontinuity signals on close neighboring discontinuity signals, which of the following statements is most correct?
- There is no reliable method for detection and sizing of SCC using alternating current field measurement.
 - Alternating current field measurement can detect SCC and sizing models are reasonably accurate.
 - Alternating current field measurement can detect SCC but sizing models are extremely inaccurate.
 - Special calibration standards must be used when SCC is expected or encountered.
- H.265
14. With alternating current field measurement, a corrosion pit can look like a shallow crack on the initial scan. What could be an alternating current field measurement method for differentiating a crack from a pit?
- There is no reliable way to differentiate a crack from a pit using alternating current field measurement.
 - Apply a mag-bias alternating current field measurement probe.
 - Review the previous examination report.
 - Scan the signal with different orientations of the interrogating signal; a pit will produce the same response regardless of probe/current orientation.
- H.266

Answers

1a 2a 3b 4d 5a 6b 7c 8a 9b 10c 11d 12a 13b 14d

REFERENCES

Alternating Current Field Measurement

The following documents were used to validate the questions and answers found in this unit. Each question specifies the source document and page number.

Reference A*

ASNT Level III Study Guide: *Electromagnetic Testing*, third edition. Columbus, OH: The American Society for Nondestructive Testing, Inc. (2007).

Reference B*

ASTM E-2261, *Standard Practice for Examination of Welds Using the Alternating Current Field Measurement Technique*. West Conshohocken, PA: ASTM International.

Reference C

Cox, J. *Eddy Current Testing Classroom Training Handbook*, revised edition (ET-CT-5). Harrisburg, NC: PH Diversified (1997).

Reference D*

Libby, H.L. *Introduction to Electromagnetic Nondestructive Test Methods*. Malabar, FL: Robert E. Krieger Publishing Company, Inc. (1985).

Reference E

Lugg, M.C. "The Use of the ACFM Technique for Detection of Environmental Cracking." *NDT Methods for Monitoring Degradation, Proceedings of the Joint EC-IAEA Specialists Meeting*. Von Estorft, U., L.M. Davies and P. Trampus (eds.). Amsterdam, Netherlands: JRC Petten, European Commission (10-12 March 1999): pp. 206-214.

Reference F

Rudlin, J.R. "A Beginner's Guide to Eddy Current Testing." *British Journal of NDT*. Vol. 31, No. 6 (1989): pp. 314-320.

Reference G*

Sadek, H. *Electromagnetic Testing Classroom Training Book*. Columbus, OH: The American Society for Nondestructive Testing, Inc. (2006).

Reference H*

Udpa, S.S., tech. ed., and P.O. Moore, ed. *Nondestructive Testing Handbook*, third edition: Vol. 5, *Electromagnetic Testing*. Columbus, OH: The American Society for Nondestructive Testing, Inc. (2004).

Reference Codes

Each question in this book is followed by letter(s) and page number(s) indicating the specific recommended reference where the answer may be found. For example:

1. Which of the following has no effect on the inductance of a coil?
 - a. Increasing the number of turns.
 - b. Increasing the coil diameter.
 - c. Increasing the current.
 - d. Decreasing the number of turns.

G.13

In this example, the letter "G" refers to Reference G in the list above and 13 is the specific page in Reference G where the answer to the question is located.

Additional References

The following references may also be useful for Alternating Current Field Measurement Testing qualification preparation and course study.

Dover, W.D. and C.C. Monahan. "The Measurement of Surface Breaking Cracks by the Electrical Systems ACPD/ACFM." *Fatigue & Fracture of Engineering Materials and Structures*. Vol. 17, No. 12 (1994): pp. 1485-1492.

Lewis, A.M., D.H. Michael, M.C. Lugg and R. Collins. "Thin-Skin Electromagnetic Fields Around Surface-Breaking Cracks in Metals." *Review of Progress in Quantitative NDE*. Vol. 8A. New York: Plenum Pub. Corp. (1989): pp. 237-244.

Lugg, M.C., "ACFM—A New NDT Technique." *Metals and Materials*. Vol. 6, No. 3 (1990): pp. 142-144.

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Lugg, M.C. "The ACFM Technique and Its Applications." *Proceedings of Meeting of JSNDI*. Tokyo, Japan (26-27 May 1998): pp. 209-212.

Lugg, M.C. "The Practical Application of ACFM Modelling." *Nondestructive Testing of Materials, Studies in Applied Electromagnetics and Mechanics*: Vol. 8. Collins, R., W.E. Dover, J.R. Bowler and K. Miya (eds.). Amsterdam, Netherlands: IOS Press (1996).

Raine, A. "Alternating Current Field Measurement: Getting New Technologies Accepted by Old Industries." *Materials Evaluation*. Vol. 60, No. 3 (2002): pp. 389-395.

Raine, A. "A Review of the Development of the Alternating Current Field Measurement Technique for Subsea Inspection." *INSIGHT*. Vol. 44, No. 12 (2002): pp. 748-752.

Raine, A. "The Application of the Alternating Current Field Measurement (ACFM) Inspection Technique in Both Upstream and Downstream Petrochemical Applications." *ASNT Fall Conference and Quality Testing Show – 2002, Paper Summaries Book*. Columbus, OH: The American Society for Nondestructive Testing, Inc. (2002): pp. 22-24.

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Raine, G.A. "The Application of the ACFM Technique for the Inspection of Welds." *Proceedings of the Nondestructive Testing of Welds Conference*. Houston, TX: American Welding Society (22-23 May 2002).

Raine, G.A. and C.C. Monahan. "Alternating Current Field Measurement (ACFM): A New Technique for the NDT of Process Plant and Piping Components." *Proceedings of the ASME 1996 PVP Conference*. Montreal, Canada (July 1996).

Zhou, J., M.C. Lugg and R. Collins. "A Non-uniform Model for Alternating Current Field Measurement of Fatigue Cracks in Metals." *International Journal of Applied Electromagnetics and Mechanics*. Vol. 10, No. 3 (1999): pp. 221-235.

Reference Usage

Reference A Total = 5

Level I (1)
Level II (3)
Level III (1)

Reference B Total = 15

Level I (6)
Level II (8)
Level III (1)

Reference C Total = 10

Level I (9)
Level II (1)
Level III (0)

Reference D Total = 2

Level I (1)
Level II (1)
Level III (0)

Reference E Total = 1

Level I (1)
Level II (0)
Level III (0)

Reference F Total = 16

Level I (8)
Level II (8)
Level III (0)

Reference G Total = 33

Level I (25)
Level II (8)
Level III (0)

Reference H Total = 43

Level I (17)
Level II (14)
Level III (12)

*Recommended training references for Electromagnetic Testing as listed in ANSI/ASNT CP-105: ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel (2011).