

Eddy Current Testing (ET) Level II Practice Test (Sample)

Study Guide



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SAMPLE

Questions

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- 1. In modulation analysis testing, which of the following does not affect the test frequency applied to the test coil?**
 - A. Discontinuities in the test specimen**
 - B. Dimension changes of the test specimen**
 - C. Chemical composition of the test specimen**
 - D. A filter in the test circuit**
- 2. The impedance change in an eddy current test coil is most easily analyzed as a combined change in:**
 - A. Capacitive reactance and resistance**
 - B. Harmonic frequencies and inductive reactance**
 - C. Signal amplitude and phase**
 - D. Retentivity and harmonic frequencies**
- 3. In an impedance diagram, the solid curves represent different values of what?**
 - A. Heat treatment**
 - B. Conductivity**
 - C. Fill factor**
 - D. Permeability**
- 4. For age hardenable aluminum and titanium alloys, what indicates changes in hardness?**
 - A. Retentivity**
 - B. Permeability**
 - C. Conductivity**
 - D. Magnetostriction**
- 5. The choice of test frequency when eddy current testing a nonferrous material is determined by what?**
 - A. Degree of phase discrimination required**
 - B. Eddy current penetration needed**
 - C. Rate of response required**
 - D. All of the above**

- 6. What does a change in impedance indicate during Eddy Current Testing?**
- A. Improvement in test signal quality**
 - B. A variation in the material's properties**
 - C. Consistency of material type**
 - D. The reliability of the testing equipment**
- 7. How is the characteristic frequency (fg) calculated in an impedance diagram for a solid nonmagnetic rod?**
- A. $fg = \sigma\mu / d^2$**
 - B. $fg = \sigma\mu / 2$**
 - C. $fg = 5060/\sigma\mu / d^2$**
 - D. $fg = R / L1$**
- 8. What principle allows testing of similar specimens under the same conditions?**
- A. Ohm's law**
 - B. Kirchoff's law**
 - C. The Similarity law**
 - D. None of the above**
- 9. When performing eddy current testing, an increase in frequency typically results in what effect regarding penetration depth?**
- A. Increased penetration depth**
 - B. Decreased penetration depth**
 - C. No change in penetration depth**
 - D. Improved material resolution**
- 10. What is the primary advantage of using eddy current testing?**
- A. Non-destructive evaluation**
 - B. Requires extensive surface preparation**
 - C. High accuracy in measuring wall thickness**
 - D. Ability to detect all types of material defects**

Answers

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1. D
2. C
3. C
4. C
5. D
6. B
7. C
8. C
9. B
10. A

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Explanations

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1. In modulation analysis testing, which of the following does not affect the test frequency applied to the test coil?

- A. Discontinuities in the test specimen**
- B. Dimension changes of the test specimen**
- C. Chemical composition of the test specimen**
- D. A filter in the test circuit**

In modulation analysis testing, the test frequency applied to the test coil is not influenced by a filter in the test circuit. Filters are used to manage signals within the circuit, such as removing noise or unwanted frequencies, but they do not alter the frequency that is initially applied to the test coil for the test itself. On the other hand, discontinuities in the test specimen, dimension changes of the specimen, and the chemical composition of the specimen all play significant roles in how eddy currents respond within the material and can impact the effective frequency of the test because they affect the material's properties. For instance, changes in dimensions might alter the skin effect, affecting how eddy currents behave, and variations in chemical composition could lead to differences in conductivity or permeability, further influencing how the test frequency interacts with the material. Thus, only a filter's role is limited to processing the signal rather than affecting the fundamental test frequency applied.

2. The impedance change in an eddy current test coil is most easily analyzed as a combined change in:

- A. Capacitive reactance and resistance**
- B. Harmonic frequencies and inductive reactance**
- C. Signal amplitude and phase**
- D. Retentivity and harmonic frequencies**

In eddy current testing, the primary analysis revolves around how much the impedance of the coil changes in response to the presence of conductive materials and defects. Impedance in an electrical circuit encompasses both resistance and reactance. In the context of eddy current testing, changes in impedance can be represented through the signal amplitude and phase shift. Signal amplitude relates to the strength of the response detected by the coil, which varies with changes in material properties or geometrical configurations. The phase shift provides critical information about the nature of the conductive material and its interaction with the eddy currents generated within the test coil. By analyzing both of these factors together, inspectors can draw conclusions regarding the condition of the tested component. This choice emphasizes the practical application of signal processing in eddy current testing. It highlights how the measurement data is interpreted to identify defects or material properties, making it a crucial concept for effective analysis in this nondestructive testing method.

3. In an impedance diagram, the solid curves represent different values of what?

- A. Heat treatment**
- B. Conductivity**
- C. Fill factor**
- D. Permeability**

In an impedance diagram used in Eddy Current Testing, the solid curves represent different values of fill factor. The fill factor is an important concept as it relates to the distribution of eddy currents in a conductive material and how they probe the material's properties. Understanding the fill factor is crucial because it reflects how effectively the test coil's magnetic field interacts with the material being tested. A higher fill factor indicates that a larger volume of the material is influencing the impedance, providing a clearer indication of the material's condition. This relationship helps technicians assess material integrity and identify any anomalies or defects. Options such as heat treatment, conductivity, and permeability, while related to the properties of materials and their responses in testing scenarios, do not specifically correlate with the representation provided by the solid curves on the impedance diagram in the context of Eddy Current Testing. Therefore, it is the fill factor that is accurately depicted in these solid curves, highlighting its significance in interpreting test results.

4. For age hardenable aluminum and titanium alloys, what indicates changes in hardness?

- A. Retentivity**
- B. Permeability**
- C. Conductivity**
- D. Magnetostriction**

The changes in hardness of age-hardenable aluminum and titanium alloys can be indicated by conductivity. As these alloys undergo aging treatments, their microstructure evolves, leading to variations in the arrangement and density of alloying elements, which in turn affects their electrical conductivity. In age-hardenable materials, the formation of precipitates during the aging process impacts both the hardness and electrical properties. As the precipitates grow and the material strengthens, the conductivity generally decreases. This relationship can be utilized in non-destructive testing methods, where measuring the electrical conductivity gives insight into the material's hardness and overall mechanical properties. Other options relate to different physical properties not directly associated with the indication of hardness changes in these particular alloys. Retentivity pertains to a material's ability to retain magnetization and does not provide information on hardness. Permeability refers to a material's ability to support the formation of a magnetic field, which is unrelated to mechanical hardness. Magnetostriction relates to the change in dimensions of a material when exposed to a magnetic field and similarly does not correlate with hardness assessments.

5. The choice of test frequency when eddy current testing a nonferrous material is determined by what?

- A. Degree of phase discrimination required**
- B. Eddy current penetration needed**
- C. Rate of response required**
- D. All of the above**

The selection of test frequency in eddy current testing (ET) of nonferrous materials is influenced by multiple factors, making the option "all of the above" the most comprehensive answer. When considering the degree of phase discrimination required, a higher frequency can improve the resolution of defects by providing clearer phase information, which is critical for differentiating between various types of discontinuities. This is especially important in complex geometries or in parts with multiple features. Moreover, the depth of eddy current penetration is crucial because it determines how deep the induced currents will go into the material. Lower frequencies allow for deeper penetration, which can be necessary for detecting subsurface flaws. Conversely, higher frequencies result in shallower penetration and are used for detecting surface-breaking defects. Finally, the rate of response required during testing is also a factor. Higher frequencies enable faster response times, which can be essential in applications requiring rapid assessments or in automated systems where speed is crucial. Considering all these interactions, it becomes clear that choosing the appropriate frequency incorporates all the listed factors, justifying why the correct answer is "all of the above."

6. What does a change in impedance indicate during Eddy Current Testing?

- A. Improvement in test signal quality**
- B. A variation in the material's properties**
- C. Consistency of material type**
- D. The reliability of the testing equipment**

A change in impedance during Eddy Current Testing indicates a variation in the material's properties. Impedance in this context is a measure of how much the material resists or impedes the flow of alternating current (AC) created by the test probe. When the properties of the material change—such as its conductivity, permeability, or thickness—this will affect the way the eddy currents behave, resulting in a change in impedance. For instance, if there is a flaw, such as a crack or corrosion, or if the material is composed of a different alloy, the interaction between the magnetic field generated by the probe and the material will alter. As this occurs, the eddy currents will either be enhanced or diminished, which leads to a measurable change in impedance. This is a critical aspect of Eddy Current Testing, as it allows testers to identify inconsistencies and potential defects within the material, ensuring safety and reliability in various applications.

7. How is the characteristic frequency (fg) calculated in an impedance diagram for a solid nonmagnetic rod?

A. $fg = \sigma\mu / d^2$

B. $fg = \sigma\mu / 2$

C. $fg = 5060/\sigma\mu / d^2$

D. $fg = R / L1$

The characteristic frequency (fg) in the context of an impedance diagram for a solid nonmagnetic rod is related to the material properties and the dimensions of the rod. The correct formula reflects the relationship between the conductivity and the magnetic permeability of the material, as well as the dimensions of the rod. In this case, $fg = 5060 / \sigma\mu / d^2$ is the expression that properly relates these parameters under the circumstances of Eddy Current Testing. The coefficient 5060 serves as a constant that is derived from the context of the specific system being analyzed, considering factors such as the dimensions in millimeters and the units of conductivity. The presence of σ (conductivity) and μ (permeability) in the denominator indicates that as conductivity increases, the characteristic frequency decreases, while a higher magnetic permeability may influence the eddy current flow as depth and frequency change. This particular formulation encapsulates the necessary relationship between the physical dimensions of the material, its electromagnetic characteristics, and how they influence the eddy current responses in the testing methodology. Understanding this relationship helps in interpreting the results of the impedance diagram in practical applications of Eddy Current Testing.

8. What principle allows testing of similar specimens under the same conditions?

A. Ohm's law

B. Kirchoff's law

C. The Similarity law

D. None of the above

The principle that allows for the testing of similar specimens under the same conditions is known as the Similarity law. This law states that if two or more specimens exhibit similar geometry and material properties, they can be tested under the same conditions, and the results can provide valid information about their behavior. This is particularly useful in Eddy Current Testing since the technique relies on the interaction of electromagnetic fields with conductive materials. By applying the Similarity law, one can ensure consistency in testing parameters, such as frequency, probe type, and the characteristics of the environment, leading to reliable comparisons in results. Consequently, testing similar materials or geometries allows for effective evaluation of performance and identification of flaws or discrepancies, making the process efficient and scientifically sound. This principle helps streamline testing procedures, especially in industrial applications where multiple items may need to be evaluated quickly.

9. When performing eddy current testing, an increase in frequency typically results in what effect regarding penetration depth?

- A. Increased penetration depth**
- B. Decreased penetration depth**
- C. No change in penetration depth**
- D. Improved material resolution**

An increase in frequency during eddy current testing results in decreased penetration depth. This is due to the skin effect, where higher frequencies induce eddy currents that are concentrated nearer to the surface of the conductive material being tested. As the frequency increases, the skin depth—the depth below the surface where the current density drops significantly—decreases. Consequently, eddy currents do not penetrate as deeply, leading to decreased penetration depth. This characteristic is crucial to understand, particularly when assessing the suitability of eddy current testing for various applications and material thicknesses. Understanding the impact of frequency on penetration depth allows technicians to select the appropriate testing parameters based on the material and the type of defects they aim to detect.

10. What is the primary advantage of using eddy current testing?

- A. Non-destructive evaluation**
- B. Requires extensive surface preparation**
- C. High accuracy in measuring wall thickness**
- D. Ability to detect all types of material defects**

The primary advantage of using eddy current testing is that it provides non-destructive evaluation of materials. This means that the test can be performed without causing any damage to the component being examined, which is crucial in many industries where maintaining the integrity of a part is essential for safety and functionality. Eddy current testing uses electromagnetic induction to detect flaws and measure the properties of conductive materials, making it an efficient way to evaluate the integrity of parts in a way that won't compromise their usability. This feature is particularly valuable in applications such as aerospace, automotive, and manufacturing, where components are often expensive and critical to the overall system's performance. In contrast, rigorous surface preparation may not be a requirement for eddy current testing, as the method can often assess areas that are not perfectly smooth. While high accuracy in measuring wall thickness is a feature of eddy current testing, it is not the only advantage, nor does it encompass the broader benefit of non-destructive evaluation. The inability to detect all types of material defects is also notable, as eddy current testing is primarily effective for certain types of defects, particularly those related to conductivity rather than other material characteristics.