



Eddy Current Testing Level I

Course Outline

- 1. Introduction to Electromagnetic Testing (Eddy Current/Flux Leakage)**
 - a. Brief history of testing
 - b. Basic principles of testing

- 2. Electromagnetic Theory**
 - a. Eddy current theory
 - (1) Generation of eddy currents by means of an AC field
 - (2) Effect of fields created by eddy currents (impedance changes)
 - (3) Effect of change of impedance on instrumentation
 - (4) Properties of eddy current
 - (a) Travel in circular direction
 - (b) Strongest on surface of test material
 - (c) Zero value at center of solid conductor placed in an alternating magnetic field
 - (d) Strength, time relationship, and orientation as functions of test system parameters and test-part characteristics
 - (e) Have properties of compressible fluids
 - (f) Small magnitude of current flow
 - (g) Relationship of frequency and plane with current in coil
 - (h) Effective permeability variations when induced in magnetic materials
 - (i) Effect of discontinuity orientation
 - (j) Power losses
 - b. Flux leakage theory
 - (1) Terminology and units
 - (2) Principles of magnetization
 - (a) B-H curve
 - (b) Magnetic properties
 - (c) Magnetic field
 - (d) Hysteresis loop
 - (e) Magnetic permeability
 - (f) Factors affecting permeability
 - (3) Magnetization – electromagnetism theory
 - (a) Oersted's law
 - (b) Faraday's law
 - (c) Electromagnetic
 - (4) Flux leakage theory and principle
 - (a) Residual
 - (b) Active
 - (c) Tangential leak
 - (d) Normal leakage fields



3. Readout Mechanism

- a. Calibrated or uncalibrated meter
- b. Null meter with dial indicator
- c. Oscilloscope and other monitor displays
- d. Alarm, lights, etc.
- e. Numerical counters
- f. Marking system
- g. Sorting gates and tables
- h. Cutoff saw or shears
- i. Automation and feedback
- j. Strip-chart recorder

4. Types of Eddy Current Sensing Elements

- a. Probes
 - (1) Types of arrangements
 - (a) Absolute
 - (b) Differential
 - (2) Lift-off
 - (3) Theory of operation
 - (4) Applications
 - (5) Advantages
 - (6) Limitations
- b. Through, encircling, or annular coils
 - (1) Types of arrangements
 - (a) Absolute
 - (b) Differential
 - (2) Fill factor
 - (3) Theory of operation
 - (4) Applications
 - (5) Advantages
 - (6) Limitations
- c. Factors affecting choice of sensing elements
 - (1) Type of part to be inspected
 - (2) Type of discontinuity to be detected
 - (3) Speed of testing required
 - (4) Amount of testing (percentage) required
 - (5) Probable location of discontinuity

5. Types of Flux Leakage Sensing Elements

- a. Principles of magnetic-measurement techniques
- b. Inductive-coil sensors
 - (1) Theory of electromotive force (emf) induced in coil
 - (2) Various constructions and designs of coils
 - (3) Coil parameters affecting the flux leakage response
 - (4) Sensing-coil systems and connections (single- and multi-element probes)



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- c. Semiconductor sensing elements
 - (1) Hall-effect probes
 - (2) Magnetoresistors
 - (3) Magnetodiodes
 - (4) Magnetotransistors
 - (5) Magnetic and electric characteristics of semiconductor sensing elements
- d. Other methods of magnetic leakage field detection
 - (1) Magnetic-tape system
 - (2) Magnetic powder
 - (3) Magnetic-resonance sensor