



Ultrasonic Testing Level I

Course Outline

1. Introduction

- a. Definition of ultrasonics
- b. History of ultrasonic testing
- c. Applications of ultrasonic energy
- d. Basic math review
- e. Responsibilities of levels of certification

2. Basic Principles of Acoustics

- a. Nature of sound waves
- b. Modes of sound-wave generation
- c. Velocity, frequency, and wavelength of sound waves
- d. Attenuation of sound waves
- e. Acoustic impedance
- f. Reflection
- g. Refraction and mode-conversion
- h. Snell's law and critical angles
- i. Fresnel and Fraunhofer effects

3. Equipment

- a. Basic pulse-echo instrumentation (A-, B-, C-scan and computerized systems)
 - (1) Electronics – time base, pulser, receiver, and various monitor displays
 - (2) Control functions
 - (3) Calibration
 - (a) Basic instrument calibration
 - (b) Calibration blocks (types and use)
- b. Digital thickness instrumentation
- c. Transducer operation and theory
 - (1) Piezoelectric effect
 - (2) Types of crystals
 - (3) Frequency (crystal-thickness relationships)
 - (4) Near field and far field
 - (5) Beam spread
 - (6) Construction, materials, and shapes
 - (7) Types (straight, angle, dual, etc.)
 - (8) Beam-intensity characteristics
 - (9) Sensitivity, resolution, and damping
 - (10) Mechanical vibration into part
- d. Couplants
 - (1) Purpose and principles
 - (2) Materials and their efficiency

4. Basic Testing Methods

- a. Contact
- b. Immersion



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5. Testing Methods

- a. Contact
 - (1) Straight-beam
 - (2) Angle-beam
 - (3) Surface-wave
 - (4) Pulse-echo transmission
 - (5) Multiple transducer
 - (6) Curved surfaces
- b. Immersion
 - (1) Transducer in water
 - (2) Water column, wheels, etc.
 - (3) Submerged test part
 - (4) Sound-beam path – transducer to part
 - (5) Focused transducers
 - (6) Curved surfaces
- c. Comparison of contact and immersion methods

6. Calibration (Electronic and Functional)

- a. Equipment
 - (1) Monitor displays (amplitude, sweep, etc.)
 - (2) Recorders
 - (3) Alarms
 - (4) Automatic and semiautomatic systems
 - (5) Electronic distance/amplitude correction
 - (6) Transducers
- b. Calibration of equipment electronics
 - (1) Variable effects
 - (2) Transmission accuracy
 - (3) Calibration requirements
 - (4) Calibration reflectors
- c. Inspection calibration
 - (1) Comparison with reference blocks
 - (2) Pulse-echo variables
 - (3) Reference for planned tests (straight beam, angle-beam, etc.)
 - (4) Transmission factors
 - (5) Transducer
 - (6) Couplants
 - (7) Materials

7. Straight-Beam Examination to Specific Procedures

- a. Selection of parameters
- b. Test standards
- c. Evaluation of results
- d. Test reports

8. Angle-Beam Examination to Specific Procedures

- a. Selection of parameters
- b. Test standards
- c. Evaluation of results
- d. Test reports