

Acoustic Emission Testing Course

Level I - Outline

I. Basic AE Physics Course

1. Principles of AE Testing
 - a. Characteristics of AE
 - i. Continuous emission
 - ii. Burst emission
 - iii. Emission/signal levels and frequencies
 - b. Sources of AE
 - i. Sources in crystalline materials – Introduction
 - ii. Sources in nonmetals – Introduction
 - iii. Sources in Composites – Introduction
 - iv. Other sources
 - c. Wave propagation – Introduction
 - i. Wave velocity in materials
 - ii. Attenuation
 - iii. Reflection, multiple paths
 - iv. Source input vs. signal output
 - d. Repeated loadings: Kaiser and felicity effects, and felicity ratio
 - i. In metals
 - ii. In composites
 - e. Terminology (ASTM E1316)
2. Sensing the AE Wave
 - a. Sensors
 - i. Principles of operation
 - ii. Construction
 - iii. Frequency
 - b. Sensor Attachment
 - i. Coupling materials
 - ii. Attachment devices

II. Basic AE Technique Course

1. Instrumentation and Signal Processing
 - a. Cables
 - i. Coaxial cable
 - ii. Twisted pair cable
 - iii. Noise problems in cables
 - iv. Connectors
 - b. Signal conditioning
 - i. Preamplifiers
 - ii. Amplifiers
 - iii. Filters
 - iv. Units of gain measurement
 - c. Signal detection
 - i. Threshold comparator
 - ii. Units of threshold measurement
 - iii. Sensitivity determined by gain and/or threshold

- d. Signal processing
 - i. Waveform characteristics
 - ii. Discrimination techniques
 - iii. Distribution techniques
- e. Source location techniques
 - i. Single channel location
 - ii. Linear location
 - iii. Planar location
 - iv. Other location techniques
- f. AE test systems
 - i. Single channel systems
 - ii. Multi-channel systems
 - iii. Dedicated industrial systems
- g. Accessory techniques
 - i. Audi indicators
 - ii. X-Y and strip chart recording
 - iii. Oscilloscopes
 - iv. Others

2. AE Test Techniques

- a. Equipment calibration and setup for test
 - i. Calibration signal generation techniques
 - ii. Calibration procedures
 - iii. Sensor placement
 - iv. Adjustment of equipment controls
 - v. Discrimination technique adjustments
- b. Loading procedures
 - i. Type of loading
 - ii. Maximum test load
 - iii. Load holds
 - iv. Repeated and programmed loadings
 - v. Rate of loading
- c. Data display
 - i. Selection of display mode
 - ii. Use and reading of different kinds of display
- d. Noise sources and pre-test identification techniques
 - i. EM noise
 - ii. Mechanical noise
- e. Precautions against noise
 - i. Electrical shielding
 - ii. Electronic techniques
 - iii. Prevention of movement
 - iv. Attenuating materials and applications
- f. Data interpretation and evaluation – Introduction
 - i. Separating relevant AE indications from noise
 - ii. Accept/reject techniques and evaluation criteria
- g. Reports
 - i. Purpose
 - ii. Content and structure

3. Codes, Standards and Procedures

- a. Guide-type standards (glossaries, calibration, etc)
 - b. Standardized/codified AE test procedures
 - c. User-developed test procedures
4. Applications of AE Testing
- a. Laboratory Studies (Material Characterization) – At least 3 categories
 - i. Crack growth and fracture mechanics
 - ii. Environmentally assisted cracking
 - iii. Dislocation movement (metals)
 - iv. Clarifying deformation mechanisms (composites)
 - v. Phase transformations and phase stability
 - vi. Creep
 - vii. Residual stress
 - viii. Corrosion
 - ix. Fatigue
 - x. Rupture
 - xi. Ductile/brittle transition
 - xii. Other material characterization applications
 - b. Structural Applications – At least 4 categories
 - i. Pressure vessels (metal)
 - ii. Storage tanks (metal)
 - iii. Composite pressure vessels/storage tanks
 - iv. Piping and pipelines
 - v. Bucket trucks
 - vi. Aircraft
 - vii. Bridges
 - viii. Mines
 - ix. Dams, earthen slopes
 - x. Pumps, valves, etc.
 - xi. Rotating plant
 - xii. In-process weld monitoring
 - xiii. Leak detection and monitoring
 - xiv. Other structural applications