عنوان دوره:

Time of Flight Diffraction (TOFD) Evaluation Course

هدف دوره:

این دوره مطابق با سر فصلهای التراسونیک TOFD مندرج در CP-105-2011 بوده و برای کارشناسان، بازرسان، پرسنل QC، دستگاه نظارت و تمامی افراد علاقمند و مرتبط با آزمایشهای غیرمخرب مناسب است.

محتوای دوره:

- مقدمه و آشنایی
- مفاهیم پایه TOFD
- تجهیزات
- کالیبراسیون
- آشنایی بادستورالعملها و استانداردهای مربوطه

پیش نیاز: گواهینامه سطح ۲ آلتراسونیک یا گذراندن دوره التراسونیک پیش نیاز PA/TOFD به مدت ۶ روز	**کارگاه آموزشی:** دارد	**قیمت :** ۲۰۰،۰۰۰،۰۰۰ ریال
نوع گواهینامه: **According to SNT-TC-1A of ASNT requirements (TUBI TAK certificates)**		

Time of Flight Diffraction Level II Topical Outline

Note: It is recommended that this course have as a minimum prerequisite of an Ultrasonic Level II unrestricted certification.
The intent of this document is to provide "Basic" knowledge on TOFD ultrasonic testing consistent with other methods and to acknowledge TOFD as unique enough to warrant an additional body of knowledge and qualification requirements.

Time of Flight Diffraction (TOFD) Evaluation Course

1.0 Introduction
- 1.1 Terminology of TOFD
- 1.2 History of TOFD (e.g., M.G. Silk)
- 1.3 Responsibilities of levels of certification

2.0 Basic Principles of TOFD
- 2.1 Review of ultrasonic wave theory, refracted longitudinal waves
- 2.2 Introduction to TOFD concepts and theory
- 2.3 Technique limitations

3.0 Equipment
- 3.1 Computer-based systems
  - 3.1.1 Processors
  - 3.1.2 Control panel including input and output sockets
  - 3.1.3 Block diagram showing basic internal circuit modules
  - 3.1.4 Portable battery-operated versus full computer-based systems
- 3.2 Beam profile tools
  - 3.2.1 Probe center separation (PCS) calculators for FLAT material/components
  - 3.2.2 Probe center separation (PCS) calculators for CURVE surfaces
  - 3.2.3 Beam spread effects and control
  - 3.2.4 Multiple zone coverage and limitations
- 3.3 Probes
  - 3.3.1 Composite materials
  - 3.3.2 Damping characteristics
  - 3.3.3 Selection of frequency and diameter
- 3.4 Wedges
  - 3.4.1 Incident and refracted angle selections
  - 3.4.2 High-temperature applications
- 3.5 Scanners
  - 3.5.1 Mechanized
  - 3.5.2 Manual

4.0 Testing Techniques
- 4.1 Line scans (single tandem probe setups)
- 4.2 Line scans (multiple probe setups)
- 4.3 Raster scans

5.0 Calibration
- 5.1 Material velocity calculations

- 5.2 Combined probe delay(s) calculation(s)
- 5.3 Digitization rates and sampling
- 5.4 Signal averaging
- 5.5 Pulse width control
- 5.6 PCS and angle selection
- 5.7 Sensitivity
- 5.8 Pre-amplifiers
- 5.9 Effects of curvature

6.0 Data Collection

- 6.1 Single probe setups
- 6.2 Multiple probe setups
- 6.3 Non-encoded scans
  - 6.3.1 Time-based data storage
- 6.4 Encoded scans
  - 6.4.1 Line scans
  - 6.4.2 Raster scans
- 6.5 Probe offsets and indexing

7.0 Procedures

- 7.1 Specific applications
  - 7.1.1 Material evaluations
  - 7.1.1.1 Base material scans
  - 7.1.2 Weld inspections
    - 7.1.2.1 Detection and evaluation of fabrication welding flaws
    - 7.1.2.2 Detection and evaluation of in-service cracking
    - 7.1.2.3 Detection of volumetric loss such as weld root erosion and partial penetration weld dimensional verifications
    - 7.1.2.4 Geometric limitations
    - 7.1.2.5 Cladding thickness and integrity evaluations
  - 7.1.3 Complex geometries
    - 7.1.3.1 Transitions, nozzles, branch connections, tees, saddles, etc.
- 7.2 Data presentations
  - 7.2.1 Standard (A-scan, D-scan)
  - 7.2.2 Other (B-scan, C-scan)
- 7.3 Data evaluation
  - 7.3.1 Codes/standards/specifications
  - 7.3.2 Flaw characterization
  - 7.3.3 Flaw dimensioning
  - 7.3.4 Geometry
  - 7.3.5 Software tools
    - 7.3.5.1 Linearization
    - 7.3.5.2 Lateral/back wall straightening and removal
    - 7.3.5.3 Synthetic aperture focusing technique (SAFT)
    - 7.3.5.4 Spectrum processing
    - 7.3.5.5 Curved surface compensation
  - 7.3.6 Parabolic cursor(s)
- 7.4 Reporting

7.4.1 Imaging outputs
7.4.2 Onboard reporting tools