



COURSE CURRICULUM

TIME OF FLIGHT DIFFRACTION IN UT LEVEL I & II

OVERVIEW:

Time of Flight Diffraction is an Ultrasonic technique developed originally to improve the sizing accuracy of flaws previously detected by other means. Early applications of the technique advanced from solely sizing flaws to applications relying on TOFD for principle detection means, this pioneering technology resulted in major flaws being missed due to poor application and a general lack of understanding by persons operating the equipment.

ABOUT THE COURSE:

This course is designed to provide the participants, a better understanding about theory and application of time of flight diffraction. This TOFD welds course provides detailed information on the inspection of ferritic steel welds by the ultrasonic time of flight method. Suitable for personnel with existing UT Certification in welds, and recognized by PCN, providing excellent preparation for the Level 1 and 2 examinations.

QUALIFICATION: Shall have minimum PCN Level II in Ultrasonic Testing.

MINIMUM TRAINING REQUIREMENTS

Level 1	40 Hours
Level 2	40 Hours
Level 2 direct with no time at Level 1	80 Hours

EXPERIENCE REQUIREMENTS:

Level 1	3 months
Level 2	9 months
Level 2 direct with no time at Level 1	12 months

VISION REQUIREMENTS: Vision requirements as per PSL-44 (<http://www.bndt.org/downloads/psl44.pdf>)

LAST DATE FOR REGISTRATION: One week prior to the commencement of the course (subject to availability)



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COURSE CONTENT/SYLLABUS:

For TOFD level I

Background to the Importance of the TOFD Technique-History of TOFD Development- Principles of TOFD-Diffraction Process-Basic TOFD Set-up-Types of TOFD Scan-Summary of Advantages and Disadvantages of TOFD, including limitations-Basic Hardware-Advantage of Digital Recording-Digitization of the Analogue Ultrasonic Signals-Amplitude-Sampling Rate-Selection of Frequencies for Filtering-Amount of Data collected during an Inspection-Grey scale imaging and B-scans-Signal Averaging-Pulse Width Control-Software-On-line-Analysis and Off-line Facilities-Precision and Resolution-Beam Spread Considerations-Basics for Calculation of Beam Spread-Example of Selection of Number of Scans for an Inspection-Choice of Probe Angle-Transducer size and frequency- Choice of Probe Centre Separation- Calibration of Setting of Gain- Digitization Rate- Signal Averaging and Pulse Width- No Signals – common faults- Manual versus Mechanical Scanning-General- Manual Scanning-Mechanical Scanning- Sampling Interval-Summary of Choice of Parameters for TOFD Scan- Introduction- Timing Errors- Near Surface Problems- Off-axis Error and Back Wall Blind Zone- Off-axis Depth Error- Back Wall Blind Zone- Errors in Couplant Thickness, Surface Height Variations and Velocity- Large Grained Materials- Overall Errors and Monitoring Growth-Overall Errors- Monitoring Defect Growth- Data Assessment – flaw characterization- Shear Waves- Pores and Slags in TOFD Records. - Internal Cracks- Upper Surface Breaking Cracks- Lower Surface Breaking Cracks- Effect of Changing Defect Profile- Weld Root Flaws- Check Transparency- Transverse Flaws. - Analysis Software- Linearization- Lateral/Back Wall Straighten and Removal-Parabolic Cursor- Synthetic Aperture Focusing Technique (SAFT)- Split Spectrum Processing. - Curved Surface- Complex Geometry

For TOFD level II

As level 1, but in addition:

Flaw Sizing with the Pulse Echo Technique- Comparison of Flaw Sizing Accuracy for Different Techniques- Angular Variation of Diffraction Signals- Effect of Change in Probe Separation and Importance of Calibration with Lateral and Back Wall Signals- Change in Probe Separation-Importance of Calibration- Error due to Variations in Couplant Depth- Error due to Variations in Surface Profile- Velocity Error- Index Point Migration Errors- Other Errors- Multiple Arcs- Procedure Writing- Equipment and Probe Checks- Equipment Checks. - Screen Height Linearity-Amplitude Linearity- Time Base Linearity- Probe Index Emission Point- Beam Angle- Beam Spread- TOFD Combined Probe Delay- Sensitivity- Resolution- Probe Checks- Material Velocity Measurement- Probe Frequency- Probe Pulse Length.



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LEARNING OUTCOMES:

Successful candidate can

- Select the UT TOFD technique for the test method to be used
- Define the limitations of application of the testing method
- Translate NDT codes, standards, specifications and procedures into NDT instructions adapted to the actual working conditions
- Set up and verify equipment settings
- Perform and supervise tests
- Interpret and evaluate results according to applicable standards, codes, specifications or procedures;
- Prepare UT TOFD written instructions
- Carry out and supervise all tasks at or below level 2
- Provide guidance for personnel at or below level 2 and
- Report the results of UT TOFD test

EXAMINATION AND VALIDITY: Training program comprises of daily assessment after completion of each chapter and the participants are required to get above 70% marks. Based on daily assessment exams, candidate is awarded with successful completion of training. Then the participants are required to undergo examination which consists of specific and practical examination. Candidate has to obtain a minimum of 70% in each examination to get certified as PCN TOFD level II. This certificate is valid for 5 years from the date of certification. The certificate has to be renewed as per PCN requirements.

DOCUMENTS TO BE SUBMITTED FOR REGISTRATION:

1. PSL 57-A Initial Examination application
2. PSL 30- Log of Experience
3. PSL 44-Vision Requirements (which has to be certified by a registered medical practitioner)
4. PCN Wallet card copy
5. PCN UT level II Certificate copy

NOTE:

1. TIW reserves the right to disqualify the participants from certification program when the personnel is found that they he/she shall not meet the PCN requirements
2. Participants are not allowed to use their own equipment during the training and examination. TIW provides candidate with Omni scan MX2 advanced Flaw detector for practical inspection and laptop for interpretation(for both training and examination)
3. Candidates must bring Scientific calculator and Safety shoes. Protective gloves, protective eye glasses are also available for the use of students if required.