

Course No. 1294

Time of Flight Diffraction (TOFD) Training Course

CORROSION, INSPECTION & NDT
INDUSTRIAL ENGINEERING, MAINTENANCE & OPERATIONS

DURATION

5 Days

DELIVERY

Classroom



Course Overview

The Time of Flight Diffraction (TOFD) Training Course is a specialized professional program designed to develop the technical knowledge and practical skills required to understand and apply Time of Flight Diffraction technology for weld inspection and structural integrity assessment. TOFD is an advanced ultrasonic non-destructive testing technique used to detect, locate, size, and evaluate internal discontinuities in welded components. The course provides participants with a structured understanding of TOFD principles, equipment, probe configuration, calibration, scanning, data acquisition, interpretation, reporting, and practical applications.

Time of Flight Diffraction is particularly valuable in applications where accurate detection and sizing of weld discontinuities are important for quality control, fabrication inspection, maintenance, and asset integrity management. Unlike conventional ultrasonic approaches that primarily depend on reflected signals from discontinuities, TOFD uses diffracted signals generated at the extremities of defects. Analysis of the arrival time of these signals can provide valuable information about the location and through-wall dimensions of discontinuities.

The course covers the technical foundations required for effective TOFD inspection, including ultrasonic wave behavior, diffraction principles, probe arrangements, scanning configurations, calibration, inspection coverage, data acquisition, signal interpretation, defect characterization, and reporting. Participants will also examine factors that can influence inspection reliability, including material properties, component thickness, weld geometry, surface condition, probe positioning, equipment settings, and calibration quality.

The Time of Flight Diffraction (TOFD) Training Course combines technical learning with practical exercises, case studies, inspection scenarios, and analysis of TOFD data. Participants will develop the ability to plan a TOFD examination, verify equipment and probe readiness, perform systematic scanning, assess recorded data, identify relevant indications, evaluate discontinuities, and document inspection results. The program supports organizations seeking to strengthen advanced non-destructive testing capabilities and improve decision-making related to weld quality, asset integrity, fabrication, maintenance, and in-service inspection.

Objectives

- Analyze the fundamental principles of Time of Flight Diffraction and its role in advanced non-destructive testing of welds.
- Explain ultrasonic wave behavior and diffraction mechanisms associated with the extremities of internal discontinuities.
- Evaluate TOFD application requirements based on material type, component thickness, weld geometry, and inspection objectives.
- Apply appropriate probe selection and configuration principles to achieve the required inspection coverage.
- Perform equipment calibration and system verification before commencing TOFD inspection activities.
- Evaluate the quality and reliability of acquired TOFD data and identify factors that may affect inspection results.
- Analyze TOFD signals and recorded data to identify relevant discontinuity indications.
- Estimate discontinuity location and key dimensions using available TOFD inspection data.
- Evaluate inspection results against approved inspection procedures and applicable acceptance requirements.
- Prepare clear and technically structured TOFD inspection reports containing examination conditions, findings, and relevant indications.
- Apply systematic methods for reviewing, recording, storing, and traceably managing TOFD inspection data.
- Develop a practical TOFD examination plan for weld inspection within an integrated non-destructive testing program.

Who Should Attend

This course is designed for non-destructive testing inspectors, ultrasonic testing technicians, weld inspectors, inspection engineers, quality engineers, asset integrity engineers, welding engineers, materials engineers, maintenance engineers, and technical professionals involved in advanced inspection and non-destructive testing activities.

The program is particularly relevant to professionals working in the inspection of pipelines, pressure vessels, storage tanks, industrial equipment, structural components, power generation facilities,

industrial plants, petrochemical facilities, manufacturing operations, construction projects, and maintenance programs. Technical supervisors, quality control personnel, inspection managers, and specialists responsible for selecting inspection techniques and evaluating non-destructive testing results can also benefit from the course.

Asset integrity managers, quality managers, maintenance managers, project managers, technical consultants, and engineering decision-makers can use the knowledge gained from the course to better understand the capabilities and limitations of Time of Flight Diffraction and determine how TOFD can contribute to broader inspection, quality assurance, and asset integrity strategies.

Learning Outcomes

- Explain the fundamental physical and technical principles of Time of Flight Diffraction.
- Distinguish TOFD from conventional ultrasonic testing approaches used for weld inspection.
- Identify suitable applications for TOFD in welded components and industrial assets.
- Select appropriate probe arrangements based on weld geometry, component thickness, and required inspection coverage.
- Perform equipment calibration and verify system readiness before an examination.
- Establish appropriate inspection zones and scanning coverage for a defined weld configuration.
- Interpret diffracted signals associated with the extremities of relevant discontinuities.
- Analyze TOFD images and recorded inspection data systematically.
- Determine discontinuity location and estimate key dimensions based on available examination data.
- Assess data quality and recognize unwanted signals, noise, or indications associated with component geometry and inspection conditions.
- Prepare structured TOFD inspection reports and document examination findings accurately.
- Integrate TOFD results with other non-destructive testing methods and broader asset integrity programs.

Course Outline

DAY 01

Fundamentals of Time of Flight Diffraction and Ultrasonic Inspection

- Introduction to non-destructive testing and its role in asset integrity.
- Fundamentals of ultrasonic testing and ultrasonic wave propagation through materials.
- Principles of diffraction and wave behavior at the extremities of discontinuities.
- Main components of a TOFD inspection system and their functions.
- Applications of Time of Flight Diffraction in weld inspection and industrial components.
- Advantages, limitations, and factors affecting TOFD application.

PRACTICAL APPLICATION

Analyze an inspection scenario and determine whether TOFD is suitable for the specified application.

DAY 02

Equipment Setup, Probe Configuration, and Calibration

- TOFD ultrasonic inspection equipment and system configuration.
- Probe types, probe arrangement, and positioning requirements.
- Probe frequency, beam characteristics, and configuration considerations.
- Inspection surface preparation and access requirements.
- TOFD calibration principles and system performance verification.
- Signal quality verification and pre-examination checks.

PRACTICAL APPLICATION

Configure a TOFD inspection system and perform calibration and initial system verification.

DAY 03**TOFD Examination and Data Acquisition**

- Planning a TOFD examination for welded components.
- Defining inspection direction, coverage areas, and scanning paths.
- Probe placement and scanning techniques.
- Data acquisition and systematic recording of inspection information.
- Factors affecting data quality, including surface condition, weld geometry, material thickness, and probe positioning.
- Identification of unwanted signals and sources of inspection noise.

PRACTICAL APPLICATION

Perform a simulated weld examination, review the acquired data, and identify areas requiring additional evaluation.

DAY 04**Data Analysis and Discontinuity Evaluation**

- Reading and analyzing TOFD inspection images and recorded data.
- Identification of diffracted signals associated with discontinuity extremities.
- Determining discontinuity location within the inspected component.
- Evaluation of discontinuity height, length, and position using available data.
- Differentiating relevant discontinuities from indications associated with weld geometry or inspection conditions.
- Cases requiring re-examination or complementary non-destructive testing methods.

PRACTICAL APPLICATION

Analyze TOFD examination data, identify discontinuities, evaluate their characteristics, and prepare preliminary findings.

DAY 05

Results Evaluation, Reporting, and Integration into Inspection Programs

- Review and verification of TOFD examination results and data completeness.
- Evaluation of results against approved inspection procedures and applicable acceptance requirements.
- Assessment of discontinuities and decisions regarding acceptance, rejection, repair, or further evaluation.
- Preparation of professional TOFD inspection reports and examination records.
- Data management, traceability, and preservation of inspection records for future review.
- Integration of TOFD with complementary non-destructive testing methods and asset integrity programs.

FINAL WORKSHOP

Develop and execute a complete TOFD weld inspection plan covering examination scope, probe selection, equipment setup, calibration, scanning paths, data acquisition, signal analysis, discontinuity evaluation, results documentation, and preparation of the final technical inspection report.

Register or Request More Information

Course page: <https://quest-training.com/courses/time-of-flight-diffraction-tofd-training-course>

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