

Inspection and Validation Techniques for Welded Joints

Recommended Duration: 3–4 Days

COURSE OVERVIEW

This training focuses on inspection method selection and application before, during, and after ultrasonic peening (HFMI) treatments for welded joints. It addresses offshore-specific challenges including coated surfaces, needle-gunned steel, and corrosion conditions. Recommended course duration: 3–4 days depending on the level of hands-on inspection practice required.

TARGET AUDIENCE

This course is intended for professionals involved in inspection, validation, and integrity management of welded structures before and after ultrasonic peening (HFMI), including:

- Inspection engineers and NDT specialists
- Structural and fatigue engineers
- Asset integrity and maintenance engineers
- Offshore, marine, and energy-sector engineers
- Quality, verification, and certification personnel
- Engineers and supervisors responsible for HFMI execution and acceptance

REQUIRED QUALIFICATIONS / BACKGROUND

Participants are expected to have:

- A technical or engineering background (structural, mechanical, materials, or inspection disciplines)
- Basic familiarity with welded joints and common NDT methods
- Understanding of fatigue, cracking mechanisms, or asset integrity principles is beneficial

The course is suitable for both experienced inspectors seeking deeper understanding of HFMI-related validation and engineers responsible for specifying or accepting inspection programs.

COURSE DURATION & FORMAT

Recommended duration: 3–4 days

Format:

- Instructor-led training (classroom or virtual)
- Technical lectures combined with real-world offshore case studies
- Optional hands-on inspection and validation exercises
- Group discussions and method-selection exercises

The duration can be adjusted depending on the level of practical inspection training required.

DAY 1 — Fundamentals of Weld Integrity & Pre-Peening Inspection**1. Introduction to Welded Joint Integrity**

- Fatigue-critical weld details
- Importance of accurate inspection prior to HFMI
- Offshore constraints and safety considerations

2. Pre-Peening Inspection Methods

- Visual Testing (VT)
- Magnetic Particle Testing (MT)
- Dye Penetrant Testing (PT)
- Ultrasonic Testing (UT & PAUT)
- Radiographic Testing (RT)
- Surface Profilometry / 3D Scanning

3. Limitations for Offshore Coated or Corroded Structures

- Effect of coatings on MT/PT/UT
- Inspection after needle gunning
- Corrosion masking effects
- Recommended cleaning practices

DAY 2 — In-Process Inspection & Monitoring During Peening**1. In-Process Monitoring Techniques**

- Visual coverage verification
- Imprint/indentation depth checks
- Tool parameter monitoring (frequency, amplitude)
- Temperature monitoring for sensitive materials

2. Documentation & Traceability

- Parameter logging
- Peening coverage mapping
- Operator qualification requirements

3. Practical Session (Optional)

- Hands-on demonstration of in-process verification
- Identification of under- and over-treated welds

DAY 3 — Post-Peening & Recurrent Inspection Methods**1. Post-Peening Inspection Techniques**

- VT for toe radius and surface uniformity
- MT for ferromagnetic weld crack detection

- PT for aluminium, titanium, Inconel welds
- UT/PAUT for subsurface crack monitoring

2. Validation of Peening Quality

- Residual stress measurement (XRD, hole-drilling, Barkhausen noise)
- Surface geometry verification (profilometry/laser scans)
- Documentation and acceptance criteria

3. Recurrent Inspection (Long-Term Monitoring)

- Fatigue life extension tracking
- Inspection interval determination
- Offshore re-inspection challenges

DAY 4 (Optional) — Case Studies, Method Selection Exercise & Certification

1. Method Selection Framework

- Choosing inspection techniques based on:
 - coating condition
 - corrosion level
 - weld material
 - loading conditions
 - access and safety

2. Offshore Case Studies

- HFMI on ageing structures
- Failures linked to poor inspection
- Lessons learned

3. Competency Exercise

- Students select the appropriate inspection sequence
- Crack detection and validation workflow development

4. Final Assessment & Certification

LIST OF RELEVANT INSPECTION METHODS FOR ULTRASONIC PEENING

Surface Methods:

- Visual Testing (VT)
- Magnetic Particle Testing (MT)
- Dye Penetrant Testing (PT)
- Eddy Current Testing (ET)
- ACFM (Alternating Current Field Measurement)
- 3D Scanning / Profilometry

Subsurface Methods:

- Ultrasonic Testing (UT)
- Phased Array UT (PAUT)
- TOFD
- Radiography (RT/DR)

Residual Stress & Validation:

- X-Ray Diffraction (XRD)
- Hole-Drilling Method
- Barkhausen Noise Analysis
- Ultrasonic Residual Stress Measurement

Process Monitoring:

- Parameter logging
- Indentation depth check
- Temperature monitoring
- Tool wear inspection