Advanced Welding, Inspection, and Metallurgy for Engineers Training Course

23 - 27 Nov 2026

Boston

7500 € (Per Person)

Ref: #INM4537_113387

Course Introduction / Overview:

This comprehensive training course is designed to provide maintenance engineers and technical professionals with a robust understanding of welding technology, inspection principles, and metallurgical concepts critical for ensuring the integrity and reliability of industrial assets. In modern engineering, the quality of a weld can be the determining factor in the operational safety and longevity of equipment, from pressure vessels to structural components. This course bridges the gap between theoretical knowledge and practical application, focusing on the challenges faced in maintenance environments. Drawing upon foundational principles outlined in seminal works like "Welding Metallurgy" by Sindo Kou, participants will explore the intricate relationship between welding processes, material behavior, and potential defects. BIG BEN Training Center has developed this program to empower attendees to make informed decisions regarding weld repairs, inspection scheduling, and failure analysis. The curriculum covers everything from fundamental welding processes and safety protocols to advanced non-destructive testing (NDT) techniques and the interpretation of international codes and standards, ensuring a holistic mastery of the subject. Participants will leave equipped with the skills to enhance plant reliability, reduce downtime, and maintain the highest safety standards in their operations.

Target Audience / This training course is suitable for:

- Maintenance Engineers.
- Reliability Engineers.
- Inspection Engineers.
- Welding Supervisors and Foremen.
- Quality Assurance and Quality Control (QA/QC) Personnel.
- Plant Engineers and Managers.
- Asset Integrity Engineers.
- Mechanical Engineers.
- Project Engineers involved in repairs and modifications.
- Technical professionals responsible for welded structures and components.

Target Sectors and Industries:

- Oil and Gas (Upstream, Midstream, and Downstream).
- Power Generation (Fossil, Nuclear, and Renewables).
- Petrochemical and Chemical Processing.
- Manufacturing and Fabrication.
- Construction and Infrastructure.
- Aerospace and Defense.
- Marine and Shipbuilding.
- Mining and Mineral Processing.
- Governmental bodies and regulatory agencies.

Target Organizations Departments:

- Maintenance and Reliability.
- Engineering and Design.
- Quality Assurance / Quality Control (QA/QC).
- Asset Integrity Management.
- Operations and Production.
- Inspection and Testing.
- Health, Safety, and Environment (HSE).
- Project Management.

Course Offerings:

By the end of this course, the participants will have able to:

- Identify and differentiate various welding processes and their applications in maintenance.
- Understand the fundamental principles of welding metallurgy and heat treatment.
- Analyze the effects of welding on the microstructure and mechanical properties of materials.
- Select and apply appropriate non-destructive testing (NDT) methods for weld inspection.
- Interpret welding symbols, drawings, and technical specifications accurately.
- Develop and review Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR).
- Recognize common weld defects, understand their causes, and determine corrective actions.
- Apply knowledge of major international codes and standards (ASME, AWS, API).
- Conduct effective failure analysis on welded joints and components.
- Implement best practices for welding repairs and in-service asset management.

Course Methodology:

The training methodology at BIG BEN Training Center is designed to foster a dynamic and engaging learning environment that maximizes knowledge retention and practical application. This course moves beyond traditional lectures by integrating a blended learning approach. Theoretical sessions will establish a strong foundation in welding technology, metallurgy, and inspection principles, supported by high-quality visual aids and presentations. These sessions are complemented by interactive group discussions, allowing participants to share their unique workplace challenges and collaborate on solutions. A significant portion of the course is dedicated to practical case studies, where attendees will analyze real-world examples of weld failures, inspection reports, and repair procedures. Hands-on workshops and simulation exercises will provide a safe space to practice interpreting welding codes and evaluating NDT results. Our expert instructors facilitate a continuous feedback loop, encouraging questions and ensuring that complex concepts are thoroughly understood. This participant-centered approach ensures that engineers not only learn the material but are also confident in applying their new skills directly to their maintenance responsibilities upon returning to their organizations.

Course Agenda (Course Units):

Unit One: Fundamentals of Welding Technology and Safety

- Introduction to welding for maintenance and repair.
- Overview of major welding processes (SMAW, GTAW, GMAW, SAW).
- Principles of welding physics, arcs, and heat flow.
- Selection of welding consumables and filler materials.
- Comprehensive welding safety protocols and hazard identification.
- Understanding welding positions and joint design basics.
- Introduction to welding documentation and terminology.

Unit Two: Welding Metallurgy for Maintenance Engineers

- Fundamentals of physical metallurgy and crystal structures.
- The Iron-Carbon phase diagram and its relevance to steels.
- Heat Affected Zone (HAZ) formation and its characteristics.
- Weldability of carbon steels, alloy steels, and stainless steels.
- Principles of preheating and post-weld heat treatment (PWHT).
- Mechanisms of weld solidification and cracking phenomena.
- Understanding metallurgical discontinuities in welds.

Unit Three: Weld Inspection and Non-Destructive Testing (NDT)

- The role of the welding inspector in maintenance.
- Visual Inspection (VT) techniques for pre-weld, in-process, and post-weld checks.
- Introduction to Non-Destructive Testing (NDT) principles.
- Liquid Penetrant Testing (PT) and Magnetic Particle Testing (MT).
- Ultrasonic Testing (UT) for volumetric inspection.
- Radiographic Testing (RT) principles and interpretation of films.
- Selecting the appropriate NDT method for specific applications.

Unit Four: Welding Codes, Standards, and Procedures

- Introduction to major welding codes (ASME Section IX, AWS D1.1, API 1104).
- Understanding the structure and application of codes and standards.
- Developing a Welding Procedure Specification (WPS).
- Reviewing a Procedure Qualification Record (PQR).
- Welder Performance Qualification (WPQ) requirements.
- Interpreting welding symbols on engineering drawings.
- Documentation and record-keeping for quality control.

Unit Five: Weld Defects, Failure Analysis, and Repair Strategies

- Categorization and identification of common weld defects.
- Root cause analysis of welding imperfections and failures.
- Techniques for weld failure investigation and analysis.
- Best practices for weld repair engineering and execution.
- Strategies for managing distortion and residual stress.
- Introduction to Fitness-for-Service (FFS) concepts (API 579).
- Case studies in weld failure and successful repair solutions.

FAQ:

Qualifications required for registering to this course?

There are no requirements.

How long is each daily session, and what is the total number of training hours for the course?

This training course spans five days, with daily sessions ranging between 4 to 5 hours, including breaks and interactive activities, bringing the total duration to 20 - 25 training hours.

Something to think about:

Considering the balance between production deadlines and safety, how can an engineer justify the cost and time for advanced NDT when basic visual inspection seems sufficient?

What unique qualities does this course offer compared to other courses?

This course distinguishes itself by its dedicated focus on the intersection of welding technology, inspection, and metallurgy specifically from the perspective of the maintenance engineer. Unlike many programs that concentrate on new fabrication, this curriculum is tailored to the unique challenges of in-service repairs, asset life extension, and failure analysis. It moves beyond simply teaching how to weld or inspect by emphasizing the "why" behind material behavior and defect formation in operational environments. The integration of metallurgical principles is not a standalone topic but is woven throughout the course, providing a deep understanding of how maintenance welding affects component integrity. Furthermore, the course places a strong emphasis on the practical application of international codes and standards (ASME, AWS, API) in repair scenarios, which is a critical and often overlooked skill. By incorporating real-world case studies of weld failures and repair strategies, participants gain actionable insights that can be immediately applied to improve plant reliability, ensure safety, and make cost-effective maintenance decisions. The holistic approach ensures engineers leave not just with technical knowledge, but with the critical thinking skills needed to manage the entire lifecycle of welded assets.