Welding Metallurgy and Weldability of Steels Training Course

OGT-1090 · 5 days · 15 CPD hours · English

OVERVIEW

The Welding Metallurgy and Weldability of Steels Training Course provides a comprehensive understanding of the metallurgical principles that govern welding processes, steel behaviour and weld joint performance. Welding involves more than joining two metal components; it creates complex thermal, chemical and structural changes that directly influence the strength, toughness, hardness and service reliability of welded materials. Understanding these changes is essential for professionals responsible for welding operations, fabrication quality, inspection and engineering decisions in the oil and gas industry.

This professional training programme explores the relationship between steel composition, welding procedures, thermal cycles and resulting metallurgical properties. Participants will develop an understanding of how different steel grades respond to welding heat, how microstructure transformations influence weld integrity and why certain materials are more susceptible to cracking and other welding defects. Particular attention is given to the heat-affected zone (HAZ), carbon equivalent calculations, preheat requirements, hydrogen cracking and post-weld heat treatment.

The course examines the metallurgical behaviour of carbon steels, low-alloy steels, high-strength steels and other commonly used engineering materials. It explains how welding thermal cycles affect grain growth, phase transformations, residual stresses and mechanical properties. Participants will also explore the influence of cooling rates, heat input, hydrogen content and material thickness on weldability and fabrication quality.

Within the **Welding Inspection and Metallurgy for Oil & Gas** category, this programme addresses the technical challenges associated with pipelines, pressure vessels, storage tanks, offshore structures, refineries and industrial processing facilities. It connects metallurgical theory with practical welding applications, enabling participants to evaluate material suitability, identify potential metallurgical risks and understand the implications of welding procedure variables.

Delivered through the technical training approach of the Oil & Gas Training Institute, the programme combines instructor-led discussions, engineering examples, metallurgical assessments and practical case studies. Participants will strengthen their ability to interpret material properties, assess weldability concerns and contribute to effective welding quality management.

By the end of the training, participants will be better equipped to understand the metallurgical factors affecting welded structures, support appropriate welding procedure selection and minimise the risk of weld-related failures in demanding industrial environments.

OBJECTIVES

By completing this course, participants will be able to:

1. **Explain** the fundamental principles of welding metallurgy, including steel composition, phase transformations, grain structures and metallurgical behaviour during welding.

2. **Identify** the characteristics of different steel grades, including carbon steels, low-alloy steels, high-strength steels and their suitability for welding applications.

3. **Analyse** the effects of welding thermal cycles on the weld metal, heat-affected zone and parent material, including changes in hardness, toughness and microstructure.

4. **Calculate and interpret** carbon equivalent values using recognised calculation methods to evaluate the relative weldability and hardening susceptibility of steels.

5. **Determine** appropriate preheat and interpass temperature considerations based on material composition, thickness, hydrogen potential and welding conditions.

6. **Evaluate** the causes and contributing factors of hydrogen cracking, including diffusible hydrogen, residual stresses, material hardenability and cooling conditions.

7. **Assess** the influence of welding heat input, cooling rates and thermal management on metallurgical properties and weld joint performance.

8. **Explain** the purpose and metallurgical effects of post-weld heat treatment, including stress relief and other relevant thermal treatment processes.

9. **Interpret** welding procedure specifications and supporting material information to recognise potential metallurgical risks and weldability limitations.

10. **Recommend** appropriate measures to improve weldability, minimise cracking risks and maintain the integrity of welded components in oil and gas applications.

TRAINING METHODOLOGY

The Welding Metallurgy and Weldability of Steels Training Course uses a structured, practical and technically focused learning methodology. It combines metallurgical theory with industrial welding applications to help participants understand how material behaviour influences fabrication quality and operational reliability.

The programme uses the following training approaches:

Interactive Presentations and Technical Discussions

Experienced subject specialists explain the fundamental principles of welding metallurgy through structured presentations, technical illustrations and engineering examples. Discussions cover steel composition, metallurgical transformations, weldability factors, carbon equivalent and heat-affected zone behaviour.

Metallurgical Case Studies

Participants examine practical examples involving weld cracking, excessive hardness, poor toughness and metallurgical deterioration. These case studies help them understand how incorrect welding parameters or inadequate material assessment can affect welded structures.

Carbon Equivalent Calculation Exercises

Practical exercises introduce participants to carbon equivalent calculations using relevant steel composition data. They assess how alloying elements influence hardenability and evaluate the implications for welding procedure selection and preheat requirements.

Welding Thermal Cycle Analysis

Participants explore the relationship between heat input, cooling rates and metallurgical transformations. Technical exercises demonstrate how welding conditions influence grain structure, HAZ characteristics and mechanical properties.

Hydrogen Cracking Risk Assessment

Scenario-based exercises allow participants to examine the conditions that contribute to hydrogen-assisted cracking. They assess the importance of consumable selection, hydrogen control, preheating, joint restraint and controlled cooling.

Group Activities and Technical Problem-Solving

Collaborative activities focus on evaluating material specifications, identifying weldability challenges and recommending suitable control measures. Participants discuss different approaches to managing metallurgical risks in fabrication and maintenance projects.

Industry Experience Sharing

Participants exchange professional experiences involving pipeline welding, pressure equipment fabrication, structural welding and inspection challenges. This approach connects technical knowledge with practical workplace responsibilities.

Knowledge Assessment and Review

Daily discussions, technical exercises and knowledge checks reinforce important concepts. The final assessment allows participants to demonstrate their understanding of welding metallurgy and its application to industrial welding activities.

ORGANISATIONAL IMPACT

The Welding Metallurgy and Weldability of Steels Training Course can contribute to improved fabrication quality, stronger engineering decisions and more effective welding risk management across oil and gas organisations.

Improved Welding Quality and Structural Integrity

A better understanding of steel metallurgy enables technical teams to recognise conditions that may compromise weld quality. By understanding the effects of thermal cycles, microstructure transformations and HAZ behaviour, organisations can improve their approach to welding procedure development and fabrication control.

Reduced Risk of Metallurgical Defects

Hydrogen cracking, excessive hardness and inadequate toughness can create serious challenges during fabrication and service. The course helps organisations strengthen their technical approach to identifying these risks and applying appropriate preventive measures.

More Effective Welding Procedure Selection

Understanding carbon equivalent, material composition and weldability characteristics supports more informed welding procedure decisions. This can help organisations establish suitable welding conditions for different steel grades and component thicknesses.

Improved Project Efficiency

Metallurgical problems can contribute to repair work, production interruptions, inspection delays and additional project costs. Better technical understanding can help teams identify potential issues earlier and reduce avoidable fabrication complications.

Stronger Quality Assurance and Inspection Practices

The course improves collaboration between welding engineers, inspectors, metallurgists and quality professionals. Shared technical knowledge helps teams communicate more effectively when reviewing material suitability, welding procedures and potential defects.

Enhanced Risk Management and Compliance

Participants develop a stronger understanding of the metallurgical considerations that support welding quality requirements. This can assist organisations in applying relevant engineering specifications, welding codes and quality management procedures more effectively.

Improved Maintenance and Asset Reliability

For organisations operating pipelines, pressure vessels, offshore structures and processing facilities, understanding weldability is important when planning repairs and modifications. The knowledge gained can support more informed material assessments and welding-related maintenance decisions.

Stronger Technical Capabilities

Developing internal expertise in welding metallurgy helps organisations improve technical decision-making and build a more capable workforce. It also supports knowledge sharing between engineering, fabrication, inspection and maintenance departments.

PERSONAL IMPACT

Participants attending this course can strengthen their technical expertise and develop practical knowledge relevant to welding engineering, inspection, fabrication and material assessment.

Advanced Understanding of Welding Metallurgy

Participants gain a deeper understanding of how steel composition and welding conditions influence material behaviour. They become more familiar with metallurgical transformations and the factors affecting weld joint

performance.

Improved Material Assessment Skills

The programme develops participants' ability to examine steel grades, understand alloying elements and interpret carbon equivalent values. This knowledge supports better material selection and weldability assessments.

Greater Confidence in HAZ Evaluation

Participants develop a clearer understanding of the heat-affected zone, including grain growth, hardness variations and microstructural changes. They become better prepared to discuss HAZ-related concerns during welding and inspection activities.

Enhanced Cracking Prevention Knowledge

By studying hydrogen cracking mechanisms and contributing factors, participants improve their ability to recognise cracking risks and understand appropriate preventive measures.

Better Welding Procedure Interpretation

Participants improve their ability to review welding procedure information and understand the relationship between heat input, preheat, interpass temperature and metallurgical outcomes.

Stronger Technical Problem-Solving Abilities

Practical exercises and case studies help participants approach welding-related problems systematically. They learn to connect material properties, welding conditions and potential defects when evaluating technical challenges.

Improved Professional Communication

The programme strengthens participants' ability to communicate metallurgical concerns with welding supervisors, inspectors, engineers, quality professionals and project teams.

Career Development Opportunities

A stronger understanding of welding metallurgy can support professional development in welding engineering, materials engineering, quality assurance, fabrication management and welding inspection.

WHO SHOULD ATTEND

The Welding Metallurgy and Weldability of Steels Training Course is designed for professionals involved in welding engineering, fabrication, inspection, material selection and quality management within the oil and gas and related industrial sectors.

It is particularly suitable for:

- **Welding Engineers:** Professionals responsible for developing, reviewing and controlling welding procedures who need a stronger understanding of metallurgical behaviour and weldability factors.

- **Metallurgical Engineers:** Specialists involved in material evaluation, microstructure assessment, steel performance and metallurgical failure prevention.
- **Materials Engineers:** Professionals responsible for selecting suitable materials and evaluating their compatibility with welding processes and service conditions.
- **Welding Inspectors:** Inspectors who need to understand the metallurgical causes of welding defects, HAZ characteristics and cracking mechanisms.
- **Quality Assurance and Quality Control Engineers:** QA/QC professionals responsible for monitoring welding quality, reviewing technical documentation and supporting fabrication compliance.
- **Pipeline Engineers:** Engineers involved in pipeline construction, maintenance and repair who need to understand the weldability of pipeline steels and hydrogen cracking risks.
- **Fabrication Engineers and Supervisors:** Professionals overseeing welding operations who need to understand how welding parameters influence metallurgical properties.
- **Welding Supervisors and Foremen:** Personnel responsible for supervising welding activities, controlling preheat and interpass temperatures and maintaining welding quality.
- **Mechanical and Project Engineers:** Engineers involved in pressure vessels, structural components, piping systems and industrial fabrication projects.
- **NDT and Inspection Personnel:** Professionals seeking to improve their understanding of metallurgical conditions that can contribute to weld discontinuities and cracking.
- **Maintenance and Reliability Engineers:** Specialists responsible for evaluating welded components, planning repairs and supporting the reliability of industrial assets.
- **Technical Consultants and Industry Specialists:** Professionals advising organisations on welding procedures, material performance and fabrication quality.

The programme is also suitable for technical managers and professionals seeking to expand their knowledge of welding metallurgy and improve their understanding of steel weldability in industrial applications.

COURSE OUTLINE

Fundamentals of Welding Metallurgy and Steel Behaviour

Heat-Affected Zone, Thermal Cycles and Microstructural Transformations

Steel Weldability, Carbon Equivalent and Preheat Requirements

Hydrogen Cracking, Welding Defects and Post-Weld Heat Treatment

Welding Procedure Evaluation, Metallurgical Testing and Industrial Applications

SCHEDULED DATES

Dates	Venue	Format	Fee
25 - 29 Jan 2027	Abu Dhabi, United Arab Emirates	In person	$11,500
25 - 29 Jan 2027	Abuja, Nigeria	In person	$11,500
25 - 29 Jan 2027	Accra, Ghana	In person	$11,500
25 - 29 Jan 2027	Addis Ababa, Ethiopia	In person	$11,500
25 - 29 Jan 2027	Al Ain, United Arab Emirates	In person	$11,500
25 - 29 Jan 2027	Al Khobar, Saudi Arabia	In person	$11,500
25 - 29 Jan 2027	Alberta, Canada	In person	$11,500
25 - 29 Jan 2027	AlUla, Saudi Arabia	In person	$11,500
25 - 29 Jan 2027	Amman, Jordan	In person	$11,500
25 - 29 Jan 2027	Amsterdam, The Netherlands	In person	$11,500
25 - 29 Jan 2027	Athens, Greece	In person	$11,500
25 - 29 Jan 2027	Baku, Azerbaijan	In person	$11,500
25 - 29 Jan 2027	Barcelona, Spain	In person	$11,500
25 - 29 Jan 2027	Berlin, Germany	In person	$11,500
25 - 29 Jan 2027	Boston, USA	In person	$11,500
25 - 29 Jan 2027	Brussels, Belgium	In person	$11,500
25 - 29 Jan 2027	Budapest, Hungary	In person	$11,500
25 - 29 Jan 2027	Cairo, Egypt	In person	$11,500
25 - 29 Jan 2027	Cape Town, South Africa	In person	$11,500
25 - 29 Jan 2027	Casablanca, Morocco	In person	$11,500
25 - 29 Jan 2027	Dammam, Saudi Arabia	In person	$11,500

Dates	Venue	Format	Fee
25 - 29 Jan 2027	Dhahran, Saudi Arabia	In person	$11,500
25 - 29 Jan 2027	Doha, Qatar	In person	$11,500
25 - 29 Jan 2027	Dubai, United Arab Emirates	In person	$11,500
25 - 29 Jan 2027	Edinburgh, United Kingdom	In person	$11,500
25 - 29 Jan 2027	Edmonton, Canada	In person	$11,500
25 - 29 Jan 2027	Frankfurt, Germany	In person	$11,500
25 - 29 Jan 2027	Geneva, Switzerland	In person	$11,500
25 - 29 Jan 2027	Houston, USA	In person	$11,500
25 - 29 Jan 2027	Istanbul, Turkey	In person	$11,500
25 - 29 Jan 2027	Jakarta, Indonesia	In person	$11,500
25 - 29 Jan 2027	Jeddah, Saudi Arabia	In person	$11,500
25 - 29 Jan 2027	Jubail, Saudi Arabia	In person	$11,500
25 - 29 Jan 2027	Khamis Mushait, Saudi Arabia	In person	$11,500
25 - 29 Jan 2027	Kigali, Rwanda	In person	$11,500
25 - 29 Jan 2027	Kuala Lumpur, Malaysia	In person	$11,500
25 - 29 Jan 2027	Lisbon, Portugal	In person	$11,500
25 - 29 Jan 2027	Liverpool, United Kingdom	In person	$11,500
25 - 29 Jan 2027	London, United Kingdom	In person	$11,500
25 - 29 Jan 2027	Los Angeles, USA	In person	$11,500
25 - 29 Jan 2027	Luanda, Angola	In person	$11,500
25 - 29 Jan 2027	Madrid, Spain	In person	$11,500
25 - 29 Jan 2027	Manama, Bahrain	In person	$11,500
25 - 29 Jan 2027	Marbella, Spain	In person	$11,500
25 - 29 Jan 2027	Marrakech, Morocco	In person	$11,500
25 - 29 Jan 2027	Miami, USA	In person	$11,500
25 - 29 Jan 2027	Milan, Italy	In person	$11,500

Dates	Venue	Format	Fee
25 - 29 Jan 2027	Munich, Germany	In person	$11,500
25 - 29 Jan 2027	Muscat, Oman	In person	$11,500
25 - 29 Jan 2027	Nairobi, Kenya	In person	$11,500
25 - 29 Jan 2027	New York, USA	In person	$11,500
25 - 29 Jan 2027	Nice, France	In person	$11,500
25 - 29 Jan 2027	Oslo, Norway	In person	$11,500
25 - 29 Jan 2027	Paris, France	In person	$11,500
25 - 29 Jan 2027	Port Louis, Mauritius	In person	$11,500
25 - 29 Jan 2027	Prague, Czech Republic	In person	$11,500
25 - 29 Jan 2027	Pretoria, South Africa	In person	$11,500
25 - 29 Jan 2027	Riyadh, Saudi Arabia	In person	$11,500
25 - 29 Jan 2027	Rome, Italy	In person	$11,500
25 - 29 Jan 2027	Sarajevo, Bosnia and Herzegovina	In person	$11,500
25 - 29 Jan 2027	Sharm El Sheikh, Egypt	In person	$11,500
25 - 29 Jan 2027	Singapore, Singapore	In person	$11,500
25 - 29 Jan 2027	Stockholm, Sweden	In person	$11,500
25 - 29 Jan 2027	Tokyo, Japan	In person	$11,500
25 - 29 Jan 2027	Toronto, Canada	In person	$11,500
25 - 29 Jan 2027	Tromso, Norway	In person	$11,500
25 - 29 Jan 2027	Vienna, Austria	In person	$11,500
25 - 29 Jan 2027	Zagreb, Croatia	In person	$11,500
25 - 29 Jan 2027	Zurich, Switzerland	In person	$11,500
25 - 29 Jan 2027	Online, Virtual	Online	$11,500

CERTIFICATE