

Advanced Onsite Welding Techniques and Inspection

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Overview

Heavy industrial fabrication and plant maintenance demand rigorous execution in structural joining and quality assurance. The Advanced Onsite Welding Techniques and Inspection programme provides engineers, supervisors, and fabricators with in-depth competencies required for field assembly, structural repairs, and quality verification. Participants develop structured expertise across metal preparation, shielded metal arc welding, gas tungsten arc welding, gas metal arc welding, and specialized alloy fabrication. The curriculum also details weld inspection methods, welding procedure specifications, and defect prevention across field environments. This course is delivered by Agile Leaders Training Center.

Who Should Attend

- Welding engineers responsible for qualifying repair procedures and overseeing structural fabrication.
- Quality control inspectors tasked with non-destructive examination and code compliance verification.
- Maintenance technicians carrying out field repairs on pressure vessels, piping, and structural components.
- Production supervisors coordinating onsite welding teams and consumable logistics.
- Fabrication specialists preparing for advanced technical responsibilities in heavy industry.

Departments and Industries

This programme serves technical specialists and engineering personnel across sectors that require dependable field joining and verification.

- Maintenance and Repair Units in Oil and Gas Refineries
- Quality Assurance and Quality Control Departments in Heavy Engineering
- Fabrication and Erection Teams in Industrial Construction
- Fleet Maintenance Sections in Marine and Shipbuilding Facilities
- Mechanical Integrity Groups in Power Generation and Utilities

Learning Objectives

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

- Select appropriate cutting and shaping tools to prepare joint geometries according to design tolerances.
- Execute shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding using qualified parameters.
- Formulate and evaluate welding procedure specifications and supporting procedure qualification records.
- Apply thermal controls, including pre-heating and post-weld heat treatment, to preserve metallurgy and prevent cracking.
- Identify surface and subsurface weld discontinuities using systematic visual and non-destructive inspection methods.
- Coordinate field fabrication projects from initial joint fit-up to final inspection sign-off.

Course Agenda

Day 1: Metalwork Principles and Cutting Methods

- Fundamentals of structural metallurgy and material classification
- Mechanical properties of carbon steels, alloy steels, and cast iron
- Introduction to engineering drawing symbols and joint designs
- Thermal cutting processes including oxy-fuel and plasma arc cutting
- Mechanical edge preparation, beveling tools, and safety protocols
- Practical exercise on metal cutting and joint edge alignment

Day 2: Shaping Techniques and Procedure Specifications

- Cold and hot metal forming methods for structural profiles
- Development of welding procedure specifications for site work
- Classification, storage, and handling of covered electrodes and shielding gases
- Joint fit-up tolerances, root openings, and tack welding practices
- Practical workshop on plate preparation and fit-up verification
- Review of joint configuration standards and parameter sheets

Day 3: Shielded Metal Arc Welding and Consumable Control

- Operating principles and electrical characteristics of shielded metal arc welding
- Electrode selection according to base metal chemistry and service conditions
- Welding technique for carbon steel plates in flat, horizontal, and vertical positions
- Control of heat input, travel speed, and arc length
- Safety practices for confined-space and elevated onsite welding
- Practical session on multi-pass fillet and groove welding

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Day 4: Gas-Shielded and Submerged Arc Welding Processes

- Gas metal arc welding modes of metal transfer and shielding gas selection
- Gas tungsten arc welding torch assembly, tungsten selection, and shielding control
- Process parameters for root pass deposition on high-integrity joints
- Submerged arc welding principles and industrial application boundaries
- Hardfacing and protective cladding techniques for wear resistance
- Hands-on welding trials using semi-automatic wire processes

Day 5: Pipe Fabrication and Alloy Welding

- Pipe welding techniques in 2G, 5G, and 6G orientations
- Purging methods and backing gases for corrosion-resistant alloys
- Techniques for welding austenitic and duplex stainless steel
- Specific requirements for welding aluminium alloys and copper-nickel piping
- Quality control during field assembly of process pipework
- Practical workshop on pipe joint fit-up and circumferential welding

Day 6: Thermal Treatment and Defect Rectification

- Pre-heating calculation methods to prevent hydrogen-induced cracking
- Interpass temperature monitoring using temperature-indicating materials and pyrometers
- Post-weld heat treatment cycles, soaking times, and cooling rates
- Systematic identification of planar, volumetric, and geometric weld flaws
- Excavation and repair procedures for defective weld metal
- Practical demonstration of thermal checking and weld repair excavation

Day 7: Quality Control and Procedure Qualification Records

- Duties of the welding inspector during fabrication and post-weld verification
- Structure and qualification of procedure qualification records
- Destructive testing methods including tensile, bend, and Charpy impact tests
- Visual inspection criteria and standard measuring gauges
- Documentation workflows for site inspection records and welder logs
- Practical session on visual weld assessment and defect measurement

Day 8: Non-Destructive Examination and Quality Standards

- Principles of liquid penetrant testing for surface defect detection
- Magnetic particle inspection techniques on ferromagnetic materials
- Interpretation of ultrasonic and radiographic testing reports
- Weld acceptance criteria in structural and piping codes
- Preparation of inspection test plans and non-conformance reports
- Practical workshop on penetrant and magnetic crack detection

Day 9: Field Welding Project Implementation

- Project planning and material staging for site welding jobs
- Execution of multi-process welding on a simulated structural assembly
- In-process quality monitoring, parameter tracking, and interpass cleaning
- Application of quality control checklists during field assembly
- Dimensional verification and straightness checks on completed fabrications
- Group review of joint completion and practical project outcomes

Day 10: Standards Compliance and Technical Assessment

- Consolidated review of multi-process joining and inspection techniques
- Code compliance audits for onsite welding operations
- Verification of welder performance qualification records
- Theoretical assessment on welding technology, metallurgy, and inspection
- Evaluation of project workpieces and inspection documentation
- Course summary, feedback session, and professional development planning

Practical Exercises

Participants complete structured field simulations to reinforce procedural discipline and inspection precision.

- Suggested activity: Formulate a draft welding procedure specification based on base metal chemistry and joint requirements.
- Suggested activity: Calibrate cutting torch parameters and prepare bevelled plate edges within specified tolerances.
- Suggested activity: Conduct a visual and dimensional inspection on a multi-pass welded joint using fillet gauges.
- Suggested activity: Perform liquid penetrant testing on a repaired weld seam to verify complete flaw removal.

FAQs

What welding processes are demonstrated during this programme?

The course addresses shielded metal arc welding, gas metal arc welding, gas tungsten arc welding, and submerged arc welding, alongside cutting and thermal treatment methods.

How are inspection standards integrated into the sessions?

Inspection principles run through all modules, including visual examination with welding gauges, non-destructive testing evaluation, and the development of procedure qualification records.

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What materials and metals are examined?

Participants study structural carbon steels, cast iron, austenitic stainless steel, and aluminium alloys, focusing on their metallurgy, pre-heat requirements, and consumable selection.

Conclusion

Mastery of field welding operations requires equal attention to deposition skill, metallurgical discipline, and inspection rigor. By connecting multi-process manual techniques with formal quality assurance procedures, this programme prepares technical professionals to deliver structural and pressure boundary joints that comply with strict engineering standards and withstand operational demands.

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