

# € TRAINING

Welding Technology



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## Introduction:

Welding is a common and a very important joining process in most industries, and of particular importance in the chemical, oil, and gas industries, including, for example, pipelines and storage tanks. This 5-day training program aims to provide the fundamental principles of welding and welding techniques, helping participants recognize various welding processes.

## Course Objectives:

At the end of this course the participants will be able to:

- Understand the use and application of welding techniques and standards.
- Understand the various types of welding joints.
- Learn about the different types of electrodes and standards.
- Appreciate the variations of welding various types of metals.
- Know, through the study of basic metallurgy, how heat treatment may be used to overcome some of the problems associated with welding, including the HAZ.
- Recognize and define the basic types of welding defects and failure.
- Learn how NDT can be used to detect weld defects.
- Understand how to apply materials testing techniques to examine the strength and quality of welded joints.
- Gain an understanding of corrosion test methods and interpretation of results.

## Targeted Audience:

- Welding Personnel
- Metallurgy Personnel
- Inspection Personnel
- Equipment Engineers
- Maintenance Engineers and Planners
- Design Engineers
- Service Company Representatives

## Course Outlines:

### Unit 1: Introduction and Weld Joint Design:

- Introduction, welding terminology, codes and standards, welding failure, and case studies.
- Introduction to quality, meeting requirements, customer satisfaction, quality control, how can quality be achieved?
- Weld joint design, load performance, types of joints, butt joint, square, grooved butt joint, single V, Double V butt Joint, bevel and double bevel butt, U, J and T, flush.
- Welding techniques, positional welding, backing, examples, butt welds without backing.

### Unit 2: Welding Processes:

- Welding processes, process options, benefits, problems and applications, oxyacetylene process, fusion

welding processes, shielded metal arc welding SMAW, submerged arc welding, TIG welding, solid wire MIG welding, types of flux/electrodes, metal transfer mode, power source and welding current, arc starting, shielding gas, operating characteristics, applications.

- Arc welding electrodes, US standard electrodes, electrode identification, electrode size and currents, common electrode types, extended electrode classification examples, BS classification of electrodes

### Unit 3: Welding Defects and Imperfections:

- Welding defects, introduction, heat affected zone, HAZ, weld defects and imperfections, porosity, solidification cracking, hydrogen cracking, incomplete root fusion or penetration, residual stresses and cracking, reheat cracking, lamellar tearing, liquation cracking, slag inclusion.
- Geometric shape imperfections - types and causes, excess weld metal, undercut, overlap cold lapping, linear misalignment, incomplete filled groove, troubleshooting.

### Unit 4: Welding Technical Prints, Symbols, and Basic Metallurgy:

- Welding drawings symbols, introduction, types of projection, welding joints, symbols for welds, parts of the welding symbols, placement of welding symbols, special welds, weld all around, field weld symbols, and multiple reference lines.
- Basic metallurgy crystalline structure of metals, crystal growth and overall bulk solidification of metals, solid solution, intermetallic compounds, diffusion, the microstructure of carbon steel, heat treatment of steel, critical cooling rate and mass effect, heat-affected zone HAZ in Welding, HAZ of carbon and alloy steels, HAZ of stainless steel.
- Materials for welded sections, weldability of steel groups, stainless steels, cast irons, aluminum alloys, filler alloys, avoiding weld imperfections.

### Unit 5: Materials Testing and Non-Destructive Testing NDT:

- Materials testing and failure, tensile testing, properties obtained from the tensile test, ductility and fracture in metals, impact testing Izod and Charpy, transition temperature, hardness tests Vickers and Rockwell, failure due to fracture, stress concentration, fracture toughness, fatigue failure, improving fatigue resistance, creep failure, destructive testing of welds, bend tests, bead-on-plate test, controlled thermal severity C.T.S. test, the test, and assessment hierarchy.
- Nondestructive testing NDT, definition and purpose of non-destructive testing, engineering demands for sounder materials, ensuring the integrity and reliability, maintaining the uniform quality level of a product, dye penetrant, magnetic methods, X-ray methods, gray methods, ultrasonic methods, eddy current testing, selection of N. D. T. methods, ISO standards for NDT Inspection.