



FE184: Metallurgy for Non- Metallurgists

Training Description:

This intensive training course provides non-metallurgical professionals with a comprehensive understanding of metallurgy and its application in engineering, manufacturing, maintenance, inspection, procurement, quality assurance and asset integrity. The training course explains metallurgical principles using practical examples rather than complex scientific theory, enabling participants to understand how metals are produced, processed, selected, tested and why they fail in service.

The training course focuses on the relationship between material properties, manufacturing processes, heat treatment, corrosion, welding, inspection and failure mechanisms. Participants will develop the knowledge required to make informed engineering decisions involving metallic materials throughout their service life.

Training Objectives:

By the end of the training, participants will be able to:

- ✓ Understand the fundamentals of metallurgy and materials science
- ✓ Explain the relationship between atomic structure and material properties
- ✓ Identify major classes of engineering metals and alloys
- ✓ Understand metal production and manufacturing processes
- ✓ Interpret common mechanical properties and material specifications
- ✓ Recognize various heat treatment processes and their effects
- ✓ Understand corrosion mechanisms and corrosion prevention
- ✓ Appreciate welding metallurgy and weld defects
- ✓ Interpret common metallurgical testing methods
- ✓ Recognize common failure mechanisms in engineering components
- ✓ Communicate effectively with metallurgists, inspectors and materials engineers
- ✓ Make better material selection decisions for engineering applications

Training Designed for:

This training course is intended for Mechanical Engineers, Maintenance Engineers, Reliability Engineers, Asset Integrity Engineers, Project Engineers, Plant Engineers, Production Engineers, Inspection Engineers, Quality Assurance & Quality Control Personnel, NDT Inspectors, Procurement Engineers, Purchasing Professionals, Operations Supervisors, Maintenance Supervisors, Technical Managers, Plant Managers, Oil & Gas Professionals, Petrochemical Engineers, Power Plant Personnel, Manufacturing Professionals and Anyone involved in selecting, purchasing, inspecting, maintaining, or operating metallic equipment.

Training Requirement:

“Hand’s on practical sessions, equipment and software will be applied during the course if required and as per the client’s request.”

Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client’s learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Program:

DAY ONE:

FUNDAMENTALS OF METALLURGY AND ENGINEERING MATERIALS

❖ Introduction to Metallurgy

- What is metallurgy?
- Importance of metallurgy in engineering
- Types of metallurgy
 - Physical metallurgy
 - Mechanical metallurgy
 - Extractive metallurgy

❖ Atomic Structure

- Structure of atoms
- Metallic bonding
- Crystal structures
- Grain structure
- Grain boundaries

❖ Engineering Materials

- Ferrous metals
- Non-ferrous metals
- Alloys
- Composites
- Polymers
- Ceramics

❖ Engineering Properties

- Strength
- Hardness
- Toughness
- Ductility
- Brittleness
- Elasticity
- Plasticity
- Fatigue resistance
- Wear resistance

❖ Exercises:

- Identifying engineering materials
- Understanding material properties through practical demonstrations

DAY TWO:

METAL PRODUCTION, MANUFACTURING PROCESSES AND HEAT TREATMENT

❖ Iron and Steel Production

- Iron ore
- Blast furnace process
- Steelmaking
- Secondary refining

❖ Manufacturing Processes

- Casting
- Forging
- Rolling
- Extrusion
- Drawing
- Machining
- Powder metallurgy
- Additive manufacturing overview

❖ Steel Classification

- Carbon steels
- Low alloy steels
- Stainless steels
- Tool steels

❖ Non-Ferrous Alloys

- Aluminium
- Copper
- Nickel
- Titanium
- Magnesium
- Zinc alloys

❖ Heat Treatment

- Annealing
- Normalizing
- Hardening
- Tempering
- Stress relieving
- Solution treatment
- Age hardening

❖ Effects of Heat Treatment

- Hardness
- Strength
- Toughness
- Residual stresses
- Distortion

❖ Exercise:

- Selecting heat treatment for different applications

DAY THREE:

MATERIAL SELECTION, CORROSION AND WELDING METALLURGY

❖ Material Selection

- Selection criteria
- Service conditions
- Mechanical requirements
- Corrosion considerations
- Cost considerations

- Life-cycle cost
- ❖ **Material Specifications**
 - ASTM
 - ASME
 - ISO
 - EN
 - API
- ❖ **Reading Material Certificates**
 - Mill Test Certificates (MTC)
 - Chemical composition
 - Mechanical properties
- ❖ **Corrosion Fundamentals**
 - Electrochemical corrosion
 - Uniform corrosion
 - Galvanic corrosion
 - Crevice corrosion
 - Pitting corrosion
 - Stress corrosion cracking
 - Erosion-corrosion
 - High-temperature oxidation
- ❖ **Corrosion Prevention**
 - Material selection
 - Coatings
 - Cathodic protection
 - Corrosion inhibitors
 - Design improvements
- ❖ **Welding Metallurgy**
 - Welding processes overview
 - Heat affected zone (HAZ)
 - Weld microstructure
 - Residual stresses
 - Weld defects
 - Weld repairs
- ❖ **Exercise:**
 - Material selection case studies
 - Corrosion identification exercise

DAY FOUR:

METALLURGICAL TESTING, INSPECTION AND QUALITY CONTROL

- ❖ **Mechanical Testing**
 - Tensile testing
 - Hardness testing
 - Impact testing
 - Bend testing
 - Fatigue testing
 - Creep testing

- ❖ **Metallographic Examination**
 - Sample preparation
 - Microscopic examination
 - Grain size evaluation
 - Microstructure interpretation
- ❖ **Chemical Analysis**
 - Optical emission spectroscopy
 - XRF
 - PMI (Positive Material Identification)
- ❖ **Non-Destructive Testing**
 - Visual Inspection (VT)
 - Magnetic Particle Testing (MT)
 - Dye Penetrant Testing (PT)
 - Ultrasonic Testing (UT)
 - Radiographic Testing (RT)
 - Eddy Current Testing (ET)
- ❖ **Quality Assurance**
 - Material traceability
 - Inspection documentation
 - Acceptance criteria
 - Standards compliance
- ❖ **Exercise:**
 - Reviewing metallurgical test reports
 - Interpreting inspection results

DAY FIVE:

FAILURE ANALYSIS AND PRACTICAL APPLICATIONS

- ❖ **Introduction to Failure Analysis**
 - Why components fail
 - Failure investigation methodology
 - Root cause analysis
- ❖ **Common Failure Mechanisms**
 - Overload failure
 - Fatigue failure
 - Brittle fracture
 - Ductile fracture
 - Creep
 - Wear
 - Corrosion failure
 - Hydrogen embrittlement
 - Stress corrosion cracking
- ❖ **Fracture Features**
 - Beach marks
 - Chevron patterns
 - Dimple rupture
 - Cleavage fracture

❖ Engineering Case Studies

- Pressure vessels
- Pipelines
- Pumps
- Valves
- Rotating equipment
- Heat exchangers
- Boilers
- Storage tanks
- Structural steel failures

❖ Preventing Failures

- Proper material selection
- Good design practices
- Heat treatment control
- Inspection planning
- Preventive maintenance
- Corrosion management
- Quality control

❖ Final Exercise:

- Failure investigation case study

❖ Course Conclusion

❖ POST-ASSESSMENT and EVALUATION

Participants will engage in:

- Material identification exercises
- Metallography image interpretation
- Heat treatment selection scenarios
- Material selection workshops
- Corrosion identification exercises
- Weld defect recognition
- Review of Mill Test Certificates (MTCs)
- Mechanical test result interpretation
- Failure analysis case studies
- Problem-solving exercises

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Gamification, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

CMCT Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

USD\$ TBA - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:00	Recess (Prayer Break & Lunch)
13:00 - 14:00	Last Session

For training registrations or in-house enquiries, please contact:

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