COURSE OVERVIEW FE0104
Material Selection & Failure Analysis

Course Title
Material Selection & Failure Analysis

Course Date/Venue
Session 1: May 04-08, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
Session 2: September 21-25, 2025/ Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Course Reference
FE0104

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes real-life case studies and exercises where participants will be engaged in a series of interactive small groups and class workshops.

This course is designed to provide participants with a detailed and up-to-date overview of Material Selection & Failure Analysis. It covers the importance of material selection in engineering design as well as the key factors influencing material choice; material properties, material selection process, categories of engineering materials and material standards and specifications; the environmental and economic considerations and material selection for structural applications, electrical applications and thermal applications; the corrosion and chemical resistance in material selection; and the material selection for high-temperature applications, lightweight materials for design efficiency and specialty materials for unique applications.

During this interactive course, participants will learn the purpose of failure analysis, types of material failure and steps involved in failure analysis; the common failure modes and mechanisms as well as the fracture mechanics and crack propagation; the fatigue failures and detriment wear and erosion mechanisms and corrosion-induced failures; visual inspection and macroscopic analysis, microscopy techniques in failure analysis and non-destructive testing (NDT) methods; the mechanical testing for failure analysis, chemical analysis techniques and data analysis and interpretation; and root cause analysis and failure prevention, documentation and reporting failure analysis and trends and innovations in material selection and failure analysis.

Course Objectives

Upon the successful completion of the course, each participant will be able to:-

- Apply and gain an in-depth knowledge on material selection and failure analysis
- Discuss the importance of material selection in engineering design as well as the key factors influencing material choice
- Recognize material properties, material selection process, categories of engineering materials and material standards and specifications
- Discuss environmental and economic considerations and apply material selection for structural applications, electrical applications and thermal applications
- Identify the corrosion and chemical resistance in material selection
- Carryout material selection for high-temperature applications, lightweight materials for design efficiency and specialty materials for unique applications
- Discuss the purpose of failure analysis, types of material failure and steps involved in failure analysis
- Identify the common failure modes and mechanisms as well as the fracture mechanics and crack propagation
- Analyze fatigue failures and detriment wear and erosion mechanisms and corrosion-induced failures
- Apply visual inspection and macroscopic analysis, microscopy techniques in failure analysis and non-destructive testing (NDT) methods
- Employ mechanical testing for failure analysis, chemical analysis techniques and data analysis and interpretation
- Carryout root cause analysis and failure prevention, documentation and reporting failure analysis and trends and innovations in material selection and failure analysis

Who Should Attend

This course provides an overview of all significant aspects and considerations of material selection and failure analysis for facility integrity engineers, inspection engineers, metallurgy and corrosion engineers, materials engineers, design engineers, mechanical engineers, chemical engineers, corrosion field personnel, supervisors and other technical staff.

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. George Poulos, MBA, MSc, BSc, CEng, is a **Senior Corrosion & Metallurgical Engineer** with over **45 years** of extensive experience within the **Oil & Gas, Petrochemical, Refinery, Construction, Aircraft & Shipbuilding** Industry. His wide experiences cover in the areas of **Pressure Vessels**, **Piping Inspection**, **Risk-Based Inspection**, **Fitness-for-Service** (**FFS**), **Metallurgical** Failure, **Metallurgy & Metallurgical Processes, Metallurgical** Lab, Corrosion and **Metallurgy**, Analysis & Prevention, **Corrosion** Fabrication & Inspection, **Fabrication** & **Repair**, **Corrosion** Prevention, **Corrosion** Engineering, **Corrosion Control**, **Corrosion Inhibition**, **Corrosion** Management in Process Operations, **Corrosion** & Prevention of Failures, **Material** Selection, **Cathodic Protection** Systems, **Steel Metallurgy**, **Steel** Structure Welding, **Steelmaking** Slag, **Steel** Making Application, **Steel Making** Process, **Steel** Manufacturing, **Steel Forging**, **Steel** Manufacturing & Process Troubleshooting, **Hot Rolling** Process, **Hot Strip Mill**, **Mill** Operations, **Roll Mill**, **Electric Arc Furnace** (**EAF**), **Slit Rolling**, **Carbon Steel Pipe** Wall Thickness & Grade Selection, **Ferro-Alloys**, **Heat Treatment** & **Prevention Techniques** and **Post Weld Heat Treatment**. Further, he is also well-versed in **Welding** Inspection, **Welding** & **Machine** Techniques, **TIG** & **Arc Welding**, **Shielded Metal Arc Welding**, **Gas Tungsten** & **Gas Metal Arc Welding**, **Welding** Procedure Specifications & Qualifications, **Aluminium Welding**, **Hot Work-Safety**, **SMAW**, **GTAW**, **Welding** Techniques, **Pipeline Welding** Practices, **Welding** Engineering, **Welding** Fatigue & Fracture Mechanics, **Welding Inspection Technology**, **Welding Safety**, **Welding** Defects Analysis, **Welding Technology**, **Welding Problems**, **Welding & Non Destructive** Testing and **Metallurgy Techniques**.

During his career life, Mr. Poulos has gained his practical and field experience through his various significant positions and dedication as the **Chief Executive**, **Head of Technical Studies**, **Manager**, **Senior Consultant**, **Lead Welding Engineer**, **Senior Welding Engineer**, **Design Engineer**, **Sales Engineer**, **Author**, **Welding Instructor**, **Visiting Lecturer** and **Technical Proposal Research Evaluator** from various international companies such as Greek Welding Institute, Hellenic Quality Forum and International Construction Companies such as Shipbuilding, Aircraft Industry and Oil and Gas Industry.

Mr. Poulos is a **Registered Chartered Engineer** and has a **Master's** degree in **Naval Architecture**, a **Bachelor's** degree in **Welding Engineering** and a Master of Business Administration (**MBA**) from the **Sunderland University**, **Aston University** and **Open University**, **UK**, respectively. Further, he is a **Certified Trainer/Instructor**, an active Member of Chartered Quality Institute (**CQI**), The British Welding Institute (**TWI**), The Royal Institution of Naval Architects (**RINA**) and American Welding Society (**AWS**), a Registered **EWF/IW** (European Welding Federation-International Welding Institute W/E) and an **IRCA** Accredited External Quality Systems Auditor through BVQI. He is an **Author** of Technical Book dealing with Protection/Health/Safety in the Welding/Cutting domain and delivered various trainings, seminars, conferences, workshops and courses globally.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Fee

US$ 5,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the workshop for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction to Material Selection*** *Importance of Material Selection in Engineering Design • Key Factors Influencing Material Choice • Overview of Material Properties & Performance • Case Studies Illustrating the Impact of Material Selection*
0930 – 0945	*Break*
0945 – 1030	***Material Properties & their Relevance*** *Mechanical Properties (Strength, Hardness, Ductility) • Physical Properties (Density, Thermal Conductivity) • Chemical Properties (Corrosion Resistance, Reactivity) • Environmental Considerations (Toxicity, Recyclability)*
1030 – 1130	***Material Selection Process*** *Stages in the Material Selection Process • Evaluating Design Requirements • Screening & Ranking Materials • Cost-Benefit Analysis in Material Choice*
1130 – 1215	***Categories of Engineering Materials*** *Metals & Alloys (Steel, Aluminum, Titanium) • Polymers & Composites (Plastics, Carbon Fiber) • Ceramics & Glasses (Structural Ceramics, Glass) • Advanced Materials (Smart Materials, Nanomaterials)*
1215 – 1230	*Break*

1230 – 1330	***Material Standards & Specifications*** *Importance of Adhering to Standards (ASTM, ISO) • Role of Specifications in Material Performance • Reviewing Material Datasheets & Specifications • Compliance with Industry Standards*
1330 – 1420	***Environmental & Economic Considerations*** *Sustainability in Material Selection • Lifecycle Cost Analysis of Materials • Environmental Impact & Recyclability • Energy Efficiency & Material Sourcing*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0830	***Material Selection for Structural Applications*** *Load-Bearing Capacity & Mechanical Properties • Fatigue & Fracture Resistance • Temperature Tolerance & Thermal Stability • Corrosion & Wear Resistance*
0830 – 0930	***Material Selection for Electrical & Thermal Applications*** *Conductivity (Electrical & Thermal) • Insulating Properties & Dielectric Strength • Effects of Temperature on Conductivity • Expansion & Stability*
0930 – 0945	*Break*
0945 – 1100	***Corrosion & Chemical Resistance in Material Selection*** *Types of Corrosion (Uniform, Galvanic, Pitting) • Selecting Materials for Chemical Environments • Coating & Surface Treatments for Corrosion Protection • Case Studies on Corrosion Failure*
1100 – 1215	***Material Selection for High-Temperature Applications*** *High-Temperature Materials (Superalloys, Ceramics) • Oxidation & Thermal Degradation Resistance • Impact of Thermal Cycling on Materials • Applications in Aerospace & Power Generation*
1215 – 1230	*Break*
1230 – 1330	***Lightweight Materials for Design Efficiency*** *Importance of Weight Reduction in Design • Properties of Lightweight Materials (Aluminum, Composites) • Structural Integrity & Lightweight Materials • Application Examples in Automotive & Aerospace*
1330 – 1420	***Specialty Materials for Unique Applications*** *Biomaterials in Medical Applications • Transparent Materials in Optical Devices • Smart Materials & Their Applications • Materials for Cryogenic Applications*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3

0730 – 0830	***Basics of Failure Analysis*** *Definition & Purpose of Failure Analysis • Types of Material Failure (Fracture, Fatigue, Wear) • Importance of Understanding Failure Mechanisms • Steps Involved in Failure Analysis*
0830 – 0930	***Common Failure Modes & Mechanisms*** *Ductile & Brittle Fracture Mechanisms • Fatigue & Cyclic Loading Effects • Creep & Stress Rupture in High Temperatures • Corrosion-Related Failures*
0930 – 0945	*Break*
0945 – 1100	***Fracture Mechanics & Crack Propagation*** *Basics of Fracture Mechanics • Stress Intensity Factors & Crack Growth • Modes of Crack Propagation (Mode I, II, III) • Impact of Material Toughness on Fracture Behavior*
1100 – 1215	***Analyzing Fatigue Failures*** *Fatigue Life & Endurance Limit • Identifying Signs of Fatigue Failure • Factors Influencing Fatigue (Loading, Environment) • Case Studies on Fatigue Failures*
1215 – 1230	*Break*
1230 – 1330	***Wear & Erosion Mechanisms*** *Types of Wear (Abrasive, Adhesive, Erosive) • Material Properties Affecting Wear Resistance • Environmental Effects on Wear Behavior • Methods for Preventing Wear & Erosion*
1330 – 1420	***Corrosion-Induced Failures*** *Forms of Corrosion & their Effects on Materials • Analyzing Failure Due to Corrosion • Preventive Measures for Corrosion Control • Case Studies on Corrosion-Induced Failures*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4

0730 – 0830	***Visual Inspection & Macroscopic Analysis*** *Initial Assessment through Visual Inspection • Identifying Surface Defects & Fractures • Using Magnification for Detailed Inspection • Documentation of Findings with Photos & Notes*
0830 – 0930	***Microscopy Techniques in Failure Analysis*** *Optical Microscopy & Its Applications • Scanning Electron Microscopy (SEM) for Surface Analysis • Transmission Electron Microscopy (TEM) for Microstructure • Metallography & Microstructural Evaluation*
0930 – 0945	*Break*
0945 – 1100	***Non-Destructive Testing (NDT) Methods*** *Types of NDT Techniques (Ultrasonic, Radiography, Magnetic) • Benefits of Using NDT in Failure Analysis • Applications of NDT in Detecting Subsurface Defects • Selecting Appropriate NDT Techniques for Analysis*
1100 – 1215	***Mechanical Testing for Failure Analysis*** *Tensile & Hardness Testing • Fracture Toughness & Impact Testing • Fatigue Testing & Life Estimation • Creep Testing for High-Temperature Materials*
1215 – 1230	*Break*

1230 – 1330	***Chemical Analysis Techniques*** *Spectroscopy Methods (EDS, XRF, XPS) • Analyzing Material Composition • Identifying Contaminants & Impurities • Understanding Chemical Compatibility*
1330 – 1420	***Data Analysis & Interpretation*** *Analyzing Data from Tests & Inspections • Correlating Findings with Failure Modes • Identifying Root Causes of Failure • Documenting & Presenting Analysis Results*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

Day 5

0730 – 0830	***Case Study: Fatigue Failure in Mechanical Components*** *Overview of the Component & Failure Context • Analysis of Fatigue Failure Signs • Testing Methods Used to Verify Fatigue • Recommendations to Prevent Future Failures*
0830 – 0930	***Case Study: Corrosion Failure in Industrial Equipment*** *Background on the Corrosive Environment • Analysis of Corrosion Mechanisms Involved • Materials Selected & their Limitations • Implementing Better Corrosion Protection Strategies*
0930 – 0945	*Break*
0945 – 1100	***Case Study: Material Failure in High-Temperature Applications*** *Understanding the Application's Thermal Demands • Identifying Failure Due to Thermal Degradation • Material Analysis & Root Cause Identification • Improving Material Choice for High-Temperature Durability*
1100 – 1215	***Root Cause Analysis & Failure Prevention*** *Steps in Root Cause Analysis (RCA) • Tools for RCA (5 Whys, Fishbone Diagram) • Implementing Corrective & Preventive Actions • Continuous Improvement through Failure Analysis*
1215 – 1230	*Break*
1230 – 1300	***Documentation & Reporting in Failure Analysis*** *Structuring a Failure Analysis Report • Key Sections: Introduction, Methodology, Findings, Recommendations • Importance of Clear & Concise Documentation • Presenting Findings to Stakeholders*
1300 – 1345	***Trends & Innovations in Material Selection & Failure Analysis*** *Advancements in Material Science (Composites, Nanomaterials) • Predictive Maintenance Using Failure Analysis Data • Role of AI & Machine Learning in Material Selection • Future Directions in Failure Prevention & Material Engineering*
1345 – 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions

This practical and highly-interactive course includes real-life case studies and exercises:-

Course Coordinator

Mari Nakintu, Tel: +971 2 30 91 714, Email: mari1@haward.org