Metallurgical Failure Investigation Training Course

Professional Development Training Course Outline

Category	General Training	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Metallurgical Failure Investigation is a critical discipline in modern engineering, focused on identifying the root causes of material degradation, structural breakdowns, and component failures in industrial systems. Metallurgical Failure Investigation Training Course is designed to equip engineers, metallurgists, and quality professionals with cutting-edge expertise in failure analysis, fracture mechanics, materials characterization, corrosion engineering, and root cause analysis (RCA). With increasing global demand for reliability engineering, predictive maintenance, and asset integrity management, organizations are prioritizing professionals skilled in diagnosing failures in metals, alloys, welds, and high-performance components.

This course integrates real-world failure case studies, advanced metallography, scanning electron microscopy (SEM) interpretation, non-destructive testing (NDT), and industry-standard investigation protocols. Participants will develop strong analytical capabilities to investigate failures in sectors such as oil & gas, aerospace, automotive, power generation, marine engineering, and manufacturing industries. The program emphasizes data-driven decision-making, forensic metallurgy, and compliance with international standards such as ASTM, ISO, and ASME, ensuring participants are industry-ready for high-impact roles in failure investigation and reliability engineering.

Programme Curriculum

Metallurgical Failure Investigation Training Course

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Course Duration

5 days

Course Objectives

1. Master failure analysis techniques for industrial components and systems
2. Understand fracture mechanics and crack propagation behavior
3. Apply root cause analysis (RCA) methodologies in real-world scenarios
4. Develop expertise in corrosion mechanisms and prevention strategies
5. Interpret metallographic microstructures using optical microscopy
6. Analyze failures using scanning electron microscopy (SEM) & EDS
7. Evaluate weld failure and joint integrity issues
8. Perform non-destructive testing (NDT) for failure detection
9. Assess material selection and performance degradation factors
10. Investigate fatigue failure and stress-induced damage
11. Apply ISO, ASTM, and ASME standards in failure investigations
12. Strengthen skills in engineering forensic reporting and documentation
13. Enhance decision-making in predictive maintenance and asset reliability

Target Audience

1. Mechanical Engineers
2. Metallurgical & Materials Engineers
3. Quality Assurance / Quality Control (QA/QC) Engineers
4. Maintenance & Reliability Engineers
5. Inspection Engineers (NDT Specialists)
6. Oil & Gas Industry Professionals
7. Aerospace & Automotive Engineers
8. Plant & Production Managers

Course Modules

Module 1: Fundamentals of Metallurgical Failure Analysis

- Types of failures: brittle, ductile, fatigue, creep
- Introduction to metallurgical investigation workflow
- Failure identification techniques in engineering systems
- Material behavior under stress and environmental conditions

- **Case Study:** Turbine blade catastrophic brittle failure in power plant

Module 2: Fracture Mechanics & Crack Propagation

- Stress intensity factor and fracture toughness concepts
- Crack initiation and propagation mechanisms
- Mode I, II, and III fracture behavior
- Role of microstructural defects in failure
- **Case Study:** Aircraft fuselage crack propagation failure

Module 3: Corrosion Engineering & Environmental Degradation

- Types of corrosion: pitting, galvanic, crevice, SCC
- Electrochemical corrosion mechanisms
- Environmental effects on material degradation
- Corrosion prevention and coating systems
- **Case Study:** Offshore pipeline pitting corrosion failure

Module 4: Fatigue & Cyclic Loading Failures

- High-cycle vs low-cycle fatigue behavior
- S-N curves and endurance limits
- Surface defects and fatigue initiation points
- Fatigue life prediction methods
- **Case Study:** Automotive axle fatigue fracture failure

Module 5: Weld Failure Analysis & Joint Integrity

- Welding defects and discontinuities
- Heat affected zone (HAZ) degradation
- Residual stresses and distortion effects
- Weld inspection and qualification standards
- **Case Study:** Pressure vessel weld rupture incident

Module 6: Metallography & Microstructural Analysis

- Sample preparation techniques
- Optical microscopy and grain structure analysis
- Phase identification and transformations
- Inclusion and impurity detection
- **Case Study:** Gear failure due to abnormal grain growth

Module 7: Advanced NDT & SEM/EDS Analysis

- Ultrasonic, radiographic, and magnetic particle testing
- SEM imaging for fracture surface analysis
- Energy Dispersive Spectroscopy (EDS) for elemental composition
- Defect characterization techniques
- **Case Study:** Bridge structural failure detected via ultrasonic testing

Module 8: Root Cause Analysis & Failure Reporting

- RCA methodologies: 5 Why, Fishbone, FMEA

- Evidence collection and failure documentation
- Engineering forensic reporting standards
- Risk mitigation and corrective actions
- **Case Study:** Industrial compressor shaft failure investigation report

Training Methodology

This course employs a participatory and hands-on approach to ensure practical learning, including:

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price

23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

Ready to enroll or request a customized program? Book online or contact us:

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Email: info@fineskilltrainingcenter.com | Website: www.fineskilltrainingcenter.com