

FAILURE ANALYSIS & MACHINERY DIAGNOSIS

“Detecting, Diagnosing, and Preventing Equipment Failures to Maximize Machinery Uptime”

Schedule

Date	Venue	Fees (Face-to-Face)
08 - 12 Feb 2026	Manama, Bahrain	USD 3495 per delegate

Introduction

Machinery failures not only disrupt operations but also pose safety risks, increase maintenance costs, and reduce equipment life. Understanding the root causes of failures and developing the skills to detect early signs of distress is critical for reliability, safety, and performance improvement in any industrial setting.

This hands-on five-day training course provides participants with practical tools and techniques for analyzing machinery failures and diagnosing performance issues. Covering topics such as wear mechanisms, vibration analysis, lubrication failures, and root cause analysis (RCA), the course empowers professionals to make informed decisions that enhance machinery uptime and reliability.

Objectives

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

- Identify common mechanical failure modes and their underlying causes
- Apply diagnostic tools including vibration, thermography, and oil analysis
- Conduct systematic failure investigations using RCA methodologies
- Interpret failure evidence such as fracture surfaces, wear patterns, and heat damage
- Recommend corrective actions to prevent recurrence and improve equipment design

Why Attend

- Improve maintenance decisions through accurate failure diagnosis
- Learn to interpret failure indicators and apply condition monitoring data
- Reduce unplanned downtime and increase machinery availability
- Enhance collaboration between maintenance, reliability, and engineering teams
- Strengthen safety and compliance by preventing repeat failures

Target Audience

This program is designed for:

- Maintenance and reliability engineers
- Mechanical, rotating equipment, and plant engineers
- Condition monitoring and asset integrity specialists
- Technical inspectors, supervisors, and operations personnel
- Anyone involved in machinery troubleshooting, inspection, or failure prevention

Individual Benefits

Key competencies that will be developed include:

- Mechanical failure analysis techniques
- Use of diagnostic tools and data interpretation
- Practical root cause investigation and documentation
- Proactive problem-solving and maintenance planning
- Machinery health evaluation and performance improvement

Organizational Benefits

Upon completing the training course, participants will demonstrate:

- Reduced equipment downtime and maintenance costs
- Improved safety and regulatory compliance through failure prevention
- Better decision-making through data-driven diagnostics
- Increased reliability of critical rotating and static assets
- Stronger technical reporting and knowledge transfer practices

Instructional Methodology

The course follows a blended learning approach combining theory with practice:

- Strategy Briefings - Core principles of failure mechanisms, materials, and diagnostics
- Case Studies - Real-life failure incidents and investigations from various industries
- Workshops - Hands-on exercises in diagnosing faults using inspection data and RCA tools
- Peer Exchange - Interactive sessions on shared challenges and field solutions
- Tools - Templates for failure reports, fault trees, inspection checklists, and RCA diagrams

MAWA EVENTS

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Course Outline

Detailed 5-Day Course Outline

Training Hours: 07:30 AM – 3:30 PM **Daily Format:** 3-4 Learning Modules | Coffee breaks: 09:30 & 11:15 | Lunch Buffet: 01:00 – 02:00

Day 1: Introduction to Failure Mechanisms and Diagnostics

- Module 1: Understanding Mechanical Failures (07:30 – 09:30) • Types of failures: wear, fatigue, corrosion, creep, overload • Symptom vs. root cause: common pitfalls in diagnostics • Failure prevention mindset and reliability thinking
- Module 2: Introduction to Failure Analysis Techniques (09:45 – 11:15) • Visual inspection, NDT, and lab testing basics • Failure surface interpretation: cracks, scoring, discoloration • Failure reporting and documentation practices
- Module 3: Basics of Root Cause Analysis (11:30 – 01:00) • RCA methodologies: 5 Whys, Fishbone, Fault Tree • Defining failure modes, effects, and consequences • RCA templates and investigation workflows
- Module 4: Case Study – Misdiagnosed Failure (02:00 – 03:30) • Group review of an incorrect diagnosis and lessons learned

Day 2: Rotating Equipment – Common Failures and Monitoring

- Module 1: Bearings and Shaft Failures (07:30 – 09:30) • Wear, misalignment, fatigue, and lubrication issues • Detecting brinelling, pitting, spalling, and scoring • Handling and installation practices
- Module 2: Couplings, Gears, and Belts (09:45 – 11:15) • Tooth wear and overload • Belt slippage and tension problems • Dynamic load effects and resonance
- Module 3: Vibration Analysis Fundamentals (11:30 – 01:00) • Interpreting vibration data for early fault detection • Common signatures: imbalance, looseness, misalignment • Spectrum analysis and trending
- Module 4: Workshop – Bearing Fault Diagnosis (02:00 – 03:30) • Group exercise reviewing case vibration data

Day 3: Lubrication, Thermal, and Structural Failures

- Module 1: Lubrication-Related Failures (07:30 – 09:30) • Oil degradation, contamination, and additive breakdown • Greasing practices and over-lubrication risks • Reading oil analysis reports
- Module 2: Overheating and Thermal Distress (09:45 – 11:15) • Causes and effects of overheating in rotating and static equipment • Heat discoloration and thermal expansion symptoms • Use of infrared thermography
- Module 3: Pressure Vessel and Piping Failures (11:30 – 01:00) • Cracking, corrosion, and embrittlement • Weld and flange failure diagnostics • API 579 and inspection codes overview
- Module 4: Workshop – Thermography Case Review (02:00 – 03:30) • Sample thermal imagery and diagnostics discussion

Day 4: Root Cause Analysis and Preventive Strategies

- Module 1: Advanced RCA Techniques (07:30 – 09:30) • Evidence collection, team facilitation, and hypothesis testing • Time-event charts and logic trees • Human factors and system influences
- Module 2: Preventing Repeat Failures (09:45 – 11:15) • Developing actionable recommendations • Corrective and preventive action (CAPA) plans • Maintenance strategy review and FMEA linkage
- Module 3: Inspection and Condition Monitoring Integration (11:30 – 01:00) • Aligning failure analysis with CM programs • Role of PdM: vibration, oil, ultrasound, and thermography • Balancing preventive vs. predictive maintenance
- Module 4: Workshop – RCA Simulation (02:00 – 03:30) • Group-led root cause investigation with sample failure

Day 5: Integration, Reporting, and Final Review

- Module 1: Failure Reporting and Communication (07:30 – 09:30) • Structure of a professional failure analysis report • Visual aids, root cause mapping, and executive summaries • Lessons learned capture and communication
- Module 2: Reliability Program Alignment (09:45 – 11:15) • How failure analysis supports RCM and asset integrity • Organizational learning and RCA tracking systems • Key performance indicators for machinery health
- Module 3: Final Review and Key Takeaways (11:30 – 01:00) • Summary of learning points and techniques • Personal action plan for implementation
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Module 4: Certification and Wrap-Up (02:00 – 03:30) • Final knowledge check • Course evaluation and certificate distribution

Certification

Participants will receive a Certificate of Completion in Failure Analysis & Machinery Diagnosis, validating their technical proficiency in diagnosing equipment failures, performing structured investigations, and implementing preventive solutions to maximize machinery reliability.

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