



ME146

Fault Diagnosis and Failure Prevention

Course Introduction:

This course presents a systematic approach to fault diagnosis and failure prevention in machinery used in process, manufacturing, power generation and mining industries. Preventive maintenance is taught through theory and examples in metallurgical failure analysis, vibration analysis, machinery troubleshooting, and problem solving.

Since equipment failure cases will be reviewed, participants are encouraged to bring to the course relevant assembly drawings or such components as failed bearings, gears, mechanical seals, and similar machine elements for failure analysis discussion.

Successful failure analysis and troubleshooting requires the determination of goals, use of checklists, and setting up a failure analysis team. The case studies show that a systematic program can lead to significant failure reductions in machinery. Through examples, vendor selection protocol and reliability review is demonstrated.

A matrix approach to machinery troubleshooting uses illustrative examples in pumps, centrifugal compressors, blowers and fans, reciprocating compressors, engines and gas turbines. Next, a systematic approach to machinery problem-solving is followed with situation analysis, cause analysis, action generation, decision-making, and planning change(s). Finally, a highly effective Root Cause Failure Analysis (RCFA) method is explained in detail.

Course Objectives:

Upon successful completion of this course, the delegates will be able to:

- Gain an understanding of structured, results-oriented root cause failure analysis methods for machine components and machinery systems
- Learn how parts fail, why they fail in a given mode and how to prevent failures
- Acquire a thorough understanding of making the best possible use of available failure statistics
- Recognize how these can be used in machinery/machinery systems specifying, purchasing, installing, commissioning, and operating machinery
- Gain a basic understanding of the main logic, procedures, and systems required
- Learn to critique the advantages, applications, performance, and economics of the system originally supplied by the original equipment manufacturer
- Learn about the influence of various potentially retrofitted auxiliary systems including instrumentation and controls
- Learn some basics about the role of operations personnel and training and how they can help maximize troubleshooting and failure prevention effectiveness

- Gain some insight into how troubleshooting and failure analysis link with predictive and preventive maintenance, reliability and testing, and what that does for audit planning
- Discover some of the latest technology
- Identify methods for self-improvement

Who Should Attend?

This course is for maintenance and machinery engineers, supervisors, and technicians involved in machinery operation and troubleshooting. Personnel from all process industries (refining, petrochemical, chemical, mining, pharmaceutical, fertilizer, food, and utilities) will benefit.

This course is for all engineers, technologists, and other operational personnel who currently or may in the future be involved with the technology or business of running a process plant, a refinery, a power plant, and/or an oil and gas facility. Personnel can be involved in large scale commercial production and/or maintenance, smaller operations with smaller machinery that may be less complex, operations, maintenance, repair and overhaul, systems optimization and performance verification, specification, retrofit design, business and management of machinery systems and personnel, Support of machinery trains and their support systems. While this course is of major benefit to newer people in the field, it is also valuable as a revision and technology update for more experienced personnel.

Course Outline:

Day 1:

- **The Failure Analysis and Troubleshooting System**
 - Causes of machinery failure
 - Contributing factors often overlooked
- **Metallurgical Failure Analysis Methodology**
 - Failure analysis of bolted joints
 - Shaft failures and their origins
 - Ductile vs. brittle failures of shafts
 - Stress raisers in shafts
- **Machinery Component Analysis and Reliability Improvement**
 - Redesign opportunities
 - Analyzing wear failures

- Bearings in distress
- **Machinery Component Analysis and Reliability Improvement (continued)**
 - Rolling element bearing (AFB) bearing failure analysis

Day 2:

- **Machinery Component Analysis and Reliability Improvement (continued)**
 - Journal and tilt-thrust bearings
 - Gear failure analysis
 - Coupling failure avoidance
- **Machinery Component Analysis and Reliability Improvement (continued)**
 - Determining the cause of mechanical seal distress
 - Mechanical seal selection strategies
 - O-ring failures and their causes
- **Continuous Reliability Improvement**
 - Optimized lubrication for pumps and electric motors
 - Economics of dry sump oil mist lubrication
 - Lubrication considerations for pump and electric motors
 - Major machinery lubrication management

Day 3:

- **Vendor Selection and Reliability Review Methods**
 - Centrifugal pump selection examples
 - Compressor reliability review examples
- **Machinery Troubleshooting**
 - The matrix approach to machinery troubleshooting
 - Pumps
 - Centrifugal compressors
- **Machinery Troubleshooting (continued)**
 - Blowers and fans
 - Reciprocating compressors
 - Engines
 - Gas turbines
 - Other machinery

Day 4:

- **Vibration Analysis – A Management Overview**
 - Specific machinery problems
 - Monitoring and analysis methods
 - Future outlook
- **Structured Problem-Solving Sequence**
 - Situation analysis
 - Cause analysis
 - Action generation
 - Decision making
 - Planning for change
 - Root Cause Failure Analysis (RCFA) principles
- **Formalized Failure Reporting as a Teaching Tool**
 - Actual cases cited and explained in detail
 - High speed pump failure
 - Bearing failures

Day 5:

- **Examination of Failed Components**
 - Bearings
 - Gears
 - Mechanical seals
 - Others
- **Process/Mechanical/Technical Interaction**
 - How PMT teams work
 - Turnaround management
 - Preventive vs. predictive maintenance concepts
 - Integrated vs. separate maintenance
- **Process/Mechanical/Technical Interaction (continued)**
 - Turnaround management
 - Centrifugal pump failure reduction programs

Course Certificate:

International Center for Training & Development (ICTD) will award an internationally recognized certificate(s) for each delegate on completion of training.

Course Methodology:

A variety of methodologies will be used during the course that includes:

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play
- (10%) Concepts
- Pre-test and Post-test
- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionnaires
- Group Work
- Discussion
- Presentation

Course Fees:

To be advised as per course locations. This rate includes participant's manual, Hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Timings:

Daily Course Timings:

08:00 - 08:20	Morning Coffee / Tea
08:20 - 10:00	First Session
10:00 - 10:20	Coffee / Tea / Snacks
10:20 - 12:20	Second Session
12:20 - 13:30	Lunch Break & Prayer Break
13:30 - 15:00	Last Session