



ME185: Machinery Failure Analysis, Prevention, Diagnostics Testing, Root Cause Failure Analysis (RCFA) & Troubleshooting



Training Description:

This five-day course presents a systematic approach to fault diagnosis and failure prevention in a broad range of machinery used in the Oil/Gas, Petrochemical and other process industries. The key approaches to preventive maintenance are demonstrated through both overview and the study of examples in metallurgical failure analysis, vibration analysis and a sequential approach to machinery troubleshooting and problem solving.

Equipment failure events will be reviewed and 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 and discussion.

This intensive training course explores a systematic approach to successful failure analysis and troubleshooting, including the determination of goals, use of checklists and setting up a failure analysis team. By reference to specific case studies, especially dealing with centrifugal pumps, it will be shown that such a systematic program can lead to significant failure reductions in many types of machinery. Through examples dealing with pumps and compressors, guidance is given on vendor selection and methods for reliability review.

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 generalized machinery problem-solving is described in terms of situation analysis, cause analysis, action generation, decision making and planning for change. Finally, a highly effective root cause failure analysis (RCFA) method is explained in detail.

Training Objectives:

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

- ✓ Execute system approach of machinery failure analysis, diagnostics testing and troubleshooting and identify the root causes of machinery failure and their contributing factors which are often overlooked
- ✓ Gain an in-depth knowledge on metallurgical failure analysis methodology as illustrated by failure analysis of bolted joints and shafts
- ✓ Perform machinery component analysis and reliability improvement by recognizing redesigned opportunities, bearings in distress, coupling failure avoidance opportunities and mechanical seal problems
- ✓ Develop an understanding of continuous reliability improvement and the various approaches to optimized lubrication for pumps and electric motors
- ✓ Apply and gain an understanding on vendor selection and reliability review methods through centrifugal pump selection and compressor reliability review examples and perform troubleshooting of pumps and centrifugal compressors
- ✓ Recognize the application of vibration analysis from a management perspective by studying specific machinery problems, as well as monitoring and analysis methods
- ✓ Identify and carryout a structured problem-solving sequence after careful perusal of problem-solving elements, cause analysis, action generation, decision making and planning for change
- ✓ Perform formalized failure reporting using actual cases such as highspeed pump and bearing failures





- ✓ Determine the process of examination of failed components such as bearings, gears, mechanical seals and others
- ✓ List the elements of centrifugal pump failure reduction programs taking into account the process and the mechanical & technical interactions

Training Designed for:

This course is intended for those who work with machinery and rotating equipment at industrial process plants, oil refineries, petrochemical plants, utilities, production oil/gas field or manufacturing facilities. General Maintenance Personnel and Engineers will find this course extremely useful.

Training Program:

DAY ONE:

- ❖ PRE-TEST
- ❖ Introduction
- ❖ The Failure Analysis and Troubleshooting System
 - Causes of Machinery Failure
 - Contributing Factors Often Overlooked
- ❖ Machinery Diagnostic Testing
 - Diagnostic Objectives, Mechanical Inspection
 - Test Plan Development, Data Acquisition and Processing
 - Data Interpretation, Conclusions and Recommendations
 - Corrective Action Plan
- ❖ 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

DAY TWO:

- ❖ Machinery Component Analysis and Reliability Improvement (cont'd)
 - Rolling Element Bearing (AFB) & Bearing Failure Analysis
 - Journal and Tilt-Thrust Bearings, Gear Failure Analysis
 - Coupling Failure Avoidance, Determining the Cause of Mechanical Seal Distress
 - Mechanical Seal Selection Strategies, O-Ring Failures and Their Causes

DAY THREE:

- ❖ 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
- ❖ 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, Blowers and Fans
- Reciprocating Compressors, Engines, Gas Turbines and Others

DAY FOUR:

❖ Root Cause Failure Analysis (RCFA)

- Structured Problem Solving and RCFA
- Cause Analysis, Two-Track Approach, Failure Types, The Three Levels of Cause
- Collecting Failure Data, Parts and Position, The Analysis Process
- Describing the Process, Data Analysis I, Data Analysis II
- Data Analysis III, Another Way, Human Root Causes
- Solutions, Stewardship of RCFA Results

❖ Structured Problem-Solving Sequence

- Review of Structured Problem-Solving Elements
- Cause Analysis, Action Generation, Decision Making and Planning for Change
- Root Cause Failure Analysis (RCFA) Principles

❖ Vibration Analysis – A Management Overview

- Specific Machinery Problems, Monitoring and Analysis Methods
- Future Outlook

❖ Practical Sessions

- This hands-on and includes real-life case studies and exercises

DAY FIVE:

❖ Formalized Failure Reporting as a Teaching Tool

- Actual Cases Cited and Explained in Detail
- High Speed Pump Failure & Bearing Failures

❖ 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
- Centrifugal Pump Failure Reduction Programs

❖ Course Conclusion

❖ POST-TEST and EVALUATION

Training Requirement:

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

Please note that the above topics can be amended as per client’s learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.





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, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

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

Training Fees:

As per the course location - 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 - 13:30	Recess (Prayer Break & Lunch)
13:30 - 15:00	Last Session

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

Aisha Relativo: aisha@cmc-me.com

Tel.: +971 2 665 3945 or +971 2 643 6653 | Mob.: +971 52 2954615

Training & Career Development Department

