



# Advanced Machinery Reliability Analysis



## Introduction:

Machines deteriorate as they get older so we can expect a certain amount of performance falloff and general deterioration of the machine. If we understand the failure mechanisms that are in place we can identify which parameters best indicate the deterioration of the machine. In this comprehensive course the delegates will benefit from using modern methods & technologies to learn reliability basics, fault analysis and monitoring techniques

Failure analysis and Predictive Maintenance techniques, including vibration analysis, are discussed in the course with a view to optimising the maintenance engineering effort while maximising production. Other techniques that will be addressed include infrared thermography, passive ultrasonics, tribology and performance monitoring.

## Target Audience

This seminar is directed towards Supervisors, Team Leaders and Managers in Maintenance, Engineering and Production. The seminar will also benefit anyone who wishes to update themselves on Predictive Maintenance Technologies and Failure Analysis techniques, as well as those who have to judge the suitability of these technologies for their needs, and learn how to implement them for the benefit of their organisations.

## Objectives

**At the end of this seminar participants will have:**

- An understanding of Machine Failure Analysis techniques.
- An understanding of why machines fail and how to identify the “bad actors”
- An understanding of a range of Predictive Maintenance Technologies
- Knowledge of the potential contribution of each these technologies to maintenance efficiency

- Guidelines indicating how these technologies can interact with and support each other
- Hints and Tips for practical application of these technologies so as to achieve the best results
- A practical approach to developing an action plan to utilise these technologies in their own areas of responsibility, fitting them into the overall maintenance strategy, and measuring benefits

## Key Benefits

### The knowledge gained in this seminar will:

- Allow the delegate to carry out mechanical and statistical analysis of machine failures
- enable the delegate to develop a proactive maintenance regime within the organisation.
- give the delegate confidence to carry out failure analyses thereby avoiding repetitive failures.
- allow tighter control of maintenance budgets by the avoidance of unplanned equipment failures in service.

## Training Methodology

The seminar will be conducted along workshop principles with formal lectures, case studies and interactive worked examples. Relevant case studies will be provided to illustrate the application of each tool in an operations environment. Each learning point will be re-enforced with practical exercises. There will be ample opportunities for discussion and sharing experiences.

## Organisational Impact

Analysis of machine failures and predictive maintenance of rotating plant is vital to the budgetary success of the operations organisation. On completion of this seminar the delegate will be able to critically analyse the methodologies employed within the organisation and instigate improvements where required.

## Personal Impact

Technical knowledge is key to effective control and peer respect within any maintenance organisation; when this is achieved personal satisfaction follows. This seminar will give the delegate the required level of technical knowledge and skill to achieve that personal satisfaction.

## Competencies

- Analytical competency to analyse machine failures
- Ability to put in place measures to avoid repetitive machine failures.
- Understanding of vibration analysis techniques as applied to rotating equipment.

- Ability to put in place predictive maintenance measures to quantify equipment condition.
- Interface with and control predictive maintenance service providers.
- Identify and specify new predictive maintenance equipment.

## Seminar Content

### Day 1

#### An introduction to Reliability

- **Rotating Machines**
  - Centrifugal pumps
  - Centrifugal & rotary compressors. Fans & blowers
  - Drivers – turbines and motors
- **Common problems on rotating machines**
  - Performance deterioration
  - Vibration as an indicator
  - Failure of function
- **Economics of maintenance engineering**
  - Maintenance & asset management
  - Cost of equipment failure
  - Economic evaluation & financial concepts
  - Life cycle costs
- **Equipment Reliability**
  - Reliability in design
  - Specifications & application
  - Operational reliability, including first line maintenance and TPM
  - Maintenance reliability, including Maintenance Planning and Management
  - Maintenance strategies and their implementation

### Day 2

#### Strategic Reliability

- **Reliability Engineering**
  - Reliability basics
  - Reliability prediction
  - Reliability assessment
  - Life cycle assessment
  - FMEA & FMECA
- **Reliability Maintenance**
  - Strategies
  - CBM, RBM, RCM & PdM
  - CMMS
  - Maintenance roles & responsibilities

- **Statistical analysis in maintenance**

- MTTR, MTBF, availability & reliability
- Data collation
- Data manipulation
- Data interpretation

## Day 3

### Mechanical Failure Mechanisms & Troubleshooting

- **Machine Failure Analysis**

- Understanding fault causes
- Wear and tribology
- Diagnosis of fatigue mechanisms – mechanical & thermal

- **Bearings**

- Bearing types & application
- Plain & pad bearings - hydrodynamic lubrication, failure types and identification
- Rolling element bearings – elastohydrodynamic lubrication, failure types and identification

- **Pump & compressors seals**

- Construction.
- Application
- Failures types – identification and analysis

- **Trouble shooting techniques**

- Field trouble shooting
- Engineering trouble shooting – problem solving

## Day 4

### Condition Monitoring & Predictive Maintenance

- **Predictive Maintenance Concepts**

- Predictive Maintenance – background and history
- Predictive Maintenance Technologies – an overview
- Potential Failure Analysis – deciding which technologies to apply

- **On Line or Off line?**

- Protection systems
- Monitoring systems
- Analytical systems

- **Vibration Analysis**

- Introduction to Vibration Analysis
- Frequency Analysis and the Fast Fourier Transform
- Vibration Transducers
- Basic Failure Mechanisms with examples
- Vibration Standards and Alarm Levels
- Vibration Diagnostics
- Amplitude Demodulation – aka Enveloping, SSE, HFD, Peak-Vue
- Vibration on Rolling Element Bearings
- Resonance – identification & cure

## Day 5

### Predictive Maintenance Technology

- **Other Predictive Maintenance Techniques**

- Infrared Thermography
- Thermographic applications
- Passive Ultrasonics - contact and non-contact
- Ultrasonic Applications
- Tribology – oil analysis

- **Managing Predictive Maintenance**

- Performance and Efficiency Monitoring
- Managing the Predictive Maintenance effort
- Cost Analysis
- Reporting Techniques
- Integrating Predictive Maintenance into the Maintenance Plan