



# Managing for Machinery Reliability...

## Seminar Synopsis

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### **Seminar Duration**

The duration of this seminar ranges from 1 to 2 days depending on client preference, worker availability, and the attendees' backgrounds.

### **Who should attend?**

This seminar is designed primarily for maintenance, engineering, technical support and management personnel whose job functions involve rotating machinery repair. The scope of content is appropriate for management personnel, as well as for technicians or other employees who will benefit from an overview of machinery reliability processes and requirements.

### **Associated Tasks**

Manage plant personnel involved with implementation of a Machinery Reliability program and demonstrate technical understanding sufficient to provide program leadership and assess the program's effectiveness.

### **Seminar Objectives**

Upon successful completion of the seminar, the student will be able to:

1. Explain the following maintenance philosophies, including the role each plays in an overall machinery reliability improvement process:
  - Breakdown/Corrective
  - Preventive Maintenance (PM)
  - Condition-based / Predictive Maintenance (PdM)
  - Precision Maintenance
2. Explain the relationship between Total Productive Maintenance (TPM) and Reliability Centered Maintenance (RCM), including:
  - How they relate to the above maintenance philosophies
  - Financial and equipment life benefits
  - General requirements for implementing these strategies
3. Explain the roles that Preventive Maintenance and Predictive Maintenance tasks play in an effective reliability improvement process.
4. Explain the following elements of an effective reliability improvement process:
  - Detection
  - Analysis

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- Correction
  - Verification
5. Briefly explain the following condition monitoring/PdM technologies, including examples of the benefits of each:
    - Visual Inspection and Monitoring
    - Vibration Detection and Analysis
    - Oil Analysis
    - Infrared Thermography
    - Ultrasonics
    - Performance Monitoring
    - Motor Analysis Techniques
  6. Explain the root cause failure analysis process, including the importance of the following steps:
    - History
    - Machine Details
    - Amplitude /Hand Feel
    - Spectrum
    - Phase/Relative Motion
    - Time Waveform
  7. Briefly explain balancing, alignment, and vibration standards and how they effect the reliability improvement process.
  8. Identify, briefly explain, and rank the following sources of premature machinery failure:
    - Misalignment
    - Unbalance
    - Resonance
    - Bearings
    - Looseness
    - Flow-related problems
    - Electrical
    - Bent Shaft
  9. Explain how to prevent unbalance through attention to tolerances and assembly errors.
  10. Explain the main causes of misalignment and their solutions.
  11. Explain the primary sources of premature bearing failures.

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12. Explain 12 key requirements for implementing machinery reliability and identify your company's areas of strength and areas where improvement is desirable.

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### Seminar Subjects

- **Introduction**
  
- **Maintenance Philosophies**
  - A. Breakdown
  - B. Preventive
  - C. Condition Based
  - D. Precision/Reliability Improvement, CBM, BM, TQM
  - E. Examples of Where Each is Appropriate—Case Histories
  - F. Relationship to RCM
  - G. How these philosophies are currently applied
  
- **Maximizing Machinery Reliability ....the Improvement Cycle**
  - A. Overview of the Steps to Achieving Reliability Improvement
    - 1. Detection...condition monitoring program
    - 2. Analysis...Root cause Failure Analysis
    - 3. Correction/Improvement...Assembly, Tolerances, Alignment, PM tasks, attention to detail
    - 4. Verification...Standards, QC check
  
  - B. Detection...Overview of Condition Monitoring Techniques
    - 1. Touch-Feel...Overview, Capabilities and Limitations
    - 2. Vibration...Overview, Capabilities and Limitations
    - 3. Oil Analysis...Overview, Capabilities and Limitations
    - 4. Infra Red...Overview, Capabilities and Limitations
    - 5. Performance Monitoring...Overview, Capabilities and Limitations
  
  - C. Analysis ....Integrating all the Technologies
    - 1. The Analysis Process
    - 2. The Importance of history / machine details
    - 3. Hand feel
    - 4. Vibration
    - 5. Phase
    - 6. Use all the tools at your disposal for effective analysis
    - 7. Bearing Failure Example...demonstration

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- **Correction/ Improvement.....Maintaining for Reliability**
  - A. Tolerances...Balance, Alignment, Vibration
  - B. Maintenance Practices...Assembly, Alignment
  
- **Application of the Reliability Improvement Cycle**
  - A. What are the Benefits?
  - B. How much does precision cost?
  - C. Rolls Royce mentality
  - D. Power Savings
  - E. Case Histories
  - F. Class selection of machines to improve
  - G. Development of Improvement Plan
  
- **Overview of Main Sources of Premature Machinery Failure**
  
- **Unbalance Prevention**
  - A. Key length
  - B. Accumulation of tolerances
  - C. Run out
  - D. Installation of pulleys
  - E. Cocked Bearings / spacers
  - F. Greasing couplings
  - G. Pulled Threads
  
- **Misalignment Prevention**
  - A. Overview of Precision alignment processes
  - B. Pre-alignment, Rough alignment, Precision alignment
  - C. Soft foot
  - D. Thermal growth
  
- **Resonance prevention**
  - A. Resonance overview
  - B. Resonance analysis
  - C. Resonance prevention techniques
  
- **Achieving a Precision Mentality**
  - A. Where to Start
  - B. 12-steps for Machinery Reliability