

Introduction to Modern Maintenance Management Presentation

Three Day Course on Maintenance Management Guidelines, Best Practices, Strategies, Frameworks and Techniques

Course Content

Maintenance Management for Reliability Training Course Day 1 Content

Introduction to Equipment Reliability Concepts

- Disclaimer – slides do not replace education, training, skills and experience

Limitations of Machine Design

- Understand How Machines are Designed and the Limits They Must Live Within
- The Unforgiving Nature of Machine Design
- Strength of Materials Limitations
- Cause of Aging Failures
- The Degradation Cycle
- Repeated Over-Stressing Causes Fatigue
- The Overload Cycle
- Know the Limits of Your Parts
- Stress and Fatigue are Optional

Introduction to Reliability Concepts

- High Equipment Reliability is a Choice
- What Reliability Looks Like in Operating Plant
- Value of Reliability on Unit Cost of Production
- Traditional Bathtub Curve for Equipment
- Deciding when to do Planned Preventive Maintenance
- Six Failure Patterns for Aircraft Equipment
- Reliability disconnected from Overhauls
- RCM Influenced Maintenance Strategy
- What is Reliability?

Introduction to Reliability Mathematics

- What is the Reliability of this Glass?
- How do you Measure Reliability of a Glass?
- Measuring the Number of Failures
- Measuring the Rate of Failures
- Converting to Chance of Failure
- Drawing the Failure Curve for a Glass
- No Maintenance for Random Failures
- Random Failures are Preventable
- What is the Reliability of These Parts and Systems?
- What is the Reliability of a Car Tyre?
- Preventive Maintenance for Wearing Parts
- What is the Reliability of a Knife?
- Preventive Maintenance for Wearing Parts
- What is the Reliability of a Roller Bearing?
- Roller Bearing Failure Mechanisms
- Tell-tale Bearing Failure Mode Signs
- Chance of Failure for Roller Bearings
- Variation in Bearing Failure Times
- 'Reading' Failure Curve Shapes
- Parts Fail... then Machines Stop
- Equipment is components in series
- High risk in a series arrangement
- Modelling Reliability of Complex Parts
- Calculating the Reliability of a Part

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Course Content Continued

- Modelling Failure Data on a Spreadsheet
- Rate of Failure from History of Part
- Hazard Rate from Failure History of Part
- Probability of Failure
- Formula for the Reliability of a Part
- Reliability Mathematics in 'Random Failure' Zone
- Failure Rate and Reliability Curves
- Remaining Life Left in a Part
- The Odds of a Part Surviving For Longer
- Chance of a Part Surviving Another Month

Data Analysis

- Studies into Individual Parts Failure Curves
- Using Weibull Curves for Failure Prediction
- Graph of Weibull Component Life Prediction
- Can use Weibull Shape Parameter Estimation for **each** Failure Mode
- High Reliability of Parts is Valuable
- Using Reliability to Decide Renewal of 'Wear-out' Parts in Machines
- Using Reliability to Decide Renewal of 'Random Failure' Parts in Machines
- Using Reliability to Decide Renewal of 'Wear-in' Parts in Machines
- Maintenance Strategies for Parts and Components
- Using Reliability to Decide when to Do Preventive Maintenance
- Data Analysis with Trend Plots
- Stability of Failure Rate for Analysis

Operating Equipment Risk and Reliability

- Reliability of Series Systems
- Series Systems
- Reliability Implications for Series Systems
- Reliability of Parallel Systems
- Reliability Implications for Parallel Systems
- A Machine is a Series System of Parts and Components
- Machine Failure Rate is the Sum of Its Parts Instantaneous Failure Rate
- Reliability of Machines in Series Process
- Reliability of Machines in Long Series Processes – *The Never Ending Challenge*
- Reliability of Machines
- Improving the Reliability of Machines
- Financial Benefits of Reliable Machines
- Meeting The Reliability Challenge
- Risk Can be Measured
- Risk – Reduce Chance or Reduce Consequence?
- Building for the Physics of Failure
- Modelling Machine Reliability
- Machine Reliability Block Diagram
- Best Practice Reliability Engineering Application

Reliability Growth and Improvement

- Quality Function Deployment – The Voice of the 'Customer'
- Failure Mode Effects Criticality Analysis
- Failure Mode and Effects Analysis
- Failure Modes and Functional Loss
- Failure Mode and Effects Analysis (FMEA)
- Failure Modes and Evidence of Failure
- Activity 1 - Identify failure modes and functional failures in a pump installation

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- Reliability Growth Plot of Systems
- Crow – AMSAA Reliability Growth Plotting
- Area 4 Reliability Growth Chart

Maintenance Management for Reliability Training Course Day 2 Content

Profit Centred Maintenance Management

- Make Maintenance Profit Focused
- The 6 Purposes of Maintenance
- Turning Maintenance into a Profit Centre
- Develop a Plan to Reach Mastery
- Turn Objectives into Systematic Activities
- 4 Pillars of Quality Management Systems
- Elements of a Good Management System
- What Are the Critical Success Factors?
- The Benefits of Profit Centered Maintenance Organization and Control

Maintenance Process Failure

- Maintenance Management Best Practice – Today (still misses the target)
- Make Maintenance a System of Processes
- Strategic Business Importance of Reliability
- Least Long-Run Average Production Cost
- Benefits Reliable, Productive Equipment
- Most Business make their Machines Break
- Analysing Breakdowns in a Business
- But where do the failures start?
- Effect of Internal Clearance Variation on Bearing Life
- Degradation Rate Vs Temperature
- Reliability in Time Domain
- Infant Mortality and Poor Installation
- The Problem with Preventive Maintenance
- Random Failure – Induced Stress
- Wear-out Example - Tyre Wear
- But Things also Fail from Abuse

Maintenance Strategy Selection

- Strategy to Control Equipment Failures Curves
- Using Failure Patterns to Select Maintenance Practices – ‘Infant Mortality’
- Using Failure Patterns to Select Maintenance Practices – ‘Random Failure’
- Using Failure Patterns to Select Maintenance Practices – ‘End-of-Life’
- Cause and effect of our equipment failures
- Limited Choice of Maintenance Types
- Condition Monitoring Based on Equipment Degradation Cycle
- Maintenance Strategies for Risk Reduction
- Opportunity Maintenance Explained
- Preventive Maintenance Characteristics
- Breakdown Maintenance Characteristics
- Predictive Maintenance Characteristics
- Equipment Reliability Characteristics
- Relative Production Consequences of Maintenance Types
- Maintenance Strategy Selection
- Match Maintenance Strategies to Risk
- Reliability of Systems of Parts and Components i.e. Machines

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- Equipment Reliability Strategies
- Precision Operation Extends Productive Life
- Failure Prediction Mathematics – Weibull Reliability of Parts and Components
- Implications of Reliability on Maintenance
- When and How Much Maintenance?

Human Factors and Human Error

- The Story in Human Error Rate Tables
- Human Error
- Likelihood of Human Error

Failure Analysis

- Failure Mode Effects Analysis (FMEA) Fundamentals
- Top-Down Block Diagram Analysis
- Failure Mode and Effects Analysis (FMEA)
- Failure Mode Identification
- Which parts 'age' and which suffer stress?
- Bills of Materials in Maintenance Selection
- A Basic FMEA Worksheet

Equipment Criticality and Risk Analysis

- Classical Risk Analysis Method
- What Risks Are Out There?
- Equipment Criticality
- Recognise Size of Equipment Risk
- Risk Influences Maintenance Type
- Base Maintenance on Operating Risk Matrix
- Risk Identification and Removal Worksheets

Maintenance History Data Analysis

- Match Maintenance and Operating Practices to Equipment Criticality
- Activity 2 – Match operating and maintenance requirements to criticality
- Equipment Condition Monitoring Technologies for Inspection and Prediction
- Condition Monitoring to Optimise Availability
- Selecting PM frequency depends on ...
- Developing a PM Program Spreadsheet
- Determine Component-Based PM Frequency by Statistical Analysis
- Collecting Data for Component Statistical Analysis
- Activity 3 – Develop a PM Program for the Pump Set Installation and 'Support System'
- Selecting PdM Frequency
- Collecting Data for Component Statistical Analysis
- Analysing Work Order History for Failure Modes
- Analysing Failure Timelines and Pareto Charts
- Using Reliability to Decide when to Do Preventive Maintenance
- Using Reliability to Decide Renewal of 'Wear-out' Parts in Machines
- Using Failure Density Function to Determine PM Frequency
- Useful Analysis of Maintenance History
- Probability of Failure
- Variable Probability of Failure Interval
- Wear-out: Three Point Inspection Frequency
- Developing a PdM Program Spreadsheet
- Activity 4 – Develop a PdM Program for the Pump Set Installation and 'Support System'

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- Using Reliability to Decide Renewal of 'Wear-in' Parts in Machines
- Strategy for Installed Defects (Infant Mortality)
- Activity 5 – Imbedding good practice PM and PdM into organisations

Failure Cause Removal

- Benefits of Failure Elimination
- Root Cause Failure Analysis (RCFA)
- Root Cause Failure Analysis Process
- Root Cause Failure Analysis Exam
- How RCFA Contributes To Improvement

Enterprise Asset Management Vision

- Journey from Repair-focused to Reliability-focused Culture
- How do You get Reliability?
- Tools on the Journey to Reliability

Performance Measurement

- Improving Reliability by Setting Maintenance KPIs and Measuring Outcome
- Meaningful Maintenance and Reliability Performance Measures

Maintenance Management for Reliability Training Course Day 3 Content

Maximum Life Cycle Profit

- When You Design a Plant You are Designing a Business
- When Operating Costs are Committed
- The Design Process Limits Reliability
- Design and Operating Cost Totally Optimised Risk (DOCTOR)
- Life Cycle Risk Management Strategy - Optimised Operating Profit Method
- Why You Need Defect Elimination and Failure Prevention
- Problems Waste Time, Money and Resources
- Eliminate Defects to Prevent Problems
- Count the Failure Modes Defects Cause (553)
- Function of Business is to Wisely Profit

Defect and Failure True Costs

- Defects and Failures True Costs
- Failure Costs Surge thru the Company
- Defect and Failure True (DAFT) Costs go Company-wide
- Effects of DAFT Costs
- Never, Never, Never allow production failures
- We Need to Capture All Incident Costs to Justify Removing Their Causes
- Calculate DAFT Costs on Spreadsheets
- Benefits of Reducing Operating Risk
- Standard Risk Management Process Needs DAFT Costs to Find Real Risk
- Implications of DAFT Costs to Risk
- Quantify the Financial Cost of Risk
- Determine Your Acceptable Failure Domain
- Risk Identification and Removal Worksheets

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Operating Risk Boundary

- What & When to Spend to Prevent Failure
- The Application of Risk Based Principles to Managing Maintenance
- Equipment Risk and Criticality based on Defect and Failure True Costs
- Identify What Risks You WILL NOT Carry
- Reduce Risk with Chance Reduction and Consequence Reduction Strategies
- A Process to Produce Reliability
- Maintenance Strategy Selection

Reliability Growth and Improvement

- Reliability Growth Context
- Strategies for Reliability Improvement
- Reliability Teams
- Reliability Framework
- Performance Drivers
- Cascading objectives that tie directly back to the overall business goals
- Equipment Criticality for Subassemblies
- Maintenance Task List
- Establish Equipment Condition Monitoring
- Precision Maintenance: The Practice of Defect Elimination and Failure Prevention
- The Added Value of Defect Elimination and Failure Prevention

The Precision Domain

- Precision is a Serious Opportunity
- Precision across entire 'equipment system'
- Machines fail but we replace parts...
- Typical Precision Maintenance Program Content
- Typical Standards for a Precision Maintenance Program
- Accuracy Controlled Enterprise (ACE) Procedures
- The Accuracy Controlled Enterprise is...
- Accuracy Controlled SOPs Remove Variation with Proactive Statistical Process Control
- Set Standards and Standardise their Use
- 6 Mechanical Equipment Care Standards to Set, Use and Keep Using
- Operator and Maintainer Watch-keeping Tools
- Use Visual Management to show Progress and Feedback
- Train Operators and Trades in Precision
- Getting high task reliability needs quality
- Understanding what it means to be 'in control and capable'
- How do we apply it to our machines?
- Quality Management System for Continual Maintenance Improvement
- Maintenance Management Best Practice – Profit-Focused Ultra-High Reliability

Plant and Equipment Wellness

- Plant and Equipment Wellness
- Plant and Equipment Wellness Defined
- Remove variation ... by setting standards and measuring accuracy
- Prevent failure ... by defect elimination
- Prevent failure ... by proactive precision maintenance
- Risk control ... by chance reduction risk management
- Accuracy control ... by precision domain practices
- Accuracy control ... by precision systems
- Maintenance Quality System to ISO9001

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- Accuracy Controlled Enterprise Policy
- ACE Procedures – what to do
- ACE Work Instructions – exactly how to do it
- Measure and Monitor
- ACE 3Ts
- Visual management
- Quality Management Tools
- Measure/Monitor/Improve Performance ... by process step value contribution
- The Continuous Improvement Journey
- Getting high equipment reliability..
- ... farewell; and good fortune ahead.