Course Outline –General Preventative and Predictive Maintenance

Course Topic: General Preventative and Predictive Maintenance
Recommended Contact Hours: 40 hours

Course Description:

This course introduces students to various types of principles and practices used within industry for predictive and preventative maintenance of equipment. Topics will include: safety, housekeeping, filter replacement, oil analysis, lubricating, vibration analysis, shaft alignment, balancing, motor current analysis, infrared and ultrasonic analysis, and troubleshooting.

Course Outcomes and Objectives

PPM-1 Demonstrate sound safety practices

1. Demonstrate proper safe practices when doing general preventative maintenance
2. Identify the major safety aspects of testing equipment while operating
3. Inspect mechatronic systems, functions of safety devices and protocol
4. Demonstrate how to install guards, shields, fairings and insulations
5. Practice advanced predictive maintenance safety by:
   - Identifying common predictive maintenance safety guidelines
   - Identifying the potential hazard of pinch points
   - Explaining the proper procedure for lockout, tagout, and block-out
   - Identifying the PPE required and/or not appropriate for predictive maintenance
   - Identifying the potential of burn hazards
   - Identifying the potential hazards resulting from taking readings while equipment is operating
   - Demonstrating the proper use of hand tools

PM-2 Maintain mechatronic systems corresponding to the maintenance and repair plans, exchange wear and tear parts in context with preventative maintenance

Objectives

1. Interpret oil analysis data and take action
2. Maintain oil and grease levels
3. Perform equipment checks
4. Perform general housekeeping, including:
   - Sweep and mop floor, pick up trash around work area
   - Wipe down equipment

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- Empty trash and chip bins
- Empty rag bins

5. Monitor floor management development system by doing the following:
   - Maintain neat work area
   - Replace used tolls and equipment in designated areas
   - Establish minimum and maximum quantities acceptable for floor area
   - Maintain recycle and waste segregation
6. Perform equipment checks, including:
   - Perform visual Inspection of equipment
   - Check gauges
   - Check for abnormal readings and conditions
   - Verify current readings
   - Check valve positions, abnormal noises, leaks, and temperatures
7. Maintain oil and grease levels by doing the following:
   - Check sight glass-hydraulic oils
   - Check grease canisters
   - Check air lubricators
   - Check gear box oils
8. Collect oil samples for analysis by performing the following steps:
   - Secure sample collection kit from store room
   - Clean port before taking sample
   - Take sample from equipment
   - Label sample container
   - Prepare sample for shipment to send to lab for analysis
9. Interpret oil analysis data and take action by accomplishing the following steps:
   - Read and interpret oil analysis data
   - Determine root cause of contamination
   - Initiate work orders as required
   - Locate and eliminate source of contamination
   - Schedule a repair if contaminated
10. Troubleshoot automatic lubrication systems by:
    - Identify types of lubrication systems
    - Identify components of a series type, automatic lube system
    - Troubleshoot series type, automatic lube system

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PPM-3 Demonstrate how to take out devices and assembly parts, taking into account their function, mark parts regarding to their position and function

1. Change filters
2. Explain vibration analysis by being able to:
   - Describe the basic concept of vibration analysis
   - Define the vibration cycle
   - Define vibration displacement
   - Define vibration velocity
   - Define acceleration
   - Define vibration phase
   - Describe broadband analysis
   - Describe narrowband analysis
   - Describe signature analysis
   - Explain routes, measurements, and record-keeping

PM-4 Eliminate disturbances caused by reworking and replacement of parts and assemblies Objectives

1. Change filters
2. Describe the concepts of balancing
3. Describe and compare the basic types of unbalance
4. Explain the operation of portable and stationary temperature-indicating devices

PPM-5 Using TPM (Total productive maintenance principles), evaluate the need for and perform maintenance on mechanical system (including exchange of components)

1. Monitor floor management development system (5S)
2. Explain the function of logbooks and electronic file record keeping
3. Describe the function of a computerized maintenance management system
4. Describe the purpose and function of PM and predictive maintenance analyzers
5. Describe maintenance databases by:
   - Describing the basic function of maintenance logbooks (book or electronic file).
   - Explaining the concept of a preventive maintenance system
   - Describing the process of a computerized maintenance management system
   - Describing the four steps of preventive maintenance
   - Explaining the concept of a predictive maintenance schedule
   - Describing the different monitoring types used in predictive maintenance

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PPM-6 Demonstrate how to develop and implement a predictive maintenance plan

1. Describe the purpose and function of PM and predictive maintenance analyzers
2. Describe the concept of vibration analysis
3. Define the most common terms related to vibration analysis.
4. Describe the concepts of balancing
5. Describe and compare the basic types of unbalance
6. Explain the functions and differences between on-line and off-line motor current analysis
7. Describe the purpose function of infrared thermography.
8. Explain the operation of portable and stationary temperature-indicating devices
9. Describe the basic concepts of ultrasonic analysis
10. Identify the flaws that can be indicated by ultrasonic analysis
11. Explain the function of logbooks and electronic file record keeping
12. Describe the function of a computerized maintenance management system
13. Describe the purpose and function of PM and predictive maintenance analyzers
14. Explain shaft alignment by:
    - Describing the basic concepts of shaft alignment
    - Explaining the process of base preparation and soft foot
    - Explaining the process of rough alignment
    - Explaining the process of rim and face
    - Explaining the process of reverse dial
    - Describing the technique of laser alignment
15. Describe online and offline motor current analysis by:
    - Describing the function and use of a motor current analyzer
    - Explaining the concept of phase orientation
    - Explaining the concepts of polarization index, rotary influence, dielectric installation, meg test, and step voltage
    - Interpreting the results and describe the appropriate corrective action
    - Describe predictive maintenance troubleshooting basics by doing the following:
    - Describe the relationship between predictive maintenance and troubleshooting
    - Explain the concept of troubleshooting
    - Describe the process of predictive maintenance troubleshooting
    - Describe the resources available to predictive maintenance troubleshooting
    - Describe predictive maintenance troubleshooting problems

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PPM-7 Identify and explain various types and styles of predictive and preventive maintenance components, principles, and practices used in industrial applications.

1. Describe the purpose and function of PM and predictive maintenance analyzers
2. Identify the major safety aspects of testing equipment while operating.
3. Describe the concept of vibration analysis
4. Define the most common terms related to vibration analysis.
5. Describe the concepts of balancing
6. Describe and compare the basic types of unbalance
7. Explain the functions and differences between on-line and off-line motor current analysis
8. Describe the purpose function of infrared thermography
9. Explain the operation of portable and stationary temperature-indicating devices
10. Describe the basic concepts of ultrasonic analysis
11. Identify the flaws that can be indicated by ultrasonic analysis
12. Explain the function of logbooks and electronic file record keeping
13. Describe the function of a computerized maintenance management system
14. Explain the function of logbooks and electronic file record keeping
15. Describe the function of a computerized maintenance management system
16. Define the vibration cycle
17. Define vibration displacement
18. Define vibration velocity
19. Define acceleration
20. Define vibration phase
21. Describe broadband analysis
22. Describe narrowband analysis
23. Describe signature analysis
24. Explain routes, measurements, and record-keeping
25. Explain balancing by:
    - Describing the concepts of balancing
    - Describing static unbalance
    - Describing uncouple unbalance
    - Describing quasi-static and dynamic unbalance
    - Explaining the problems resulting from imbalance
    - Describing natural frequency
    - Describing in-place balancing
    - Describing the operation of a balancing machine
    - Listing and describing the different equipment used in the balancing process

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26. Explain infrared thermography by doing the following:
    - Describe the operation of an infrared thermography camera and equipment
    - Describe the operation of portable temperature-indicating devices
    - Describe the operation of stationary temperature-indicating devices
    - Interpret the results and describe the appropriate corrective action
27. Explain ultrasonic analysis by:
    - Describe the basic concepts of ultrasonic analysis
    - Describe the different flaws that can be detected by ultrasonic analysis
    - Interpret the results and describe the appropriate corrective action

Course Outline

I. Proper Safe Practices When Doing General Preventative Maintenance
   - A. Common slip hazards
   - B. Hydraulic system injection hazards
   - C. Chemical hazards

II. Collecting Oil Samples for Analysis
   - A. Securing sample collection kit from store room
   - B. Cleaning port before taking sample
   - C. Taking sample from equipment
   - D. Labeling sample container
   - E. Preparing sample for shipment to send to lab for analysis

III. Interpreting Oil Analysis Data and Taking Action
   - A. Reading and interpreting oil analysis data
   - B. Determining root cause of contamination
   - C. Initiating work order as required
   - D. Locating and eliminating source of contamination
   - E. Scheduling a repair if contaminated with wear metal

IV. Changing Filters
   - A. Changing oil filters
   - B. Changing air filters
   - C. Disposing of used oil filters

V. Maintaining Oil and Grease Levels
   - A. Checking sight glass - hydraulic oils
   - B. Checking grease canisters
   - C. Checking air lubricators
   - D. Checking gear box oils

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VI. Performing Equipment Checks
- A. Performing visual inspection of equipment
- B. Checking gauges
- C. Checking for abnormal readings and conditions
- D. Verifying current readings
- E. Checking valve positions, abnormal noises, leaks, temperatures
- F. Performing oven quality checks to maintain oven temperature standards

VII. Monitoring Floor Management Development Systems
- A. Maintaining neat work area
- B. Replacing used tools and equipment in designated areas
- C. Establishing minimum and maximum quantities acceptable for floor area
- D. Maintaining recycle and waste segregation

VIII. Predictive and Preventive Maintenance Safety
- A. Safe practices
- B. Safety equipment

IX. Vibration Analysis
- A. Concepts
- B. Acceleration
- C. Velocity
- D. Displacement
- E. Routes
- F. Measurements
- G. Record keeping

X. Balancing
- A. Concepts and theory
- B. Readings
- C. Balancing problems

XI. On-line & Off-Line Motor Current Analysis
- A. Concepts and theory
- B. Analyzers
- C. Electrical test without power
- D. Phase orientation
- E. System checks

XII. Infrared Thermography
- A. Concepts and theory
- B. Digital images
- C. Result interpretation

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D. False readings

XIII. Ultrasonic Maintenance
- A. Concepts and theory
- B. Data point identification
- C. Result interpretation

XIV. Maintenance Data Bases
- A. Work order generation
- B. PM maintenance requests
- C. Spare part locations
- D. Daily log reports
- E. Communication between shifts
- F. Equipment histories
- G. PM completion tracking
- H. PM and CM reports
- I. Down time tracking and costs

XV. Predictive Maintenance Troubleshooting
- A. Concepts
- B. PM safety
- C. Troubleshooting requirements
- D. Operational troubleshooting
- E. System troubleshooting
- F. Troubleshooting resources
- G. Troubleshooting problems
- H. Troubleshooting case studies

List of experiments/activities

- Demonstrate safe practices when doing General Preventative Maintenance
- Collect Oil Samples for Analysis
- Interpret Oil Analysis Data and Take Action
- Change Filters
- Maintain Oil and Grease Levels
- Perform Equipment Checks
- Monitor Floor Management Development System (5S)
- Advanced predictive maintenance safety
- Introduction to vibration analysis
- Shaft Alignment

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- Balancing
- On-line & off-line motor current analysis
- Introduction to infrared thermography
- Introduction to ultrasonic analysis
- Introduction to maintenance databases
- Predictive maintenance troubleshooting

SUGGESTED LEARNING RESOURCES FOR THIS COURSE

AMTEC. (2012). AMTEC basic preventive maintenance lessons. Versailles, KY: KCTCS.
AMTEC. (2012). AMTEC advanced technologies in predictive maintenance lessons. Versailles, KY: KCTCS.
Fitch, J. (2010). Used oil analysis basics. Tulsa, OK: Noria Corp.
Fitch, J. (2010). Lubricating oil application methods. Tulsa, OK: Noria Corp.
Kemp, A. (2011). Industrial mechanics. (3rd ed.). Orland Park, IL: American Technical Publishers.
Quality Training Portal. (2011). The 5s's: workplace organization. Waitsfield, VT: Resource Engineering,

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