

# **P**REVENTIVE **M**AINTENANCE

**JOSEPH D. PATTON, Jr.**

- COMPUTER ASSISTANCE
- DESIGNING A PM PROGRAM
- CONDITION MONITOR
- ON-CONDITION
- ECONOMICS
- PLANNING AND ESTIMATING
- SCHEDULING
- IMPLEMENTING
- INFORMATION SYSTEMS

# Preventive Maintenance

Joseph D. Patton, Jr.



Instrument Society of America

## **PREVENTIVE MAINTENANCE**

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Printed in the United States of America

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*Instrument Society of America*  
67 Alexander Drive  
P.O. Box 12277  
Research Triangle Park, NC 27709

### **Library of Congress Cataloging in Publication Data**

Patton, Joseph D.

Preventive maintenance.

Includes index.

I. Maintenance. I. Title.

TS192.P34 1982 658.2'02 82-48557

ISBN 0-87664-718-2

ISBN 0-87664-639-9 (pbk.)

Design and book production  
by Publishers Creative Services Inc., New York

## **Preventive Maintenance**

**Dedicated to my wife, Susan  
and children, Jennifer and Joseph III,  
for their tolerance, understanding, and support**

# Preface and Acknowledgments

**P**reventive maintenance means all actions intended to keep durable equipment in good operating condition and to avoid failures. A good preventive maintenance (PM) program is the heart of effective maintenance. Success is often a matter of degree. The proper balance that achieves minimal downtime and costs can be tenuous between preventive maintenance and corrective maintenance. Everything is going to fail at some time. PM can prevent those failures from happening at a bad time, can sense when a failure is about to occur and fix it before it causes damage, and can often preserve capital investments by keeping equipment operating as well as it did on the day it was installed.

Inept PM, however, can also cause problems. Whenever any equipment is touched, it is exposed to potential damage. It is excessively costly to replace components prematurely. Customers may perceive the PM activity as, "that machine is broken again." A PM program requires an initial investment of time, parts, people, and money. Payoff comes months later. While there is little question that a good PM program will have a high return on investment,

many people are reluctant to pay now if the return is not immediate. PM supports a commitment to long-term life-cycle cost/total cost of ownership.

Emotions play a prominent role in preventive maintenance. We all realize that perceptions often receive more attention than facts. A good data system, either manual or computerized, is necessary to provide the facts that must guide PM. PM is a dynamic process. It must support variations in equipment, wear, environment, use, personnel, schedules, and material. Changes are taking place both in technology and in management. These changes both require and support preventive maintenance. Technology provides the tools, and management provides the direction for their use. Both are necessary for success. These concepts are equally applicable to equipment and facility maintenance and field service in commerce, government, and industry.

### Acknowledgments

**T**hanks to Amby T. Upfold and the personnel of Polysar Limited, and to Joseph Zdun, National Service Manager, and his staff at Leeds & Northrup for their review and constructive suggestions. Participants in workshops "How to Design and Implement a Preventive Maintenance Program" may recognize their enhancements. PCI consultants who have had considerable positive impact include Lawrence S. Beale, Herbert O. Feldmann, Michael A. Felluca, and Mary Ann Bianchi. Beverly C. Phillips typed the manuscripts from electronic dictation and drafted many of the illustrations.

# Contents

<b>Preface and Acknowledgments</b>	<i>xv</i>
<b>Chapter 1. Major Types of Maintenance</b>	<i>1</i>
Improvement Maintenance	
Corrective Maintenance	
Preventive Maintenance	
<i>On-Condition</i>	
<i>Condition Monitor</i>	
<i>Scheduled</i>	
Summary	
<b>Chapter 2. Advantages and Disadvantages</b>	<i>7</i>
Advantages	
<i>Management Control</i>	
<i>Overtime</i>	
<i>Work Load</i>	
<i>Equipment Uptime</i>	
<i>Production Revenue</i>	
<i>Standardization</i>	
<i>Parts Inventories</i>	
<i>Standby Equipment</i>	
<i>Safety and Pollution</i>	



<i>Quality</i>	
<i>Support to Users</i>	
<i>Benefit/Cost</i>	
Disadvantages	
<i>Potential Damage</i>	
<i>Infant Mortality</i>	
<i>Parts Use</i>	
<i>Initial Costs</i>	
<i>Access to Equipment</i>	
Summary	
<b>Chapter 3. Designing a PM Program</b>	<b>15</b>
Failure Data	
Failures that can be Prevented	
Maintenance to Prevent Failures	
Personnel	
Service Teams	
When to Start	
How to Start	
<b>Chapter 4. Economics</b>	<b>31</b>
Benefits versus Costs	
Trading PM for CM and Downtime	
<b>Chapter 5. Nondestructive Inspection</b>	<b>45</b>
Human Senses	
Sensors	
Thresholds	
<b>Chapter 6. On-Condition Maintenance</b>	<b>57</b>
Failure Patterns	
<b>Chapter 7. Condition Monitoring Prediction</b>	<b>63</b>
Failure Patterns	

<b>Chapter 8. Scheduled Preventive Maintenance</b>	<i>69</i>
<b>Chapter 9. Lubrication</b>	<i>73</i>
Lubrication Program Development	
Lubrication Program Implementation	
<b>Chapter 10. Calibration</b>	<i>81</i>
Standards	
Inspection Intervals	
Control Records	
<b>Chapter 11. Planning and Estimating</b>	<i>87</i>
Estimating Time	
Estimating Labor Cost	
Estimating Materials	
Feedback from Actual	
<b>Chapter 12. Shutdown Planning</b>	<i>95</i>
Critical Path	
Coordination	
<b>Chapter 13. Scheduling</b>	<i>101</i>
Prioritizing	
Coordination with Production	
Opportunity PM	
Assuring Completion	
<b>Chapter 14. Record Keeping</b>	<i>109</i>
Work Orders	
<b>Chapter 15. Computer Assistance</b>	<i>113</i>
On-Condition Maintenance	
Computerized PM Scheduling	
Resource Coordination	

<b>Chapter 16. Motivation</b>	<i>121</i>
Production/Maintenance Cooperation Effectiveness	
<b>Chapter 17. Implementing a New PM Program</b>	<i>125</i>
Objectives and Goals	
Plans	
<b>Chapter 18. Special Concerns</b>	<i>129</i>
Parts Availability	
Repairable Parts	
Detailed Procedures	
Quality Assurance	
Avoiding Callbacks	
Repairs at PM	
Data Gathering	
Summary	
<b>True or False Questions</b>	<i>139</i>
<b>Answers</b>	<i>184</i>
<b>Selected Readings</b>	<i>188</i>
<b>Index</b>	<i>191</i>

# List of Figures

1-1	Structure of Maintenance	<i>1</i>
2-1	PM to keep acceptable performance	<i>9</i>
3-1	A combination work order and completion form	<i>18</i>
3-2	A simple call report	<i>19</i>
3-3	A service activity report	<i>23</i>
3-4	Total maintenance costs for varied numbers of technicians	<i>26</i>
3-5	Maintenance Considerations Checklist	<i>28</i>
4-1	Relationship between cost and amount of preventive maintenance	<i>40</i>
4-2	Maintenance PM, CM, and lost revenue costs	<i>42</i>
5-1	“Go/no go” standards	<i>48</i>
5-2	An accelerometer to measure the vibration of a rotating shaft	<i>49</i>
5-3	Normal distribution of failures	<i>52</i>
5-4	Control chart warning of possible failure before it occurs	<i>53</i>
5-5	A simple manometer to warn of inadequate air flow	<i>54</i>

6-1	Infant mortality—stable—wear pattern	58
6-2	Early failures, then stable life: 68 percent	59
6-3	Consistent failure rate: 14 percent	60
6-4	User-caused failures: 7 percent	60
6-5	Increasing failures over life: 5 percent	61
6-6	Wear after a good run life: 2 percent	61
7-1	Distribution of light bulb failures	64
7-2	A typical problem/cause/action report	67
9-1	Recommended lubricants	76
9-2	Lubrication schedule	78
10-1	A calibration label	84
10-2	A calibration card	85
11-1	A typical PM procedure	88
11-2	Logic for inspection findings	90
12-1	Critical path control list	97
14-1	The Acme Veri-Visible® PM system	110
14-2	The Methods Research T-Card® system	111
14-3	The COMMS equipment data screen	112
15-1	Screen Image for creating inspection/PM work orders	116
15-2	Schedule and dispatch work orders	117
15-3	Pick-up list of parts	118
15-4	An inspection/PM overdue report	119
16-1	The two-factor theory of motivation	122
16-2	The process of motivation	123
17-1	The climb to a new PM program	125

# List of Tables

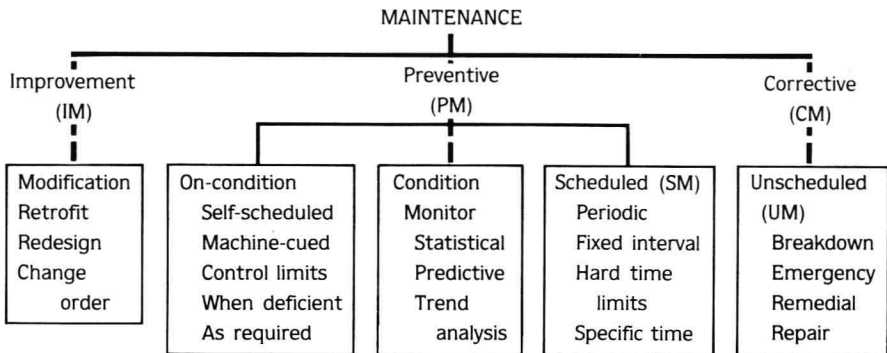
4-1	Future Value. Single Payment Compound Amount Factor	32
4-2	Present Value. Single Payment Present Worth Factor	33
4-3	Future Value of Annuity in Arrears. Value of a Uniform Series of Payments	34
4-4	Present Value of Annuity in Arrears. Uniform Series Present Worth Factor	35
4-5	Capital Recovery. Uniform Series with Present Value \$1	36
9-1	Lubrication Codes	77
18-1	Criteria for PM Repair Method	135

# Major Types of Maintenance

There are three main types of maintenance and three major divisions of preventive maintenance, as illustrated in Figure 1-1.

## IMPROVEMENT MAINTENANCE

Picture these divisions as the five fingers on your hand. Improvement maintenance efforts to reduce or eliminate



**Figure 1-1**  
**Structure of Maintenance**

entirely the need for maintenance are like the thumb, the first and most valuable digit. We are often so involved in maintaining that we forget to plan ahead and eliminate the need at its source. Reliability engineering efforts should emphasize elimination of failures that require maintenance. This is an opportunity to preact instead of react.

For example, many equipment failures occur at in-board bearings that are located in dark, dirty, inaccessible locations. The oiler does not lubricate those bearings as often as he lubricates those that are easy to reach. That is a natural tendency. One can consider reducing the need for lubrication by using permanently lubricated, long-life bearings. If that is not practical, at least an automatic oiler could be installed. A major selling point of new automobiles is the elimination of ignition points that require replacement and adjustment, introduction of self-adjusting brake shoes and clutches, and extension of oil-change intervals.

## **CORRECTIVE MAINTENANCE**

The little finger in our analogy to a human hand represents corrective (emergency, repair, remedial, unscheduled). At present, most maintenance is corrective. Repairs will always be needed. Better improvement maintenance and preventive maintenance, however, can reduce the need for emergency corrections. A shaft that is obviously broken into pieces is relatively easy to maintain because little human decision is involved. Troubleshooting and diagnostic fault detection and isolation are major time consumers in maintenance. When the problem is obvious, it can usually be corrected easily. Intermittent failures and hidden defects are more time-consuming but with diag-



nostics the causes can be isolated and then corrected. From a preventive maintenance perspective, the problems and causes that result in failures provide the targets for elimination by PM. The challenge is to detect insipient problems before they lead to total failures and to correct the defects at the lowest possible cost. That leads us to the middle three fingers—the branches of preventive maintenance.

## **PREVENTIVE MAINTENANCE**

### **On-Condition**

On-Condition maintenance is done when equipment needs it. Inspection through human senses or instrumentation is necessary, with thresholds established to indicate when potential problems start. Human decisions are required to establish those standards in advance so that inspection or automatic detection can determine when the threshold limit has been exceeded. Obviously, a relatively slow deterioration before failure is detectable by condition monitoring, whereas rapid, catastrophic modes of failure may not be detected. Great advances in electronics and sensor technology are being made.

Also needed is a change in human thought process. Inspection and monitoring should disassemble equipment only when a problem is detected. The following are general rules for on-condition maintenance:

- Inspect critical components.
- Regard safety as paramount.
- Repair defects.
- If it works, don't fix it.