



Preventive, Predictive and Corrective Maintenance

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WWOA Annual Conference October 2012

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General Overview

Basic Introduction to Maintenance

- Three types of maintenance
- Why do it?
- Benefits



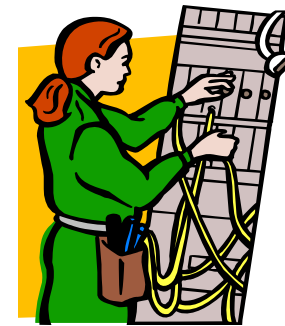


Types of Maintenance

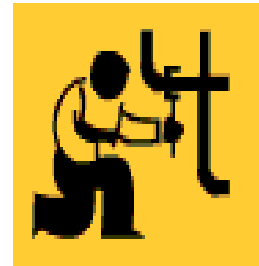
- Preventive (PM) - greasing, oil, filters



- Predictive (PdM) - Inspections



- Corrective - Repairs





Definition of Preventive Maintenance (PM)

“Schedule of planned maintenance actions aimed at the prevention of breakdowns and failures”

Primary goal-Preserve and enhance equipment reliability



Examples of PM

- Oil changes
 - Greasing
 - Changing filters
 - Belt tightening
- Anything that increases life of equipment, and helps it runs more efficiently



Preventive Maintenance Quiz

Quiz time...

TRUE or FALSE



- 1) Preventive maintenance is only necessary on large equipment, such as 100 HP blowers, large gearboxes, etc.



Quiz

FALSE!

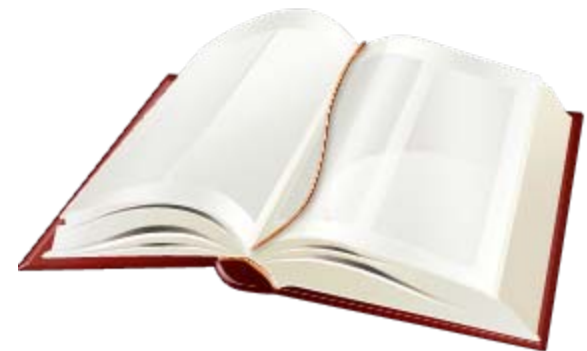
- Preventive maintenance should be performed on most equipment as recommended by the Manufacturer

Note: Determine if time spent to perform PM is greater than the replacement cost



TRUE or FALSE

2) Equipment manufacturers outline preventive maintenance procedures in the OEM manuals





QUIZ

TRUE!

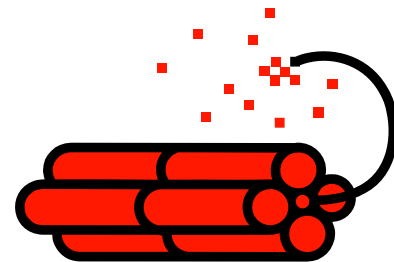
- Oil and/or grease types, quantities
- Time periods (weekly, monthly, quarterly)
- V-belt inspections
- General visual inspections
- Torque settings

Use these guidelines when creating program



QUIZ

- 3) Every 10 minutes an average furnace runs, it unleashes the equivalent energy of 3.5 sticks of dynamite

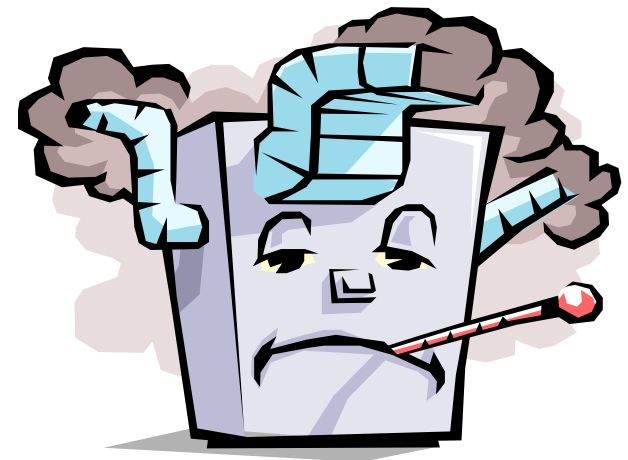




TRUE!

Department of Energy (DOE) reported this very fact in a recent study, in an effort to raise awareness of the importance of regular PM of a common household furnace.

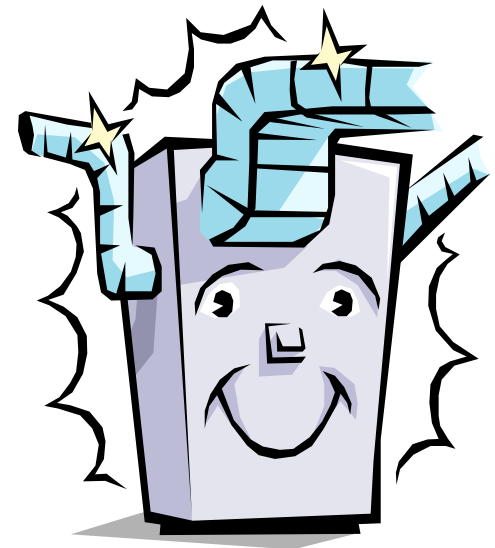
Point made: Not performing PM wastes energy AND costs money





Benefits of PM

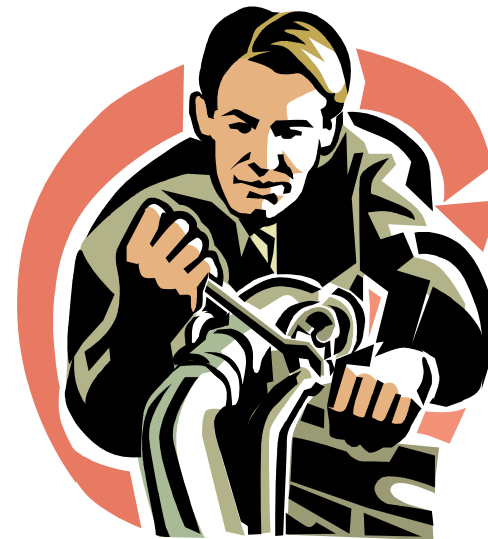
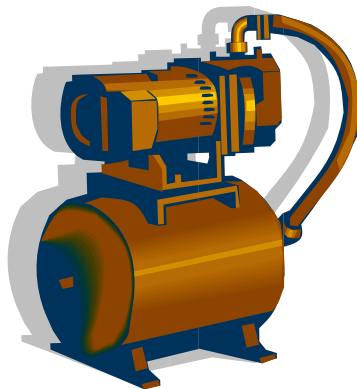
- Increases life of equipment
- Reduces failures and breakdowns
- Reduces costly down time
- Decreases cost of replacement





Who Does PM?

- Only trained, qualified maintenance personnel should perform PM's





Why do I need training?

- *To ensure proper techniques and procedures are followed*
- Over greasing is often worse than not greasing enough
- Improper tightening of packing increases shaft wear and shortens packing life
- Using improper lubricants can shorten equipment life



Training

- Often available from vendors
 - Local schools
 - Seminars
-
- Develop a training program outlining your needs
 - Establish an on the job training program if possible



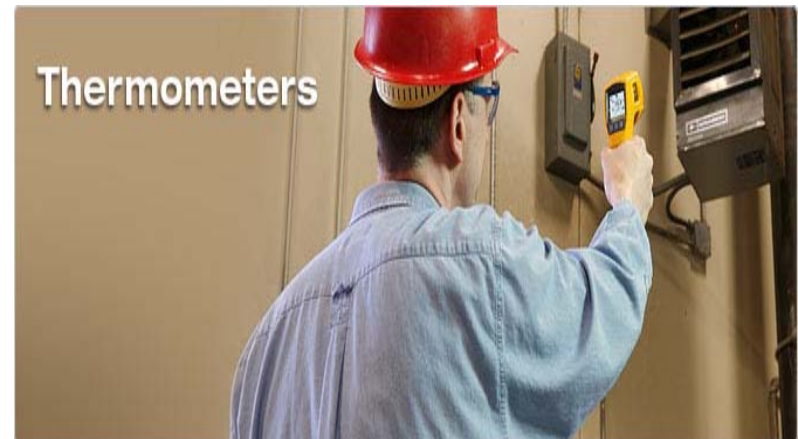
Predictive Maintenance (PdM)

- Definition - “Techniques that help determine the condition of in-service equipment in order to predict when maintenance should be performed”
- Primary goal - Minimize disruption of normal system operations, while allowing for **budgeted, scheduled** repairs



Examples of Predictive Maintenance

- Vibration Analysis
- Infrared Thermography
- Oil Analysis
- Visual Inspections





Predictive Maintenance Quiz

TRUE or FALSE

1) Predictive maintenance identifies trends and provides historical data





QUIZ

TRUE!

Predictive Maintenance, such as oil analysis, may show increasing metals in oil sample, indicating breakdown of internal parts.



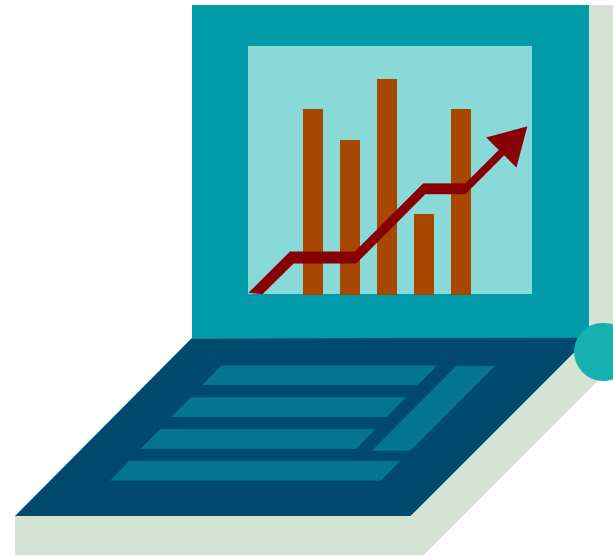
QUIZ

2) Predictive maintenance includes partial rebuild of equipment to keep it running until a complete rebuild can take place



FALSE

Predictive Maintenance shows condition of in-service equipment, and predicts when corrective maintenance should be performed.





QUIZ

3) Predictive Maintenance can be performed by almost anyone



PdM should only be performed by trained personnel using proper equipment!



Benefits of PdM

- Provides increased operational life
- Results in decrease of downtime
- Allows for *scheduled* downtime
- Allows for money to be budgeted for repairs
- Lowers need for extensive parts inventory
- DOE reports an estimated 8-12% cost savings by having a PdM program



Benefits (continued)

DOE also estimates:

- Reduction in maintenance costs - 25-30%
- Elimination of breakdowns - 70-75%
- Reduction of downtime- 35-45%
- Increase in production - 20-25%



Who does PdM?

Often done by a contracted, specialized technician

Reasons:

- 1) Qualified and trained on latest technology
- 2) Possess the proper equipment
- 3) Provide trending and historical data in report form



Oil Analysis

- Long term program that may take years before its benefits are seen
- 1) Oil analysis determines:
 - ✓ Condition of oil
 - ✓ Quality of the lubricant
 - ✓ Suitability for continued use
- 2) Wear particle analysis determines:
 - ✓ Mechanical condition of machine components
 - ✓ Identifies particle size, type, etc.



Oil Analysis Report

Oil Analysis results may:

- Detail the types of metal fragments in the sample
- Show a continued increase in particle size
- Recommend increasing sampling intervals
- Recommend shutting down machine



Thermography

Used for Electrical Infrared Inspections

➤ Detects hot spots, load imbalances and corrosion at a *safe distance*

➤ Detect failures due to excessive heat

1) Indoor equipment such as MCC's, disconnect switches and transformers

2) Outdoor equipment such as substations, transformers and outdoor circuit breakers



Vibration Analysis

- Usually done on large equipment, such as blowers, pumps, etc.
 - Determines if bearings or components are loose, moving or wearing
 - Allows for scheduled repair of equipment
 - Can provide trending that enables shutdown of equipment BEFORE failure and major damage



Equipment Inspections -PdM

- Visual inspection of equipment such as:
- Clarifiers and associated equipment
- Mechanical bar screens
- Allows for equipment to be coated, such as bar screens





What else?

- Concrete-Deteriorating concrete can indicate several things

Presence of H_2S





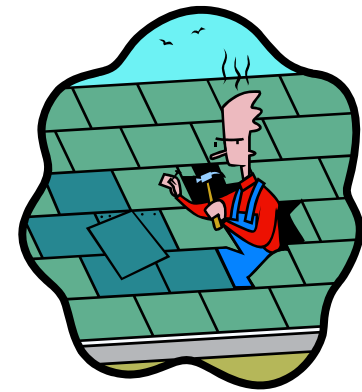
Corrosion Attack on Rebar!





Don't forget

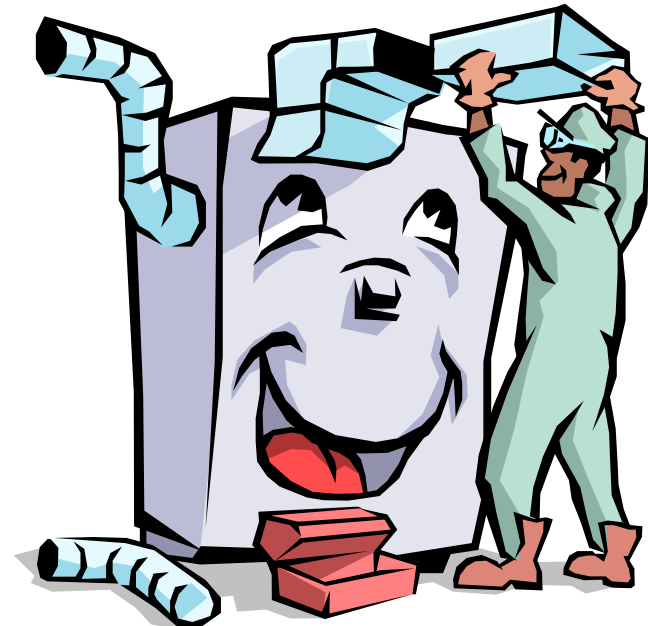
- Chemical Tanks
- Roofs
- Portable equipment (generators, diesel pumps)
- Safety equipment





Corrective Maintenance

Definition - Repair of equipment/machinery in order to bring it back to original operating condition.





Important Facts

- Use original OEM parts
- Install per manufacturer's specs
- Don't take shortcuts
- Do it right





Summary

- ✓ Proper maintenance programs have huge returns
- ✓ Keeps equipment running longer
- ✓ Allows for *scheduled, budgeted* repairs
- ✓ Reduces unscheduled down time
- ✓ Makes life less stressful



Questions?



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