

# PREVENTIVE MAINTENANCE

## Why Preventive Maintenance?

Preventive maintenance is predetermined work performed to a schedule with the aim of preventing the wear and tear or sudden failure of equipment components. Preventive maintenance helps to:

Protect assets and prolong the useful life of production equipment

- Improve system reliability
- Decrease cost of replacement
- Decreases system downtime
- Reduce injury

Mechanical, process or control equipment failure can have adverse results in both human and economic terms. In addition to down time and the costs involved to repair and/or replace equipment parts or components, there is the risk of injury to operators, and of acute exposures to chemical and/or physical agents.

Preventive maintenance, therefore, is a very important ongoing accident prevention activity, which you should integrate into your operations/product manufacturing process.

## What is Involved?

To be effective, your preventive maintenance function should incorporate the following elements:

**Planned replacements** of components designed around the following:

- Reliability of components (equipment failure is usually caused by its least reliable component)
  - check manufacturer's information

- check accepted industry best practices
- Maintaining equipment service records
- Scheduling replacement of components at the end of their useful service life
- Acquiring and maintaining inventories of:
  - least reliable components
  - critical components
  - components scheduled for replacements
- Replacing service-prone equipment with more reliable performers

By introducing the element of planning into your maintenance function, you are likely to reduce your repair and manpower requirements.

**Exploratory maintenance** to anticipate and prevent breakdowns. Diagnostic measures to analyze your plant requirements include:

- Operating and performing specifications of equipment
- Past experience with components:
  - inspection records
  - servicing records
  - replacement frequency
  - inspected component failures
- Regularly scheduled lubrication program:
  - identify lubrication points on equipment
  - colour code in order to identify lubrication frequency
  - consult manufacturer and accepted industry best practices to establish schedule

## Identifying Maintenance Hazards

The hazards associated with maintenance activities can be classified as follows:

### Safety Hazards

- Mechanical
  - equipment
  - tools
- Electrical
  - live equipment
- Pneumatic
- Hydraulic
- Thermal
- Combustion
- Falls
  - slippery floors
  - working at heights

### Health Hazards

- Chemical Agents
  - process chemicals
  - cleaning solvents
  - unexpected reaction products
  - dusts
  - other chemical agents
- Physical Agents
  - noise
  - vibration
  - other

### Ergonomic Hazards

- Biomechanical
  - lifting, pushing, pulling (manual handling)
  - stretching, ending (to reach hard to access areas)
- Work/process design
  - poorly designed tools
  - hard to access work locations

- ill fitting personal protective equipment
- complex procedures

Many of these hazards are interrelated. Examine your process, the layout of your process area, and the process equipment used, to determine the exact nature of the hazards likely to be encountered during your maintenance activities. For example, maintenance work carried out in confined spaces carries a greater risk of critical injuries and acute exposures to chemical and physical agents. These risks are associated with equipment and materials in the space itself and from nearby operations. Fatalities are quite common.

## Controlling Maintenance Hazards

Ideally, the hazards likely to occur during maintenance activities should be addressed in the planning stage.

### Process Selection

Depending on the nature of the process, special precautions may be needed to protect workers when disassembling and cleaning equipment. Consider this factor when you make a decision to select one process over another.

Also consider the following factors which contribute to the level of risk of your maintenance activities:

- How easy temporary structures are to erect
- How easy they are to access
- Support and reassembly of components of large scale equipment
- Use of hoists and mobile working platforms
- Safe use of ladders especially near live electrical equipment
- How much disassembly is required to access affected equipment

- Need for temporary hoisting equipment
- Need for personal protective equipment
- Housekeeping hazards created at floor level by the presence of dismantled components

### Equipment Selection

The process you select will determine the type of equipment you will be using. However, consider the following:

- Reliability:
  - manufacturer's data
  - in-plant operating experience
  - trade association data
- Ease of access to serviceable parts
- Ease of disassembly
- Complexity of repair procedures
- Ease of frequency of required lubrication
- Manufacturer/supplier follow-up:
  - availability of parts
  - availability of service time

### Developing Procedures

When servicing equipment, hazards not related to your process operation are likely to be introduced. For this reason, it is important to prepare written servicing procedures that include the following:

- A clear, step-by-step procedure, in checklist form, for controlling hazardous energy: (For an example see CSA Z460-05 Control of Hazardous Energy, Figure D1)
  1. Preparing for shutdown
  2. Shutting down machine, process or equipment
  3. Isolating energy to the machine, process or equipment
  4. Applying lockout devices
  5. Controlling stored energy (de-energization)
  6. Verification of isolation
  7. Release from lockout control

- Hazards identification
- Selection and specification of personal protective equipment:
  - appropriate for the hazard
  - proper fit
- Selection and specification of tools to be used:
  - right tool for the job
  - in good condition
  - appropriate for the environment (e.g., non-sparking tools in flammable atmospheres)
  - ergonomic design
- Step-by-step procedure for disassembly
- Step-by-step checklist for inspection of components (to establish a baseline for reliability)
- Identification of hazards associated with sub-procedures:
  - entering and working in confined spaces
  - welding in open and confined spaces
  - removing insulation
  - cleaning
  - handling and using solvents
  - erecting temporary structures
  - using portable equipment
  - using ladders
  - abrasive blasting
  - painting
- Erection and disassembly of scaffolding and other temporary platforms
- Disassembly of small-scale equipment
- Reassembly of small-scale equipment
- Support and disassembly of large scale equipment

Examine each procedure thoroughly to ensure that the least hazardous method is selected, and that all precautions necessary to complete the job safely are taken.

Keep records of all your maintenance activities, indicating the machine(s) involved, the part(s) involved, type of maintenance and date on which performed.

## Training

Maintenance personnel are often involved in a complex and changing set of problems. Therefore, they need more thorough training in accident prevention than regular workers.

Serious consequences to maintenance and other workers can result from not following established maintenance procedures (e.g., use of work permits, lockout procedures, confined space entry procedures). Ensure that your maintenance personnel are well trained in, and can demonstrate that they understand, all relevant procedures.

Also provide training in:

- Hazard identification
- Selection, use, and care of equipment, machine tools, personal protective clothing/equipment, etc., required to be used
- First-aid and life-saving techniques
- The hazards of and control methods for substances which may be encountered in the workplace, such as:
  - irritating, toxic or corrosive dusts
  - gases
  - vapours
  - fluids
- How to inspect chains, blocks, fall protection devices and ropes
- How to secure loads
- Understanding stresses

It is a good practice to call the maintenance crew together at the start of each job, in order to discuss the hazards involved and the method of doing it safely.

In the course of their daily work, members of the maintenance crew travel throughout the plant, becoming familiar with every machine and process. If properly selected and trained, they can do much to identify and correct unsafe conditions.

In small companies, the maintenance staff may also be responsible for inspecting and maintaining portable power tools, extension cords, and the like. If so, special procedures and training are needed.

Train equipment operators to recognize the signs of impending failure, such as abnormal noise, excessive vibration, declining or abnormal output, and to report these immediately to their supervisor.

## Legislation

The following Regulations made under the *Occupational Health and Safety Act* contain provisions that deal with maintenance:

- Industrial Establishments (R.R.O. 851/90)
- Control of Exposure to Biological or Chemical Agents (R.R.O. 833/90)
- Workplace Hazardous Materials Information System (R.R.O. 860/90)
- Designated Substances

Certain sections of the Ontario Fire Code may also be applicable to maintenance activities.

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