



Bahir Dar University
College of Agriculture and Environmental
Sciences

Laboratory Section
Maintenance and Laboratory Management
manual

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Table of Contents

Maintenance Manual	3
1. Maintenance Manual	4
1.1. Introduction	4
1.2. Scope and Applicability of the Manual	4
1.3. Purpose of the Manual	5
1.4. Occupational Health and Workshop safety	5
2. Maintenance	7
2.1. Objectives of Maintenance	7
2.2. Maintenance Strategy	7
2.3. Tools and Equipment Maintenance Management	8
2.4. Maintenance Team Duties & Responsibilities	9
2.4.1. Duties & Responsibilities of BDU Maintenance Team	9
2.4.2. Duties & Responsibilities of CAES Maintenance Team	10
2.4.3. Duties & Responsibilities of Department Maintenance Team	11
3. Types of maintenance and process	12
3.1. Preventive Maintenance and Process	12
3.1.1. Preventive maintenance Process & its Flow Chart	13
3.2. Corrective Maintenance and Process	14
3.3. Breakdown Maintenance and Process	15
4. Documentation	16
4.1. Maintenance Work Documentations	16
4.2. Work Schedule & Priority	16
4.3. Tools for Laboratory Management planning	17
5. Formats	19
Reference	23
Checklists	24

MaintenanceManual

1. Maintenance Manual

1.1. Introduction

This Maintenance Manual ensures the maximum effective of availability of teaching equipment and related facilities satisfactory condition of quality teaching system. Effective teaching and learning to take place in College of Agriculture and Environmental Sciences cannot be achieved without adequate provision and maintenance facilities. This manual focuses on facilities provision and maintenance as a necessity for effective teaching and learning in laboratories. Stake holders in the College should be encouraged in the facilitating maintenance of laboratory equipment and machines for the smooth running of trainings in terms of provision of infrastructural and workshop facilities such as tools, equipment and machines so that graduates will acquire skills, knowledge and attitude for gainful employment to contribute to the socioeconomic development of the nation.

1.2. Scope and Applicability of the Manual

This manual applies to BDU CAES laboratories and workshops to give the direction how to lead the maintenance services. Maintenance services provide attention for the maintenance of machines and equipment's due to their frequent use and strategic position in the complete production function. A machine is the name given to a mechanism consisting of the services of sequential components each performing its specific function which is part of the whole system or mechanism. For any machine some of its parts are fixed while other are replaceable. Such equipment or mechanical devices and their components require constant and continuous services such as cleaning, lubrication, repair and replacements etc. so that their operational efficiency can be maintained. Further it may be noted that plant maintenance service is not confined to the equipment and machines.

Under the range of the maintenance service, the maintenance of the buildings, electrical power, material handling equipment's, heating and air conditioning equipment's, waste disposal systems, wash rooms, water supply, jigs and fixtures and fire-fighting facilities etc., also need attention. The activity of the maintenance service also includes the provision of maintenance equipment and stock of repair parts and maintenance materials.

1.3. Purpose of the Manual

Maintenance Manuals are almost permanent about methodologies, tools, tackles and facilities for all maintenance work, which may have to be done in future.

These manuals use for:

- Actual planning and scheduling of any work, the maintenance manuals provide ready information for use as it is or for further micro-planning.
- To ensure that they follow correct procedures and to take necessary tool and spares etc. to avoid frequent visits to stores and thus save time
- Material Department may also use maintenance manual for better material procurement strategy.

1.4. Occupational Health and Workshop safety

Occupational Health and Safety is to ensure that health and safety is accessible to every worker employed in any sector across the economy. The need to protect the worker from occupational health hazards and promote safety of all at the workplace. As a result of the changing work-life trends and the growing demand for higher productivity from the worker, there is an urgent need to address issues of OHS at the workplace for each worker. Safety in the Laboratories is subject to a number of various risk assessments and safe codes of working practices which have to be observed and followed to by all laboratories users and enforced by the person in charge of these areas. Due to high risk activities taking place in the laboratories access to these areas is restricted to authorized personnel only. No other person may enter the laboratories without permission.

- No machine may be used or work undertaken unless the technician-in-charge is satisfied that the person is capable of doing so safely.
- Any person working in the mechanical and electronic workshop must have read and signed the appropriate risk assessment if the work or equipment they are using has been risk assessed.
- Never use a circuit breaker rated higher than the ampere capacity of the wire, and never substitute a wad of foil or a coin for a fuse.

- Do not handle energized equipment including fuse boxes, when standing on a damp surface.
- It is necessary to avoid bodily contact with liquid refrigerants and to avoid inhaling refrigerant gas.
- In case of refrigerant leaks, ventilate the area. Do not allow open flame in the area until it is ventilated.
- Before repairing any machinery, be sure that all power is off, and do not clean, adjust, or lubricate parts which are in motion guards or are fully enclosed.
- Machine guards should remain installed or, when necessary, removed only for maintenance and repaired and then replaced.
- Repair all equipment and appliances according to code and good repair procedures.
- Perform minor electrical repairs on mechanical equipment and appliances downstream of disconnect.
- Use Personal Protective equipment.
- Use the correct tool for the correct job.
- Never use a broken tool or a tool in disrepair.
- Make sure you know the limitations of tools.
- Inspect electrical tools for good repair before using.
- If electrical tools are to be used, they should be in good operating condition and should be grounded before use
- Use appropriate safety for appropriate work etc....

2. Maintenance

The technical meaning of maintenance involves functional checks, servicing, repairing or replacing of necessary devices, equipment, machinery, building infrastructure, and supporting utilities in industrial, business, governmental, and residential installations. Over time, this has come to include multiple wordings that describe various cost-effective practices to keep equipment operational; these activities take place either before or after a failure.

Maintenance can be considered as a combination of actions carried out in order to replace, repair, service, modify the components, or some identifiable group of components, of a workshop, so that it will continue to operate to a specified availability or a specified time. Maintenance is the totality of all measures directed towards control (preservation and restoration) of the workshop performance. Maintenance is an auxiliary process in a production process directed towards a high effectiveness of the main process.

2.1. Objectives of Maintenance

The more specific objectives of maintenance management are as follows:

- To optimize the reliability of equipment and infrastructure
- To ensure that equipment and infrastructure are always in good condition
- To carry out prompt emergency repair of equipment and infrastructure so as to secure the best possible availability for production
- To enhance, through modifications, extensions, or new low-cost items, the productivity of existing equipment or production capacity
- To ensure the operation of equipment for production and for the distribution of energy and fluids
- To improve operational safety
- To train personnel in specific maintenance skills
- To advise on the acquisition, installation and operation of machinery
- To contribute to finished product quality
- To ensure environmental protection.

2.2. Maintenance Strategy

A maintenance strategy defines the rules for the sequence of planned maintenance work. It contains general scheduling information and can therefore be assigned to as much maintenance

task list and maintenance plan as required. A maintenance strategy contains the individual work which should be performed (example every two month, every three weeketc).

Maintenance strategy is a systematic approach to up keep the facilities and equipment and it may vary from facility to facility. It involves:

- Identification, researching and execution of many repairs, replace and inspect decisions
- Is concerned with formulating the best life plan for each unit of the plant, in coordination with production and other functions concerned

2.3. Tools and Equipment Maintenance Management

Tools and Equipment maintenance management are one of the essential elements of a quality management system. Proper management of the equipment in the laboratory is necessary to ensure accurate, reliable, and timely testing. The benefits of a good tools and equipment management program are many:

- lowers repair costs, as fewer repairs will be needed for a well-maintained instrument;
- lengthens instrument life;
- Reduces interruption of services due to breakdowns and failures;
- Increases safety for workers;
- Produces greater customer satisfaction.

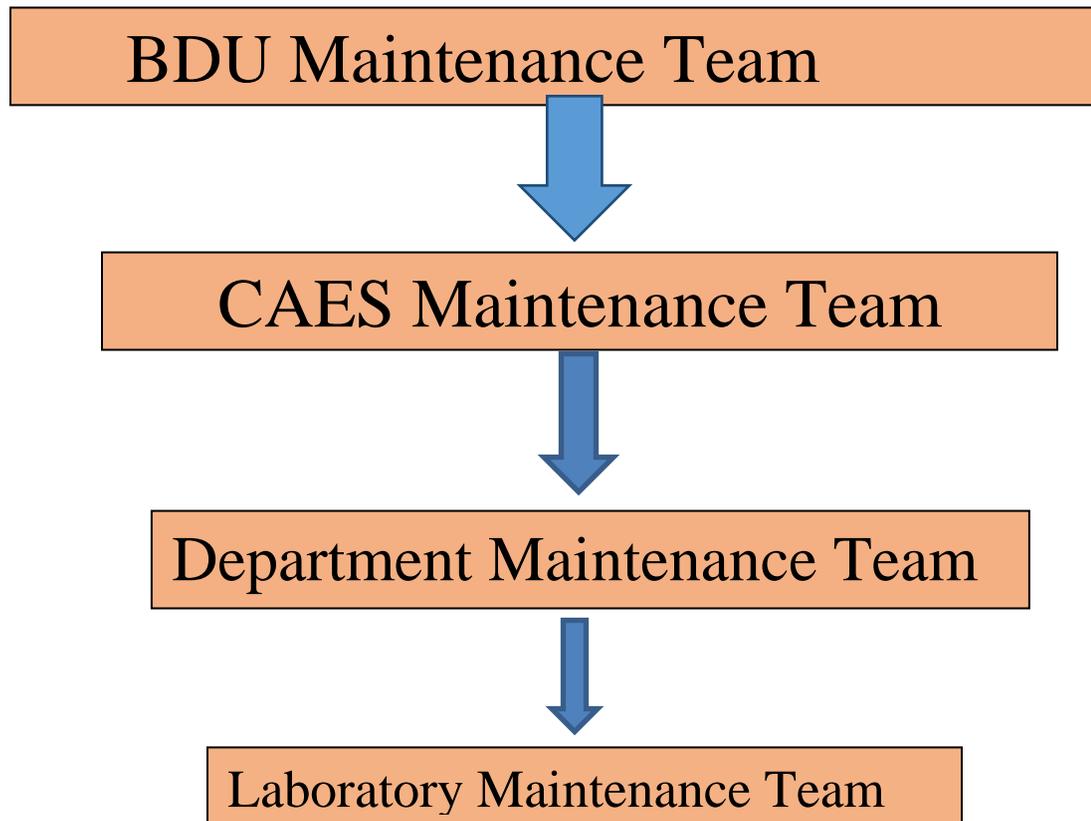
Equipment maintenance management is either single or multipurpose integrated engineered, designed, fabricated, or modified to accomplish maintenance equipment management performance. It consists of items or assemblies of equipment including standard or general-purpose items or components that are interconnected and interdependent to become a new functional object for maintenance equipment management system.

Tooling maintenance management:- Jigs, dies, fixtures, molds, patterns, taps and gauges, other equipment and manufacturing aids, including all components of this equipment, which are such a specialized nature that without important modification or modification use is limited to the development or production of particular supplies, parts thereof, or to the performance of particular services. It does not include material, facilities (except foundations and similar improvements necessary for installing special tooling), general or special machine tools, or similar capital equipment.

2.4. Maintenance Team Duties & Responsibilities

Maintenance team is the Responsible body for repairing, servicing, planning, managing, controlling, consulting machineries and equipment to maximum efficiency of training.

Maintenance team structure and linkage



2.4.1. Duties & Responsibilities of BDU Maintenance Team

Duties

- Record and document all work carried out on both paper and electronic systems
- Write reports and present progress at project meetings
- Apply specific technical skills as required to minimize downtime
- Conduct benchmarking studies to determine best practices

- Feedback to the Management team to share ideas and improve operation, recommending, supporting and implementing continuous improvement
- Identify areas of development within the team to achieve a flexible and responsive team which can support the demands of the customer
- Able to work collaboratively with other stakeholders
- Attend job training and safety programs organized by maintenance department.
- Ability to check blueprints, repair manuals, or parts catalogs as necessary.
- Experience with precision measuring instruments or electronic testing devices
- Strong time management skills.
- Maintenance team technicians/engineers, working with manager and colleagues to ensure smooth workflow with maximum output
- Actively Committed to team development
- Prepare annual plan that shows the teams activities
- Conduct regular inventory of the functionality of training machineries
- Provide capacity building training to collage level maintenance teams
- Recommend for external maintenance service
- Provide technical advisory regarding maintenance issues in the collages

Responsibilities

- Responsible for the safety of individuals on the team and that of any maintenance activity.
- Able to Understand and work in accordance with mandatory requirements of Health, Safety and Environmental requirements
- Assist in developing preventive and corrective maintenance programs.
- Self-supervising within the guidance and expectations of the management
- High levels of motivation and action orientated
- Ability to communicate with clarity, both verbally and in written form

2.4.2. Duties & Responsibilities of CAES Maintenance Team

Duties

- Perform scheduled and planned for preventative maintenance in accordance to minimized unplanned downtime

- Record and document all work carried out on all equipment on both paper and electronic systems as is required
- Undertake continuous training and development
- Repairing machines and equipment according to the schedule as necessary.
- Skilled person in the use of hand and power tools
- To take apart machines, equipment, or devices to remove and replace defective parts.
- Check blueprints, repair manuals, or parts catalogs as necessary.
- Experience with precision measuring instruments or electronic testing devices
- Strong time management skills.

Responsibilities

- Stock adequate maintenance materials and equipment to avoid shortages and excesses.
- Able to Understand and work in accordance with mandatory requirements of Health, Safety and Environmental requirements
- Maintenance team technicians/engineers, working with manager and colleagues to ensure smooth workflow with maximum output
- Actively Committed to team development
- Self-supervising within the guidance and expectations of the management
- High levels of motivation and action orientated
- Provide assistance to co-workers when needed
- Ability to communicate with clarity, both verbally and in written form

2.4.3. Duties & Responsibilities of Department Maintenance Team

Duties

- Perform effective diagnosis of break downs and timely repair of equipment to maximize availability
- Able to identify root cause of any losses
- Able to Repairing machines, equipment, or schedule as necessary.
- Excellent problem solving skills
- Skilled in the use of hand and power tools
- Ability to take apart machines or equipment's to remove and replace defective parts.
- Able to Repairing machines, equipment, or schedule as necessary.

- Ability to plan, analyze and challenge problems
- Ability to check blueprints, repair manuals, or parts catalogs as necessary.

Responsibilities

- Self-supervising within the guidance and expectations of the management
- High levels of motivation and action orientated
- Perform general maintenance works to avoid possible failures and malfunctions.
- Complete daily work assignments in a timely and accurate manner.
- Perform installations, assembling, fittings, repairs, and replacement of spare parts as needed.
- Handle emergency maintenances and repair works.
- Maintain complete records of daily maintenance activities.
- Maintain work area clean, safe and organized.
- Operate maintenance equipment safely to avoid accidents.
- Maintain the maintenance tools and equipment in safe, clean and good working conditions.
- Perform maintenance tasks based on pictures, blueprints, written descriptions and oral instructions from Supervisors.

3. Types of maintenance and process

3.1. Preventive Maintenance and Process

Preventive maintenance means all actions carried out on a planned, periodic, and specific schedule to keep an item/equipment in stated working condition through the process of checking and reconditioning. These actions are precautionary steps undertaken to forestall or lower the probability of failures or an unacceptable level of degradation in later service, rather than correcting them after they occur.

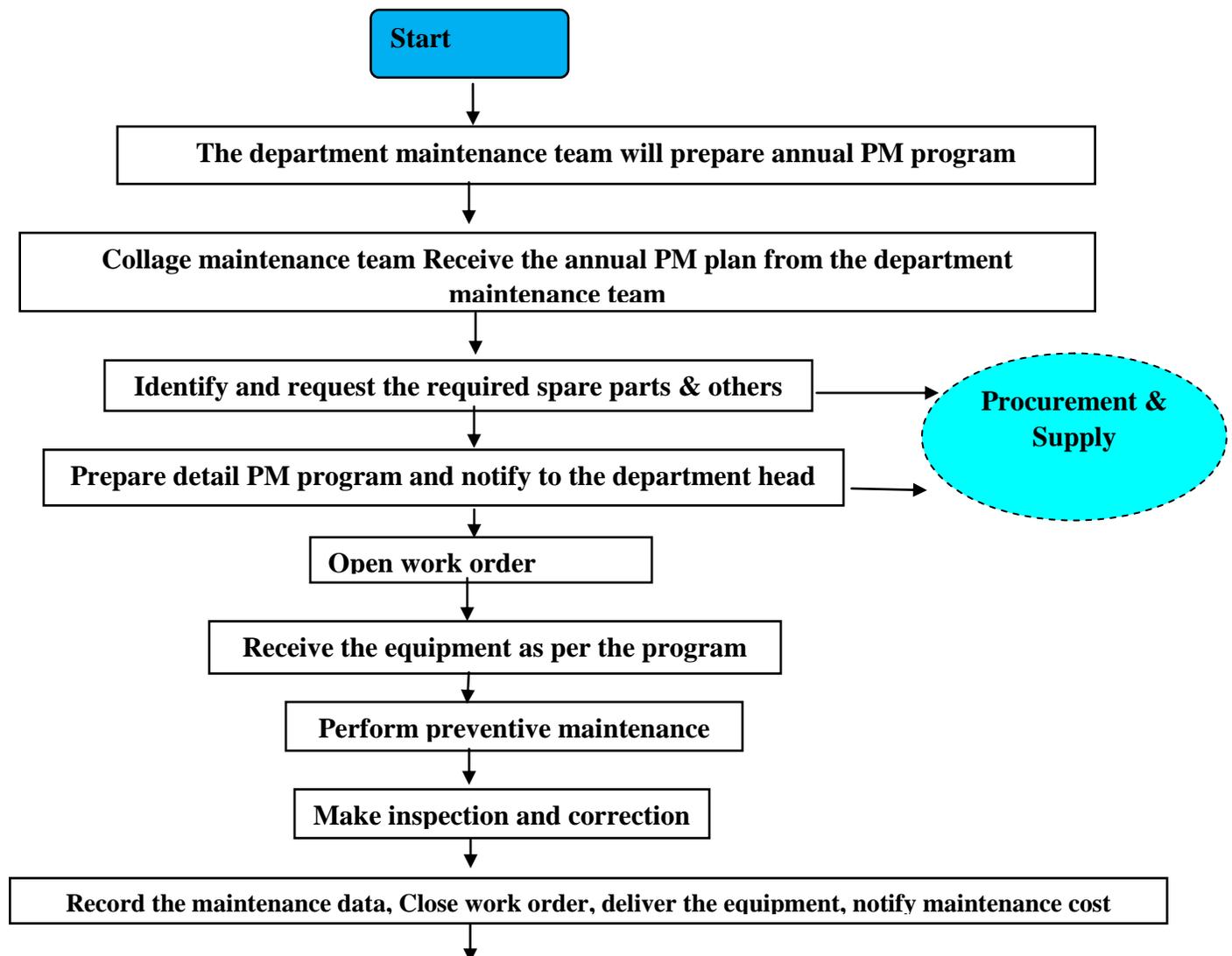
Preventive maintenance is a schedule of planned maintenance actions aimed at the prevention of breakdowns and failures. The primary goal of preventive maintenance is to prevent the failure of equipment before it actually occurs. It is designed to preserve and enhance equipment reliability by replacing worn components before they actually fail. Preventive maintenance activities include equipment checks, partial or complete overhauls at specified periods, oil changes, lubrication and so on. In addition, workers can record equipment deterioration so they know to replace or repair worn parts before they cause system failure. Recent technological advances in

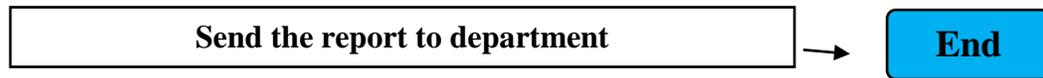
tools for inspection and diagnosis have enabled even more accurate and effective equipment maintenance.

3.1.1. Preventive maintenance Process & its Flow Chart

The team Receive, review & forward annual maintenance program

1. The department maintenance team will prepare annual PM program
2. Collage maintenance team Receive the annual PM plan from the department maintenance team before the coming budget year
3. Collage maintenance team Comment & Reviews the plan and prepares annual maintenance program and forward copy to department maintenance team.
4. The preparation of the PM program by the department maintenance team would be supported by Equipment Maintenance team as required.



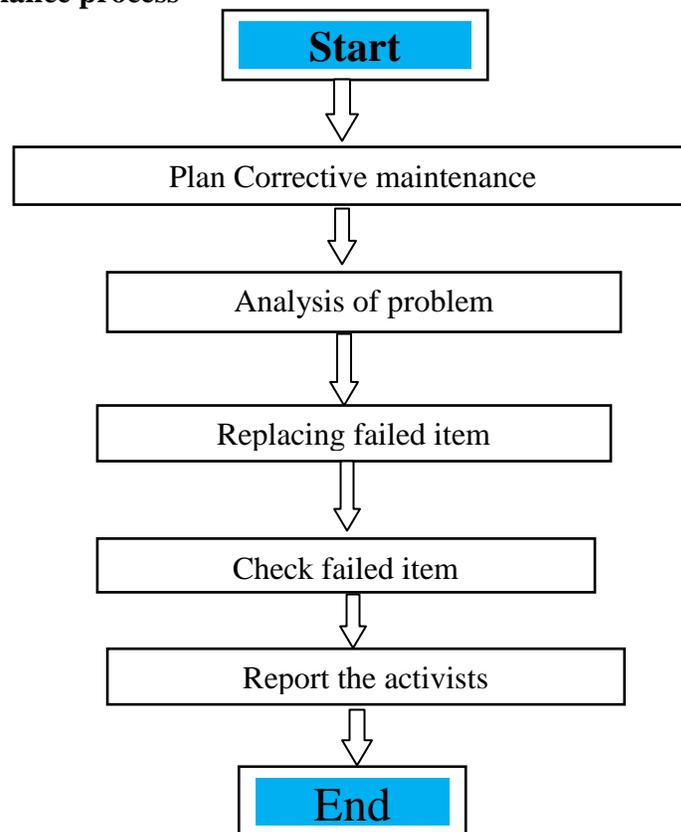


3.2. Corrective Maintenance and Process

Corrective maintenance is required when an item has failed or worn out to bring it back to working order. The two types of Corrective maintenance are the following:

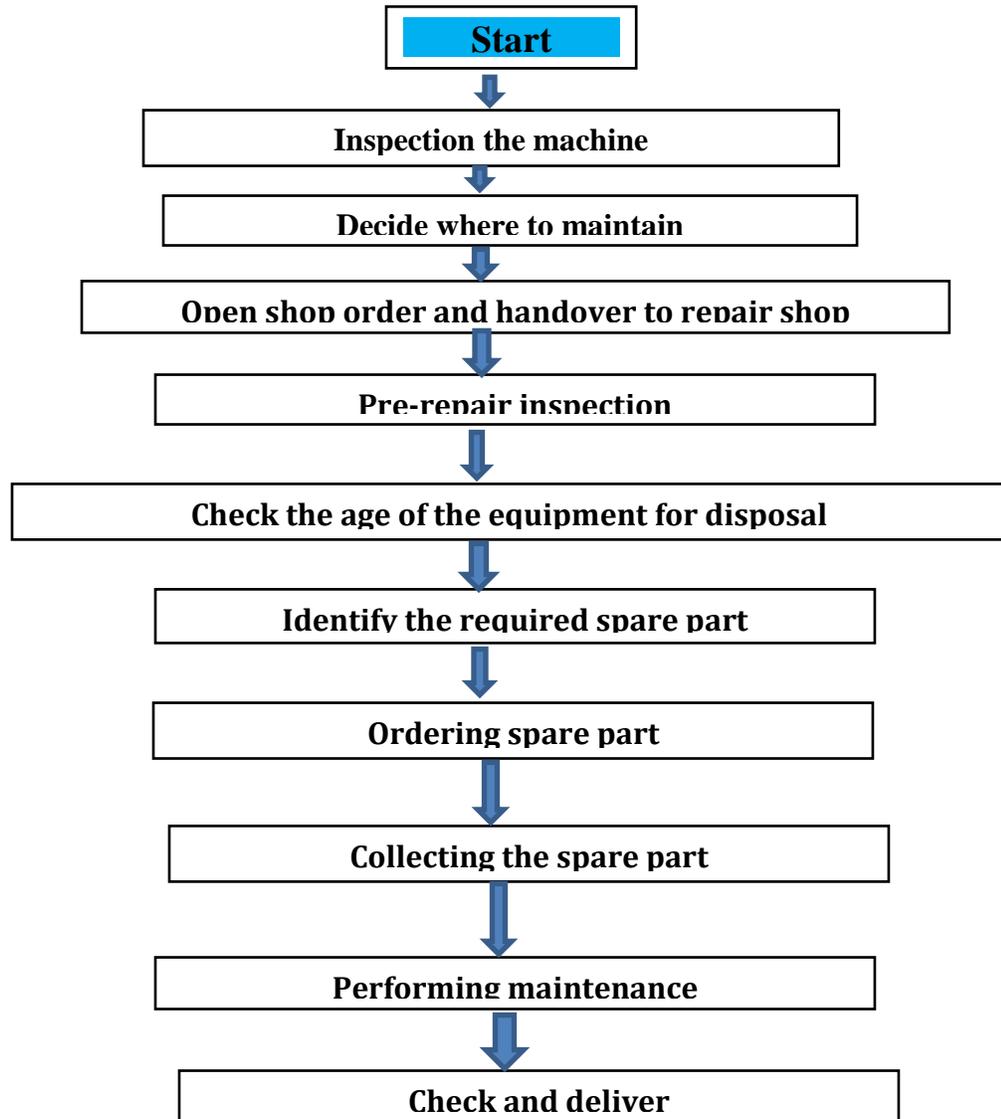
- **Planned Maintenance** is a scheduled service visit carried out by a competent and suitable agent, to ensure that an item of equipment is operating correctly and avoid any unscheduled breakdown and downtime. It is preplanned, and can be date- based on equipment running hours, or on distance travelled.
- **Unplanned Maintenance** the action which is carried out without any scheduled for thoughts or prior planning called unplanned

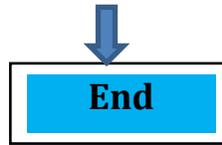
Corrective maintenance process



3.3. Breakdown Maintenance and Process

The breakdown maintenance is a type of maintenance that involves using a machine until it completely breaks down and then repairing it to working order. Breakdown Maintenance is referred to repair and maintenance work performed on a machine, production workshop or component, be it mechanical or electrical after it has failed or broken-down unexpectedly. It is also referred to as maintenance or engineering work related to unexpected plant breakdowns. It is not a planned event and other expenses such as out of budget maintenance costs including overtime, technician call outs and urgent delivery fees for spare parts or support. Maintenance breakdowns can have many causes, some being the result of improper preventive and long term maintenance planning, lack of maintenance inspections, lack or incorrect evaluation of stresses and load cycles on machinery, faulty design and materials and in some cases neglect.





4. Documentation

4.1. Maintenance Work Documentations

The aim of documentation is to give those carrying out the works the Information they need. The key to good documentation is to correctly identify the problem to be solved, and hence to specify an appropriate solution. Documentation is about documents, which communicate information. Those documents provide information and about a certain object, process or topic. A basic rule for good documentation is that the specification describes what needs to be done and the drawing, format shows where.

4.2. Work Schedule & Priority

Scheduling is, of course, one of the advantages to doing PM over waiting until equipment fails and then doing emergency repairs.

- **Sources of scheduling data**

1. Repair note is the primary source of information for scheduling purpose.
2. Maintenance Methods and time estimates, evolved earlier for various maintenance works, will give information regarding the various trades and the work-load involved.
3. Load schedule and the progress report of the various maintenance crews will give information with respect to their availability.
4. Special Material for maintenance and Spare Parts records in the stores will be the source of information as to their availability.

- **Prioritization of Maintenance Work**

All equipment breakdown maintenance activities are classified & will be prioritized as:

A. Urgent Work

Work of an urgent nature, which must be completed as soon as possible. Maintenance schedules this work to start immediately after receipt of the maintenance work order, if materials and manpower requirements available. The sense of urgency will be emanated from the user.

B. Normal Work

Normal Maintenance work is a type of which may be delayed for more than 48 hours and is scheduled as Maintenance resources permit. Most maintenance work orders including PM should fall in this category.

C. Intensive Work

This type of maintenance requires bulk of spare part and long time. It will take time until the spare part gets prepared and the nature of maintenance by itself demands time and precisions.

4.3. Tools for Laboratory Management planning

Planning is the heart of good inspection. As described earlier, the first thing to establish is what items must be maintained and what the best procedure is for performing that task. Establishing good procedures requires a good deal of time and talent.

COST ESTIMATION FORM				
Inspector's Remarks:-				
Work Required				
Activity (Code)	Labor Task Description	Man Hours	Rate	Total Costs
External work required -Quotation		Total Labor Cost →		
Company	Work Required	Quotation No.		
Spare parts Estimated requirement (include assemblies/reconditioned units Details of supplier/company etc.		No.	Total external cost → Quotation No	
Materials required – Lubricants Consumables etc		Total Spare Parts Cost →		
Description		Qty/Unit	Unit Cost	
Inspector' Name	Signature	Date	Total Material Cost →	
			Total Estimated Cost →	
APPROVED /REJECTED	Remarks regarding Cost Estimate:			
Name	Title	Signature	Date	

EQUIPMEFNT PREVENTIVE MAINTENANCE REPORT BY EQUIPMENT TYPE

Project: _____

Line item	Equipment type	Available Qty	Planned Qty	Actual serviced Qty	Availability in %	Spare cost	Lubricant cost	Labor cost	Total cost	Total down time	Remark
1											
2											
3											
4											
5											
6											
7											
8											
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Date: _____

Date: _____

Reference

1. Pasco Bakotich III, P.E Maintenance manual.
2. B.C. Dhillon, Engendering maintenance, CRC, press LLC, London 2002.
3. Organizational setup and record keeping.
4. Equipment maintenance management system manual. /ECWC/
5. [https://www.gretsampleresume.com/job-Responsibilities/maintenance worker-Responsibilities](https://www.gretsampleresume.com/job-Responsibilities/maintenance-worker-Responsibilities)

Checklists