UNIT 1.0 – Fundamentals of Industrial Maintenance

1.1 Definition and Aim of Maintenance Engineering

Definition of Maintenance Engineering

Maintenance engineering is the branch of engineering concerned with keeping machines, equipment, tools, and industrial systems in proper working condition through inspection, repair, servicing, and replacement.

It ensures that equipment performs efficiently, safely, and reliably.

Aim of Maintenance Engineering

The main aims are:

- To reduce machine breakdowns
- To increase equipment efficiency
- To improve production quality
- To ensure safety of workers and machines
- To reduce maintenance cost
- To increase service life of equipment
- To minimize production downtime
- To maintain reliability and availability of machines

1.2 Primary and Secondary Functions and Responsibility of Maintenance Department

Primary Functions of Maintenance Department

Primary functions directly support machine operation and production.

Functions:

1. Inspection of machines and equipment
2. Lubrication and servicing
3. Repair and replacement of faulty parts
4. Preventive maintenance
5. Breakdown maintenance
6. Installation and commissioning of equipment
7. Maintaining production efficiency

Secondary Functions of Maintenance Department

Secondary functions support overall maintenance activities.

Functions:

1. Inventory control of spare parts
2. Record keeping and documentation
3. Training of maintenance staff
4. Safety management
5. Cost control
6. Waste reduction
7. Energy conservation

Responsibilities of Maintenance Department

- Ensure continuous operation of equipment
- Reduce downtime and failures
- Maintain safety standards
- Schedule maintenance activities
- Maintain maintenance records
- Ensure availability of spare parts
- Improve machine reliability

1.3 Types of Maintenance

Preventive Maintenance

Definition

Preventive maintenance is planned maintenance carried out before machine failure occurs to avoid breakdowns.

Purpose

- Prevent sudden failures
- Increase machine life
- Improve reliability and safety

Activities

- Lubrication
- Cleaning
- Inspection
- Tightening bolts
- Replacing worn parts

Examples

- Regular oil change in a generator
- Lubricating bearings of a motor every month
- Cleaning air filters in compressors

Advantages

- Reduces breakdowns
- Reduces downtime
- Improves efficiency

Disadvantages

- Requires planning
- Sometimes unnecessary maintenance is done

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2. Periodic Maintenance

Definition

Periodic maintenance is maintenance performed at fixed intervals of time.

Purpose

To maintain equipment performance through scheduled servicing.

Activities

- Monthly inspection
- Half-yearly servicing
- Annual overhaul

Examples

- Servicing a car every 5000 km
- Inspection of boilers every 6 months
- Yearly maintenance of air conditioners

Advantages

- Easy to schedule
- Increases equipment reliability

Disadvantages

- Maintenance may be done even when machine condition is good

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3. Predictive Maintenance

Definition

Predictive maintenance is maintenance based on predicting equipment failure using monitoring techniques.

Purpose

To detect faults before breakdown occurs.

Techniques Used

- Vibration analysis
- Oil analysis
- Thermal imaging
- Ultrasonic testing

Examples

- Detecting bearing failure through vibration monitoring
- Using thermal camera to identify overheating motors

Advantages

- Reduces unnecessary maintenance
- Saves maintenance cost
- Increases machine availability

Disadvantages

- Requires skilled personnel
- Monitoring equipment is costly

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4. Condition-Based Maintenance (CBM)

Definition

Condition-based maintenance is maintenance performed according to the actual condition of equipment.

Purpose

To carry out maintenance only when necessary.

Monitoring Methods

- Temperature monitoring
- Pressure monitoring
- Noise monitoring
- Performance analysis

Examples

- Replacing machine bearings only when vibration level increases
- Servicing a pump when pressure drops below normal

Advantages

- Reduces downtime
- Extends service life
- Avoids unnecessary repairs

Disadvantages

- Requires continuous monitoring
- Initial setup cost is high

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5. Breakdown Maintenance

Definition

Breakdown maintenance is maintenance performed after equipment fails.

Purpose

To restore machine operation after breakdown.

Examples

- Repairing a motor after it stops working
- Replacing a broken gear in a machine

Advantages

- No maintenance cost before failure
- Simple maintenance method

Disadvantages

- Sudden production stoppage
- High repair cost
- Safety risks

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6. Corrective Maintenance

Definition

Corrective maintenance is maintenance performed to correct defects found during inspection or operation.

Purpose

To improve machine performance and reliability.

Examples

- Adjusting machine alignment

- Replacing damaged wiring

Advantages

- Prevents major failures
- Improves efficiency

Disadvantages

- Requires regular inspection

1.4 Types and Applications of Tools and Equipment Used for Maintenance

Hand Tools

Used for general maintenance work.

Examples

- Spanner
- Screwdriver
- Hammer
- Pliers
- Allen keys

Applications

- Tightening and loosening
- Fitting and assembly work

Measuring Tools

Examples

- Vernier caliper
- Micrometer

- Dial gauge
- Multimeter

Applications

- Checking dimensions
- Electrical measurements
- Alignment checking

Power Tools

Examples

- Drilling machine
- Grinder
- Welding machine

Applications

- Cutting
- Grinding
- Drilling

Lifting Equipment

Examples

- Crane
- Jack
- Hoist

Applications

- Lifting heavy equipment
- Machine installation

Diagnostic Equipment

Examples

- Vibration analyzer
- Thermometer

- Pressure gauge

Applications

- Fault diagnosis
- Condition monitoring

1.5 Maintenance Cost and Its Relation with Replacement Economy

Maintenance Cost

Maintenance cost is the total expenditure incurred for maintaining equipment in working condition.

Includes

- Labor cost
- Spare parts cost
- Lubrication cost
- Inspection cost
- Repair cost

Replacement Economy

Replacement economy refers to deciding whether to repair existing equipment or replace it with new equipment.

Relation Between Maintenance Cost and Replacement Economy

- As equipment becomes old, maintenance cost increases.
- Frequent repairs reduce efficiency.
- At a certain stage, replacement becomes more economical than repair.

Decision Factors

- Cost of repair
- Cost of new equipment

- Efficiency of old machine
- Downtime losses
- Availability of spare parts

1.6 Service Life of Equipment

Definition

Service life is the period during which equipment performs efficiently and reliably under specified operating conditions.

Factors Affecting Service Life

1. Quality of equipment
2. Operating conditions
3. Maintenance practices
4. Lubrication
5. Load conditions
6. Environmental conditions
7. Frequency of use

Methods to Increase Service Life

- Regular maintenance
- Proper lubrication
- Timely repairs
- Correct operation
- Avoid overloading
- Proper storage and cleaning

Importance of Long Service Life

- Reduces replacement cost
- Improves productivity
- Increases reliability
- Reduces downtime
- Saves maintenance expenses

UNIT 2.0 – Preventive and Periodic Maintenance

2.3 Preventive Maintenance – Concept, Need, Steps and Advantages

Concept of Preventive Maintenance

Preventive maintenance is a planned maintenance activity carried out before the occurrence of machine failure. It includes regular inspection, servicing, lubrication, cleaning, and replacement of worn parts to prevent breakdowns.

It is performed according to a fixed schedule based on time, operating hours, or machine condition.

Need of Preventive Maintenance

1. To Reduce Machine Breakdowns

Regular inspection helps identify problems before failure occurs.

2. To Increase Equipment Life

Timely maintenance reduces wear and tear.

3. To Improve Safety

Faulty parts are detected early, reducing accidents.

4. To Reduce Maintenance Cost

Small repairs prevent expensive major repairs.

5. To Improve Productivity

Machines work efficiently with fewer interruptions.

6. To Reduce Downtime

Unexpected stoppages are minimized.

Steps in Preventive Maintenance

Step 1: Inspection

Check machine condition, leakage, wear, alignment, vibration, etc.

Step 2: Cleaning

Remove dust, dirt, grease, and unwanted materials.

Step 3: Lubrication

Apply proper lubricant to moving parts.

Step 4: Adjustment

Adjust alignment, belt tension, clearance, etc.

Step 5: Replacement

Replace worn-out or damaged parts.

Step 6: Testing

Run the machine and verify proper operation.

Step 7: Record Keeping

Maintain maintenance records and schedules.

Advantages of Preventive Maintenance

- Reduces sudden breakdowns
- Increases machine life
- Improves reliability
- Reduces downtime
- Improves safety
- Increases production efficiency
- Reduces repair cost
- Ensures smooth operation

2.4 Maintenance and Replacement Schedules, Standard Data for Maintenance and Replacement of Parts

Maintenance Schedule

Definition

A maintenance schedule is a planned timetable showing when maintenance activities should be performed.

Purpose of Maintenance Schedule

- Ensure regular servicing
- Avoid machine failure
- Reduce downtime
- Improve equipment life

Types of Maintenance Schedule

1. Daily Maintenance Schedule

- Cleaning
- Lubrication check
- Visual inspection

2. Weekly Maintenance Schedule

- Belt inspection
- Tightening bolts
- Checking oil levels

3. Monthly Maintenance Schedule

- Filter cleaning
- Alignment checking
- Electrical inspection

4. Annual Maintenance Schedule

- Overhauling
- Major repairs
- Replacement of worn parts

Replacement Schedule

Definition

A replacement schedule specifies the time or condition when machine parts should be replaced.

Need for Replacement Schedule

- Avoid sudden failures
- Maintain efficiency
- Ensure safety
- Reduce maintenance cost

Standard Data for Maintenance and Replacement

Standard data includes manufacturer recommendations and maintenance records used for planning maintenance and replacement.

Standard Data Includes

- Service life of parts
- Operating hours
- Lubrication intervals
- Inspection frequency
- Replacement intervals

.5 Steps/Procedure for Periodic and Preventive Maintenance

(i) Machine Tools

Procedure

1. Clean machine surfaces
2. Check lubrication system
3. Inspect belts and gears
4. Tighten nuts and bolts
5. Check alignment and vibration
6. Inspect electrical connections
7. Replace worn parts
8. Test machine operation

(ii) Pumps

Procedure

1. Check oil and lubrication
2. Inspect seals and gaskets
3. Check suction and discharge lines
4. Clean filters and strainers
5. Inspect impeller condition
6. Check leakage and vibration
7. Tighten connections
8. Test pump performance

(iii) Air Compressors

Procedure

1. Inspect air filter
2. Check oil level
3. Drain moisture from receiver tank
4. Inspect belts and pulleys
5. Check pressure gauge
6. Inspect valves and pipelines
7. Lubricate moving parts
8. Test compressor operation

(iv) Diesel Generating (DG) Sets

Procedure

1. Check fuel level
2. Inspect engine oil level
3. Clean air filter
4. Check battery condition
5. Inspect cooling system
6. Check electrical connections
7. Start and test DG set
8. Monitor vibration and noise

Importance of Preventive and Periodic Maintenance

- Increases equipment life
- Reduces production loss
- Improves machine reliability
- Reduces repair cost
- Improves operational safety

2.6 Repair Cycle – Concept and Importance

Concept of Repair Cycle

A repair cycle is the complete sequence of activities involved in repairing equipment from fault detection to restoration of normal operation.

It includes inspection, dismantling, repairing, reassembly, testing, and returning the machine to service.

Steps in Repair Cycle

1. Fault identification
2. Inspection and diagnosis
3. Dismantling of equipment

4. Cleaning and checking parts
5. Repair or replacement of damaged parts
6. Reassembly
7. Testing and adjustment
8. Returning equipment to operation

Importance of Repair Cycle

1. Reduces Downtime

Systematic repair helps restore machines quickly.

2. Improves Reliability

Proper repairs improve machine performance.

3. Extends Equipment Life

Timely repairs prevent major damage.

4. Improves Maintenance Planning

Helps organize manpower and spare parts.

5. Reduces Maintenance Cost

Early repairs avoid costly breakdowns.

6. Ensures Safety

Properly repaired equipment operates safely.

Unit 3.0 Wear and Corrosion

3.1 Basic Fundamentals of Friction and Wear

Friction

Friction is the resisting force that opposes the relative motion between two surfaces in contact.

Types of Friction

1. **Static Friction** – Acts when bodies are at rest.
2. **Sliding Friction** – Acts when surfaces slide over each other.
3. **Rolling Friction** – Occurs in rolling motion; less than sliding friction.
4. **Fluid Friction** – Resistance offered by fluids.

Advantages of Friction

- Helps in walking
- Enables braking
- Power transmission through belts and clutches

Disadvantages of Friction

- Causes wear and tear
- Produces heat
- Reduces efficiency

Wear

Wear is the gradual removal of material from a surface due to mechanical action.

Causes of Wear

- Friction between surfaces
- Poor lubrication
- Dust and abrasive particles
- Excessive load and temperature

3.2 Wear Mechanism

Wear mechanism means the process by which material removal takes place.

Main Wear Mechanisms

1. Abrasive Wear

Occurs when hard particles scratch softer surfaces.

Example: Dust particles between machine parts.

2. Adhesive Wear

Occurs when two metal surfaces slide and small particles stick and tear away.

3. Surface Fatigue Wear

Repeated stress causes cracks and surface failure.

Example: Bearings and gears.

4. Corrosive Wear

Wear caused due to chemical reactions along with friction.

5. Erosive Wear

Occurs due to high-speed fluid or particles striking the surface.

3.3 Wear – Types, Causes and Effects

Types of Wear

- Abrasive wear
- Adhesive wear
- Fatigue wear
- Corrosive wear
- Erosive wear

Causes of Wear

- Lack of lubrication
- Misalignment

- Excessive loading
- High temperature
- Contaminants and dust

Effects of Wear

- Loss of material
- Reduced machine efficiency
- Noise and vibration
- Increase in maintenance cost
- Failure of machine parts

3.4 Wear Reduction Methods

Methods to Reduce Wear

1. Proper lubrication
2. Surface hardening
3. Use of wear-resistant materials
4. Proper alignment of machine parts
5. Regular maintenance and cleaning
6. Reducing excessive load
7. Using protective coatings

3.5 Function, Types and Applications of Lubricants

Lubricant

A lubricant is a substance introduced between moving surfaces to reduce friction and wear.

Functions of Lubricants

- Reduce friction
- Reduce wear
- Remove heat
- Prevent corrosion
- Reduce noise
- Seal gaps between moving parts

Lubrication Methods – Working and Applications

1. Screw Down Grease Cup

Working

A screw-down grease cup contains grease inside a cup fitted over the bearing. When the cap is rotated downward, pressure is created on the grease and it is forced slowly into the bearing surface for lubrication.

Applications

- Low-speed bearings
- Small machines
- Agricultural equipment

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2. Pressure Grease Gun

Working

A pressure grease gun is used to supply grease under pressure to machine parts. Grease is stored in a barrel and when the handle is pressed, grease is forced through a nozzle into bearings or joints.

Applications

- Automobiles
- Heavy machinery
- Industrial bearings

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3. Splash Lubrication

Working

In splash lubrication, rotating machine parts such as gears or connecting rods dip into an oil sump and splash oil onto other moving parts. The splashed oil forms a lubricating film over the surfaces.

Applications

- Gearboxes
- Internal combustion engines
- Enclosed machinery systems

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4. Gravity Lubrication

Working

In gravity lubrication, oil is stored in a reservoir placed above the machine part. Due to gravity, oil flows slowly through pipes or holes onto the moving surfaces and provides lubrication.

Applications

- Machine tools
- Light-duty machinery
- Workshop equipment

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5. Wick Feed Lubrication

Working

In wick feed lubrication, a cotton or woolen wick is used to transfer oil from a reservoir to the bearing through capillary action. The wick supplies oil continuously in small quantities.

Applications

- Electric motors
- Sewing machines
- Small bearings

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6. Side Feed Lubrication

Working

In side feed lubrication, oil is supplied drop by drop from an oil cup fitted at the side of the bearing. The oil reaches the moving surfaces slowly and continuously.

Applications

- Machine tool bearings
- Light-duty machines
- Small mechanical equipment

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7. Ring Lubrication

Working

In ring lubrication, a loose ring is placed around a rotating shaft. As the shaft rotates, the ring also rotates and lifts oil from the sump to the shaft and bearings, providing continuous lubrication.

Applications

- Electric motors
- Medium-speed bearings
- Industrial machines

Types of Lubricants

1. Liquid Lubricants

Examples: Mineral oil, engine oil

Applications: Engines, gearboxes

2. Semi-solid Lubricants

Examples: Grease

Applications: Bearings, low-speed machines

3. Solid Lubricants

Examples: Graphite, Molybdenum disulphide

Applications: High temperature conditions

4. Gaseous Lubricants

Example: Air

Applications: Precision instruments

3.7 Definition, Principle and Factors Affecting Corrosion

Corrosion

Corrosion is the gradual destruction of metal due to chemical or electrochemical reaction with the environment.

Principle of Corrosion

Corrosion occurs when metal reacts with oxygen, moisture or chemicals and forms compounds like oxides.

Example

Rusting of iron:

$$4Fe+3O2+6H2O \rightarrow 4Fe(OH)3$$

Factors Affecting Corrosion

Internal Factors

- Purity of metal
- Composition of metal
- Surface condition

External Factors

- Moisture
- Temperature
- Presence of salts and acids
- Atmospheric pollution

3.8 Types of Corrosion

1. Dry Corrosion

Occurs due to direct chemical attack without moisture.

2. Wet Corrosion

Occurs in presence of moisture or electrolyte.

Types of Wet Corrosion

- Galvanic corrosion
- Pitting corrosion
- Crevice corrosion
- Stress corrosion

3.9 Corrosion Prevention Methods

Methods of Preventing Corrosion

1. Painting and Coating

Protects metal surface from air and moisture.

2. Lubrication

Forms protective film over surfaces.

3. Galvanization

Coating iron with zinc.

4. Electroplating

Applying protective metal coating.

5. Cathodic Protection

Making metal cathode to prevent corrosion.

6. Use of Corrosion Resistant Materials

Example: Stainless steel

7. Proper Maintenance

Regular inspection and cleaning.

Unit 4.0 Fault Tracing

4.1 Fault Tracing – Concept and Importance

Fault Tracing

Fault tracing is the systematic process of identifying, locating, and correcting faults or defects in machines and equipment.

It helps in finding the exact cause of malfunction and restoring normal operation.

Objectives of Fault Tracing

- To identify the root cause of failure
- To reduce machine downtime
- To improve machine efficiency
- To ensure safe operation
- To reduce maintenance cost

Importance of Fault Tracing

1. Prevents sudden machine breakdowns
2. Saves repair time and cost
3. Improves reliability of equipment
4. Increases productivity
5. Ensures safety of operators
6. Helps in proper maintenance planning

4.2 Decision Tree – Concept, Need and Applications

Decision Tree

A decision tree is a step-by-step diagram used to identify faults by asking questions and checking conditions logically.

It helps technicians move from symptom to cause systematically.

Need of Decision Tree

- Simplifies troubleshooting
- Reduces confusion during fault finding
- Saves diagnosis time
- Helps inexperienced technicians
- Improves accuracy in maintenance

Applications of Decision Tree

- Machine tools troubleshooting
- Electrical fault diagnosis
- Hydraulic systems
- Pneumatic systems
- Automotive maintenance
- Thermal equipment maintenance

4.3 Sequence of Fault Finding Activities

Steps in Fault Finding

1. Identify the Problem

Observe symptoms such as noise, overheating, leakage, vibration, etc.

2. Collect Information

Check machine history, operator feedback, manuals, and maintenance records.

3. Inspect the Machine

Perform visual inspection and check components.

4. Analyze Possible Causes

Find probable reasons for the fault.

5. Test the Components

Use measuring instruments and testing methods.

6. Locate the Fault

Identify the defective component or system.

7. Repair or Replace

Correct the fault by repair or replacement.

8. Test the Machine

Run the machine and verify proper operation.

Simple Decision Tree for Fault Finding

```
Machine Not Working
        |
   Check Power Supply
      /        \
   No           Yes
Repair        Check Motor
Supply          /    \
             Fault   OK
             Repair  Check Load
```

4.4 Decision Tree for Different Equipment

A. Pump Fault Decision Tree

Problem: Pump Not Delivering Fluid

```
Pump Not Working
       |
Check Power Supply
    /        \
 No          Yes
Repair     Check Suction
Supply        |
           Blocked?
          /      \
        Yes      No
      Clean    Check Impeller
```

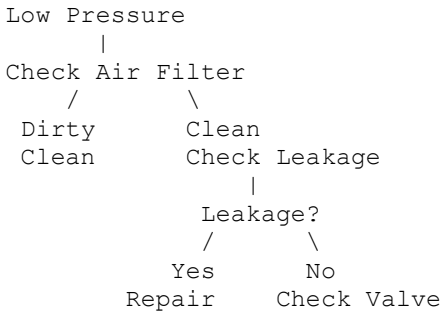
Common Causes

- No power supply

- Air leakage
- Blocked suction pipe
- Damaged impeller

B. Air Compressor Fault Decision Tree

Problem: Low Air Pressure

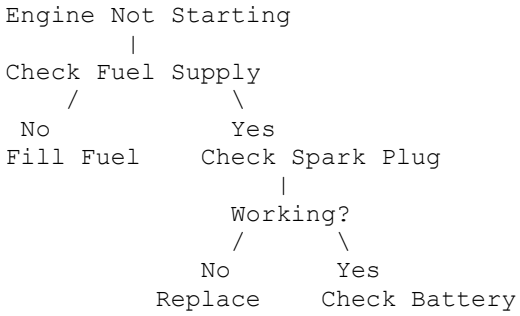


Common Causes

- Air leakage
- Dirty filter
- Valve damage
- Loose belt

C. Internal Combustion Engine Decision Tree

Problem: Engine Does Not Start

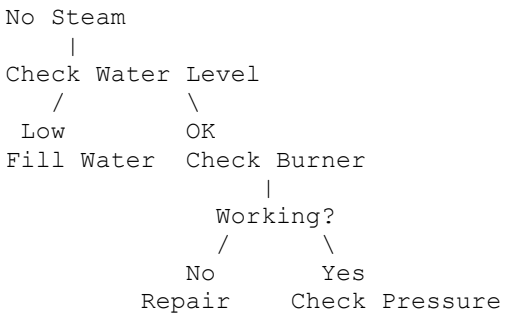


Common Causes

- No fuel
- Weak battery
- Faulty spark plug
- Blocked fuel line

D. Boiler Fault Decision Tree

Problem: Boiler Not Producing Steam

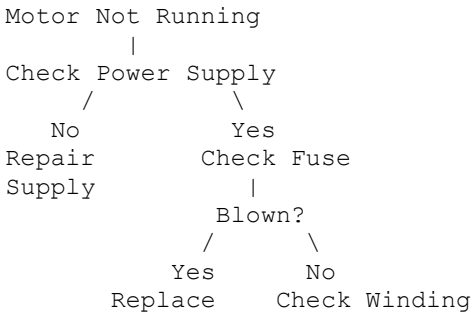


Common Causes

- Low water level
- Burner failure
- Pressure loss
- Fuel supply issue

E. Electrical Motor Decision Tree

Problem: Motor Not Running



Common Causes

- Power failure

- Blown fuse
- Winding fault
- Bearing seizure

4.5 Types of Faults in Machine Tools and Their General Causes

1. Mechanical Faults

Causes

- Wear of components
- Misalignment
- Loose fasteners
- Lack of lubrication

Examples

- Excessive vibration
- Noise
- Shaft failure

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2. Electrical Faults

Causes

- Short circuit
- Loose wiring
- Insulation failure
- Voltage fluctuation

Examples

- Motor overheating
- Fuse blowing
- Machine not starting

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3. Hydraulic Faults

Causes

- Oil leakage
- Low oil pressure
- Air in hydraulic system
- Pump failure

Examples

- Slow movement
- Loss of pressure

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4. Pneumatic Faults

Causes

- Air leakage
- Moisture in air lines
- Valve blockage
- Compressor issues

Examples

- Low air pressure
- Irregular operation

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5. Thermal Faults

Causes

- Overheating
- Poor cooling
- Excessive load
- Friction

Examples

- High temperature
- Reduced efficiency

Unit 5.0 Recovery, Reconditioning and Retrofitting

5.1 Definition of Recovery, Reconditioning and Retrofitting

1. Recovery

Recovery is the process of restoring damaged, worn-out or failed machine parts so that they can be used again.

It helps in improving the service life of components and reduces replacement cost.

Examples

- Repairing worn shafts
- Welding cracked machine parts
- Restoring damaged gears

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2. Reconditioning

Reconditioning is the process of repairing, cleaning, adjusting and restoring equipment or components to near-original working condition.

It improves performance and reliability of machines.

Examples

- Engine overhauling
- Bearing replacement
- Regrinding machine surfaces

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3. Retrofitting

Retrofitting means adding new technology or modern components to old machines to improve performance, efficiency and safety.

Examples

- Installing CNC system on conventional machine

- Replacing old motors with energy-efficient motors
- Adding automatic control systems

5.2 Methods of Recovery and Their Applications

1. Welding

Description

Used to repair cracks, broken parts and worn surfaces by joining metal.

Applications

- Shafts
- Frames
- Gears
- Machine structures

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2. Metal Spraying

Description

Molten metal is sprayed onto worn surfaces to restore dimensions.

Applications

- Shafts
- Bearings
- Rollers

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3. Electroplating

Description

A thin metal coating is deposited on the surface using electrochemical process.

Applications

- Corrosion protection

- Decorative finishing
- Surface restoration

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4. Brazing and Soldering

Description

Joining metals using filler material without melting base metal.

Applications

- Pipes
- Small machine parts
- Electrical components

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5. Machining

Description

Material is removed to restore shape and dimensions.

Applications

- Reconditioning shafts
- Surface finishing
- Precision repair

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6. Heat Treatment

Description

Heating and cooling process used to improve hardness and strength.

Applications

- Gears
- Tools
- Bearings

5.3 Selection Criteria of Recovery Methods

The recovery method is selected based on the following factors:

1. Nature of Damage

Type and extent of wear, crack or corrosion.

2. Material of Component

Recovery process depends on metal type and properties.

3. Cost of Repair

Repair should be economical compared to replacement.

4. Availability of Equipment

Machines and tools required for recovery should be available.

5. Required Accuracy

Precision requirements of repaired component.

6. Service Conditions

Load, temperature and working environment.

7. Time Required

Method should minimize machine downtime.

5.4 Reconditioning – Process, Features and Advantages

Reconditioning Process

Step 1 – Inspection

Check condition of machine or component.

Step 2 – Cleaning

Remove dirt, rust, oil and deposits.

Step 3 – Dismantling

Separate damaged components.

Step 4 – Repair or Replacement

Repair worn parts or replace damaged parts.

Step 5 – Reassembly

Assemble all components properly.

Step 6 – Testing

Check performance and accuracy.

Features of Reconditioning

- Restores machine efficiency
- Extends service life
- Improves reliability
- Reduces breakdowns
- Maintains original performance

Advantages of Reconditioning

1. Lower cost than replacement
2. Saves material and resources
3. Reduces machine downtime
4. Improves machine performance
5. Increases equipment life
6. Economical maintenance method

5.5 Retrofitting – Concept, Need and Applications

Concept of Retrofitting

Retrofitting involves modernization of old equipment by installing advanced technology and updated systems.

It upgrades machine performance without completely replacing the machine.

Need of Retrofitting

1. Improve productivity
2. Increase machine accuracy
3. Reduce energy consumption
4. Improve safety
5. Extend machine life
6. Reduce maintenance cost
7. Introduce automation

Applications of Retrofitting

Mechanical Industry

- CNC conversion of conventional machines

Electrical Systems

- Replacing old motors and drives

Automotive Industry

- Emission control system upgrades

Thermal Systems

- Boiler efficiency improvement

Hydraulic and Pneumatic Systems

- Automatic control installations