Unit No. 3.

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Testing & Maintenance of Polishing Machines.

* Objectives [Importance] of Testing :-

- The main objective of testing is to know the quality of the machine, quality of materials used for manufacturing the machine & also to check it's behaviour & performance as per the design data.
- The various results obtained during testing should tally with the design data.
- The variation in the actual results if any should be within the specified allowable limits.
- If actual results are beyond the specified limits then the manufacturer should investigate the reasons & improve the design & manufacturing process accordingly.
- To check the improved design by retesting of machine.

* Role of Bereau of Indian standards in Testing of Electrical Equipment / Significance of I.S.S. :-

- Indian National institute i.e. Indian standard Bereau specifies the standards for particular machines apparatus, equipments material & so many engineering items.
- Newly manufactured machines by a factory or film has to undergo specified testing, measurement etc. As the norms fixed by this institute to get certification or ISI marks.
- This certification is a must in some cases & customers are sure of quality of the machines as it has undergone standard tests decided by their institution.

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* Objectives of I.S.S. :-

- To specify standards for machines, equipment, apparatus, materials etc.
- To suggest standard tests for nearly manufactured machines.
- To specify the plus/minus limits for the test results.
- To specify the tolerance to accept the items
- To give I.S.S. certification.

* Tests on Electrical Machines before commissioning

Ⓐ Mechanical tests:-

- Read the data printed on the name plate & check the same for the machine.
- See that all the parts are in position & all the accessories are available & no parts are missing. See also the compactness of the machine.
- fit in the parts which are supplied separately alongwith the main machine.
- see that there is no damage during transport, tighten the nut bolts, screws etc. if loose.
- check the alignment of the shaft, coupling etc & tightness of terminal connections.
- check the condition of bearings by moving the shaft manually & provide a proper lubrication greasing.
- check the clearance betⁿ stationary & rotating parts as per the specifications.
- check the terminal connections & tighten if required.
- Bearing & lubrication for free & smoothness of rotating parts.

- check the spring tension, brush position & shape of brushes. check also commutator surface & commutator risers.

(3) Electrical tests :-

- check winding resistance as per given values.
- check insulation resistance bet^n windings & core, with external body.
- Take reduced voltage run test.
- check ~~*~~ cooling systems of electrical operation.
- check earthing provision.

After these primary tests the necessary ISI tests are carried out.

* Different Tests :-

- In Indian standard Institution (ISI) has laid down the standard specifications for various machines & different tests are framed to check the standard & quality of the machine. These tests are generally grouped in 4 categories :-

a) Routine tests
b) Type tests
c) Special tests
d) Supplementary tests

a) Routine tests :-

- These tests are carried out on earth & every machine manufactured in the industry

b) Type tests :-

- These tests are carried out on few machines from the lot of the machines of same design & specifications. The test results of few tested machines are treated same, for the complete lot of the machines say, if one hundred units are manufactured then random any 2 or 3 units are taken for testing.

c) special tests :-

- These tests are carried out on machines for specified purpose only i.e. if a purchaser asks for results from these tests then only these are carried out & results are seen by the purchasers.

d) Supplementary tests :-

- These are performed whenever necessary & are not very common. These are carried out if additional information is required about a particular machine.

Methods of testing:-

- In order to check the performance such as efficiency, regulation, losses, change in speed, condition of commutation, temperature rise etc. The machine may be tested by direct methods, indirect methods & regenerative methods.

i) Direct method of testing:-

- In this method the machine is directly connected with the load or a pulley & brake arrangement is provided or a electrical load may be connected in the form of a calibrated machine.
- Brake test & calibrated machine test are the examples of direct tests. These are for rotating machine. For static machine like transformer load test is carried out by connecting electrical load on secondary.

ii) Indirect method of testing:-

- As the name suggests load is not connected directly on the machine but it is run on no load & the data obtained from the no load test is used to find the efficiency, losses etc. at different loads.
- Swinburne's test is the example of indirect test.
- For transformer, O.C. & S.C. tests are the indirect tests.

* Advantages of indirect testing :-

- facility to test high capacity machines on which direct loading not possible.
- Time & energy saving in testing.
- Results are approximate but not far away from actual.

iii) Regenerative method of testing :-

- Two identical machines are electrically & mechanically connected together & o/p of second machine is fed back to first machine which saves power for testing. Hopkinson's test or back to back test is example of regenerative test.
- Similar back to back test is carried on two identical transformers.
- The above tests are explained in detail alongwith the illustrations in further chapter.

* Concept of routine, preventive, & breakdown maintenance :-

1) Routine Maintenance :-

As the name suggests, it is the maintenance as a routine work i.e. daily work so routine maintenance is a overall daily maintenance of the machine.

- After the stoppage of the machine on the earlier day, the next day the machine is to be nearly cleaned to remove dirt, dust near wastages scraps.
- For cleaning, a soft cloth, broom, vacuum cleaner, blower may be used.

- check the switches, starters, indicates neatly before starting machine.
- In daily routine work, current, voltage, power may be periodically observed or noted & a record may be kept for certain purpose.
- Each connection must be checked to avoid shocks from leakage current.
- While machine is working, thermal conditions must be ascertained by checking temp. Excessive temp. may damage the insulation.
- for mechanical stability of the machine, see that the working is noiseless, vibration less. If not take it for necessary corrections/ repairs / maintenance.
- So routine maintenance is to check daily electrical & mechanical stable conditions.

2) Preventive Maintenance :-

- In order that, major faults not to develop in future & to prevent from burning out, damages, breakdown etc, a due care is taken by preparing a planned schedule of maintenance which can be called as preventive maintenance.
- For the different machines like rotating machine (generator, motor) & static machines (transformer) maintenance schedule charts are prepared.
- These charts are displayed & maintenance schedule charts are prepared.
- These charts are displayed & maintenance schedule is excersised & followed.

- In this schedule the programme of maintenance is declared like,

Sr. No.	Inspection Frequency	Items to be inspected	Inspection notes	Action of maintenance

3) Breakdown Maintenance :-

- As the title name suggests, this maintenance is essential in case of failure of machine activity/ breakdown in operation of machinery.
- Failure of machine may take place due to serious electrical or mechanical fawts.
- Electrical fawts may be due to short circuit, overheating, failure of insulation, earth fawt etc.
- Mechanical faults may be due to damages of parts, bearing, jamming, failure of cooling system, clogging of ventilating ducts, much more deviation in the air gaps between rotating & static parts; loosing of stampings of iron cores etc.
- After such happenings the machine is completely shut down & immediately to be taken for, i) inspection ii) fawt finding & repairs so that continuty of working can be brought back in a shorter period to avoid further shutdowns.

- See that, to avoid such happenings,
i) Insulation is in stock. (If not make necessary replacement).
ii) See free motions of rotating parts (if not take maintenance/repair steps, greesing, oiling etc.)

iii) Check uniform air-gaps between static & rotating gears.
iv) Tighten the loose bolts, nuts, parts, terminals etc.
v) Air circulation system, cooling system be repaired.

* Advantages of Preventive Maintenance:-

1. Extends the usefull lifecycle of aspects assets decreasing the need for capital replacements.
2. Enhances the efficiency of equipment keeping them running more efficiently and lowering power expenses.
3. Enhances the performance of assets by increasing uptime.
4. Enhances customer (internal or external) service because maintenance teams have less unplanned maintenance and can respond quicker to new problems.
5. Contributes positively to the reputation of companies.
6. By implementing a preventive maintenance program, machines will work at full efficiency creating profitable uptime, while reducing downtime.
7. Reduces the chances of complete machine breakdowns, Problems are recognized earlier with a preventive maintenance plan.
8. Reduces the chance of ~~eom~~ emergency repair calls. If a machine goes down it can sometimes take a few days for a repair crew to get in there. Preventive maint-

nance can help lower the chance of something like this happening.

9. Reduces downtime to locate and replace missing parts. If a part needs to be replaced it may take a few days to receive. Parts can be ordered before an unexpected failure happens.

10. Saves money on electricity, when machines run at their highest efficiency. They will use the least amount of electricity, which means saving your wallet money.

11. Preventive maintenance will reduce the possibility of unnecessary repairs. Repairs are only done when the performance of the machine is lacking.

12. Reduces scrap caused by poorly operating machinery.

13. May reduce insurance rates since well-maintained machines are much safer.

14. Reduces late deliveries that may occur due to downed machinery.

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comparison between Preventive & Breakdown Maintenance :-

point of comparison	preventive maintenance	Breakdown maintenance
1) Definition	1) Maintenance carried out at predetermined intervals intended to reduce possibility of failure of machinery.	1) Maintenance essential in case of machine failure of machine activity / breakdown in operation of machinery.
2) When to execute?	2) carried out regular intervals.	2) carried out when machine fails to work
3) objective	3) Prevention is better than cure.	3) To bring back the machine into service as fast as possible without looking into cause of failure.
4) Down time	4) some cases.	4) can not say depends on severity of fault.
5) Delay	5) In case of urgent bulk requirement of production rate.... Preventive maintenance can be delayed.	5) It can not be delayed at any cost.

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* Comparison bet^n Routine & Break-down Maintenance of Electrical equipment :-

Sl.No.	Routine Maintenance	Breakdown Maintenance
1)	At the name suggests, it is the maintenance as a routine work i.e daily work so routine maintenance is a overall daily maintenance of the machine.	1) As the title name suggests, this maintenance is essential in case of failure of machine activity / break down in operate of machinery.
2)	In daily routine work, current voltage, power may be periodically observed or noted & a record may be kept for certain purpose.	2) Electrical faults may be due to short circuit, overheating, failure of insulation, earth fault etc.
3)	check the switches, starters, indicaters neatly before starting machine.	3) failure of machine may take place due to serious electrical or mechanical faults.
4)	for mechanical stability of the machine, see that working is noiseless, vibrationless. If not take it for necessary corrections / repairs / maintenance.	4) Mechanical faults may be due to damages of parts, bearing jamming failure of cooling system, clogging of ventilating ducts, much more deviation in the air-gaps bet^n rotating & static parts, loosing of stampings of iron core et

5) After the stoppage of the machine on the earlier day, the next day the machine is to be neatly cleaned to remove dirt, dust, near wastage, scraps. for cleaning, soft cloth, broom, vacuum cleaner, blower may be used.	c) After mechanical faults arise the machine is completely shutdown & immediately to be taken for inspection, fault finding & repairs so that continuity of working can be brought back in a shorter period to avoid further shutdowns.
6) Earth connection must be checked to avoid shocks from leakage currents. Also while machine is working, thermal conditions must be ascertained by checking temp. Excessive temp. may damage insulation.	6) To avoid mechanical faults check that insulation is in stack. [If not make necessary replacements], check uniform airgaps bet^n static & rotating parts tighten loose bolts, parts, nuts, terminals etc. Air circulation system, cooling system should be repaired.

* Frequency of Inspection:-

- As listed in the further sub-topics of maintenance schedules there is a frequency of inspections to avail failure of machine.
- Daily checkups of current, voltage, temp. Vibrations reasons for such troubles must be found by inspection. Some checks up are carried out weekly, monthly etc.
- In six-monthly, generally, complete overhauling

of machines carried out to make up the machine perfect to work further.
- Period for frequency is different of different equipment & machinery.

* Procedure for Developing Preventive maintenance schedule:-
- following points are firstly considered prior to prepare a final preventive maintenance schedule.
- Too frequent inspections will cause waste of time & will not be economical.
- Too less frequency will invite failure of operation of machine; & it will waste of time & disturbance of continuity of operation
- So, decide the frequency of inspection schedule taking into consideration the following item.

i) Age of the machine:-
- After several days, months, year of working the machine parts become incapable to give good service. It may become too costly to frequently repair these parts.
- Think of replacing the parts / replacing the machine. Also replace outdated machine & bring latest machines in the service.

ii) Cost of the machine:-
- If machine is too costly, atmost care is to be taken & hence in it's case inspections are frequent. In moderate cost

machines & low cost machines frequent inspections are not recommended.

- Position of the machine in the whole system working also decides the frequency period.
- If the machine is positioned at such a key point that failure of this machine shut downs the complete working system then in it's case due care is taken by frequent inspections.

iii) Duty cycle:-

- The frequency of inspection schedule depends on duty cycle working of the machine. Different frequency for different duty cycles, such as, (a) Continuous working
  (b) Intermittent working
  (c) Very less period working

iv) Overload working of the machine:-

- In such conditions, the inspection of temperature, rise must be frequent. Care of cooling system must be taken by frequent Inspection. Air circulation, ventilation must be taken care of.

* Factors Affecting Preventive Maintenance Schedule :-

- Considering the status of the machine, cost of machine, use of machine, type of rating of machine i.e. continuous rating, intermittent rating etc. The maintenance schedules are prepared & ones such schedules are prepared & planned, they are executed.

- But, there are unforeseen causes & situations in which, the schedules can not be followed due to following factors :-

i) Position of the machine in the plant :-

- The various machines are positioned in the factory plants as per the seq. of operations & place availability.
- In certain case of machine, it is so position due to constraints of space, the experts find difficulty in carrying out inspection / maintenance work in such situation. This factor affects the maintenance schedule.

ii) Age of the machine :-

- Due to continuous ~~wearing~~ running for several days / weeks / months / years.
- The parts are worn-out & become repair & can not be maintained which affects the maintenance schedule. Replacement is the solution.

iii) New technology in machines :-

- The ~~pre~~ previous machines may be such that

that they need to run for more period for same work, The work can be completed with good quality within shorter period by the new latest technology machine.
- Hence replacement is thought of & hence maintenance schedule is changed for new machine.

iv) Working condition of industry :-
- The industries are run to get more & more profit & hence sometimes accept heavy orders of manufacture.
- To meet with the order in a shorter time, the plant is run for more hours in a day. Hence maintenance schedule is disturbed. More emphasize is towards production than the scheduled maintenance.

v) Periodic orders :-
- Some industries have orders of production in a particular period of month or particular period in a year & in the rest of the periods there is little work or no work on the machine.
- This idle period is to be chosen for maintenance.
- This affects regular maintenance schedule.

vi) Unforeseen causes :-
- Due to accidents, fires, workers strike, the work is holdup in a certain period of time.
- This is also a cause of disturbing a maintenance schedule.

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(ii) Strategy of new management in a industry:-
- Sometimes the management is changed in the industries. Some sections have to be shut off & some sections have to be overloaded as per new management's decision.
- This also changes the maintenance schedule.

(iii) failure of machines :-
- This ~~Period~~ point also affects the normal maintenance schedule. Summarizing the points, the preventive maintenance schedule is affected due to :-
  - Access to reach machine.
  - Mode of operation of plant.
  - Management decisions.
  - Unforeseen causes.
  - Working not consistent.
  - failure of machine.
  - Replacement of machine.

* Introduction to "Total Productive Maintenance":-
- Declared maintenance schedule sometimes can not be adopted in certain cases by periods like monthly, yearly maintenance. This frequency can not be followed in the following cases :-

i) Hydro- electric power plant machinery maintenance.
ii) Thermal power plant machinery maintenance.
iii) Woolen knitting work, Hogiary mill machinery.
iv) Time bound urgent production of items to be

manufactured as per purchaser's demand

i) Hydro-electric power plant :-
- Definite quantity source of water is available when dams are full of water in rainy seasons (June to september).
- The plant can work on it's max. capacity starting all the turbine-generator-sets for electricity production all the 4 months in rainy season.
- In the scarity of water in summer season all or many of the sets have to be shut down.
- The preventive maintenance can be carried out in this session.

ii) Thermal power plant Machinery Maintenance :-
- As said above article ①, i.e. in summer season, mostly hydro-electric power plant is closed down & therefore to meets with demand of electric power, thermal powes plants are made active to meet the maximum demand.
- In rainy season, the machinery of thermal power plant is taken for breakdown maintenance.
- Such type of maintenance is known as total production maintenance.

iii) Woolen & Hogiary mill machinery :-
- The demand of woolen articles & Hogiary is much more in winter season.
- So, production of such articles is activated in prewinter season & winter season & maintenance

Work is not possible during this period & here Period of breakdown is after winter sessi

iv) Time based manufacturing :-
- Sometimes the industry receives a time bound bulkorder of some article, The industry has to execute plan to meet with the order in a time bound period.
- So, there is a continuous production during this period.
- All the machinery is engaged in production work & repair & maintenance schedule can not be followed. This case can also be taken into total productive maintenance.

* Brake Test on Dc motor / Direct Method of Testing :-
- This is the direct method of testing the machine.
- The machine is gradually loaded from no load to full load.
- The pulley is fitted on the shaft of the motor.
- The leather band brake, the tension of which is adjusted on the pulley, is surrounded around the pulley as shown in Fig.
- The o/p of the machine is converted into heat due to friction betn band brake & pulley.
- The o/p is wasted & therefore only small machines upto 5 kW can be tested by this method.

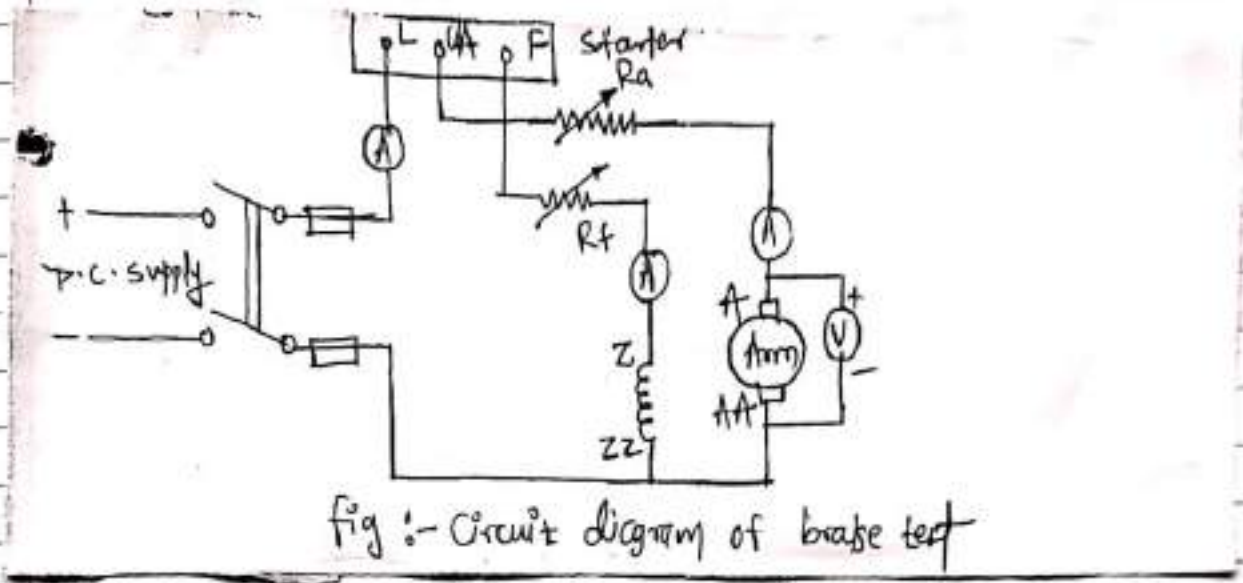

fig :- Circuit diagram of brake test

* Procedure :-

- Connect appropriate ranges of meters with proper polarities as shown in figure.
- See that the belt is loose initially for shunt or compound motor, but tight in case of series motor.
- Keep rheostats in min. position & switch on supply & start the motor with the help of ~~motor~~ starter.
- Adjust the speed of the motor to it's rated value with rheostat Rf & take down readings of meters from no load.
- With the help of hand wheel adjust load on the brake pulley to the desired load conditions, (such as 20%, 40%, ---- 100%).
- Keep speed constant throughout experiment as far as possible.
- Note down meter readings & spring balance readings.

- see that there is sufficient water in hollow pulley for cooling ~~pressure~~ purpose.
- After taking reading upto full load condition gradually reduce load & reduce speed & stop the meter.
- care should be taken to take the readings within a short time otherwise there is a possibility of burning out belt due to heat produced by friction.
- Hollow pulley having water inside, helps coolings.

* Swinburne's Test [No load test/Running Light test) for Dc motor:-
- It is the indirect method of testing D.C. shunt or compound motor.
- In this test, the machine is not loaded actually but the machine is run at no-load.
- very large capacity machines which cannot be tested with actual loading can be tested by this method & it's performance characteristics is determined by using the data obtained from such test.
- Losses & efficiency can be found at a desired load by calculations.
- This test is also called as no load test or light run test.