26. Lubricating oil

Unit-3.5

## Maintenance Schedule of Electric Motors

| S.No. | Daily | Maintenance and check Programme of Electric Motor |
|---|---|---|
| 1. | Earthing of Power connections | Inspect and tighten if necessery |
| 2. | Control Gear | Inspect fuses and Relay settings. |
| 3. | Temperature of winding | Look out for over heating |
| 4. | Bearing | Look out for over heating. |
| 5. | Lubricants | Check lubricating system. |
| 6. | Vibrations | Watchout for excessive vibrations. |

| S.No. | Weekly | Maintenance and Check Programme of Electric Motors |
|---|---|---|
| 1. | Surrounding | Care should be taken that amount of unusual dust, dripping water, acids, fumes may not enter the motor. Any board cover, canvas should not be left open to avoid the hindrance to the ventillation or jam moving parts. |
| 2. | Sleeve Bearings, Motor Lubrication, etc. | The level of oil should be checked with oil guage and if the level is down, complete it to the guage line level. Check the bearing housings, if dry, then oil them. Creeping of oil along the shaft towards winding should be avoided. |
| 3. | Ball Bearings | The bearings should be checked for noise, oil them little, add grease in the housings or replace hem. |
| 4. | Brushes and Commutator or rings | When there is sparking note the colour and condition of the commutator and brushes. The pigtail of the brushes for loose connection should also be checked. The surface of commutator should be smoothened with the help of sand paper. Clean the segments of commutator with the help of cleaning stick. |
| 5. | Rotors and Armature | The uniformity of air gap in the motor should be checked in which the sleeve bearings are used. |
| 6. | Windings | If the dust particles are observed in the winding, blow it with blower. Clean the dust with dry cloth. Note for the moisture contents in the winding. If noticed, dry them up. |
| 7. | Mechanical Condition | Sometimes there is unusual noise is heard from motor due to metal to metal contact or scorching varnish insulation. Stop the motor and check it and remove the defects. |
| 8. | Mechanical Inspection | Check the belt for suitable slackness and good surface condition. The gears should be checked for wear and tear. The controlling devices should be checked thoroughly. |
| **Monthly/Quarterly** | | |
| 1. | Windings | Check the windings for their proper insulation. It should be tested for insulation resistance, short circuit and earth or leakage. Moisture contents should also be checked. |

Contd...

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| | | |
|---|---|---|
| 2. | Brushes | Check the brushes for their proper fittings and free play in the brush holders. Brush spring pressure should be noticed. Worn out brushes should be replaced. |
| 3. | Commutator | Commutator surface should be examined for high mica and high bar, scratches and roughness. Commutator surface should be smoothened with the help of emery paper. |
| 4. | Sleeve bearings | Check the bearing for wearness, end play and its surface. If dirt or sludge is observed in the bearing, it should be flushed out with lighter oil before refilling with grease. |
| 5. | Ball or roller bearings | The leakage of grease or oil from the bearing should be observed. If the leakage is noticed, clean it. |
| 6. | Couplings and other Drives | Sometimes the belt becomes loose, adjust it. |
| 7. | Enclosed gears | Oil in the gear box should be checked for the flow for the flow for the presence of sand, water or metal scale. If the oil is not found in good condition, drain it out, flush and refill it. |
| 8. | Loads | Changing load conditions should be observed *i.e.* controlling devices troubles, poor handlings or wrong adjustments. |

**Half Yearly/Yearly**

| | | |
|---|---|---|
| 1. | Windings | Check the windings for insulation resistance, dry cracks of insulation. If needed, dry out winding, clean it, varnish it and bake it. |
| 2. | Squirrel Cage Rotor | Broken or loose bars of rotor should be observed thoroughly. Set them properly or get it soldered/ welded if needed. |
| 3. | Wound Rotor | Collector, washers and connections should be checked. If there are spots on the rings or if they are found rough or eccentric, get them turned on the lathe. |
| 4. | Armature stator | Check the stator for open, short earth or leakage fault. Insulation resistance should also be checked. Lamination cores should be checked for its corrosion or looseness, clean or tighten them properly. |
| 5. | Air Gap | Uniformity of air gap should be observed. |
| 6. | Mechanical parts | The inside and outside of frames and belts should be checked the rotor should be observed for its rubbing or misalignment. |

Unit 3.6

| S.No. | Trouble | Cause | Remedy |
|---|---|---|---|
| 1. | Motor fails to Start. | (*i*) Supply Switched off. | (*i*) Check main switch. |
| | | (*ii*) Fuse blown off. | (*ii*) Check fuses. |
| | | (*iii*) Single phasing. | (*iii*) Check 3-phase supply. |
| | | (*iv*) Over load. | (*iv*) Reduce starting load. |
| | | (*v*) Wrong connection. | (*v*) Set the connection right. |
| | | (*vi*) Open circuit in rotor. | (*vi*) Check brushes, slip rings and starter for continuity. |
| 2. | Motor overheated. | (*i*) Motor overloaded. | (*i*) Reduce load. |
| | | (*ii*) High ambient temp. | (*ii*) Use larger motor having lower temperature rise. |
| | | (*iii*) Frequent switching. | (*iii*) Use motors designed for the application. |
| | | (*iv*) Voltage too high or too low. | (*iv*) Check supply voltage |
| | | (*v*) Delta connection motor connected in star. | (*v*) Set right the connection. |
| 3. | Vibration. | (*i*) Motor misalignment. | (*i*) Realign. |
| | | (*ii*) Weak foundation. | (*ii*) Strengthen base. |
| | | (*iii*) Coupling or pulley out of balance. | (*iii*) Balance coupling. |
| | | (*iv*) Driven equipment unbalanced. | (*iv*) Rebalance. |
| | | (*v*) Defective bearing. | (*v*) Replace bearing. |

| | | | |
|---|---|---|---|
| 4. | Bearing Overheats. | (*i*) Excess grease. | (*i*) Remove surplus grease. |
| | | (*ii*) Insufficient grease. | (*ii*) Maintain proper quantity of grease. |
| | | (*iii*) Grease contaminated. | (*iii*) Replace existing grease with fresh one. |
| | | (*iv*) Wrong assembly of bearing. | (*iv*) Rectify fitment. |
| 5. | Motor runs at low speed. | (*i*) Voltage too low at motor terminals. | (*i*) Use higher voltage tap on transformer. |
| | | (*ii*) Starting load too high. | (*ii*) Reduce load. |
| | | (*iii*) Cracks in rotor bars. | (*iii*) Check rotor bars and repair. |
| 6. | Unbalance line current on 3 phase motors. | (*i*) Unequal terminal Voltage. | (*i*) Measure voltage and take corrective action. |
| | | (*ii*) Single phasing. | (*ii*) Check and remove the cause. |
| 7. | Humming noise. | (*i*) Non-uniform air gap. | (*i*) Rectify air gap. |
| | | (*ii*) Loose bearing. | (*ii*) Refit bearings. |
| | | (*iii*) Unbalanced rotor. | (*iii*) Rebalance rotor. |
| 8. | Scrapping noise. | (*i*) Fan rubbing with Shield. | (*i*) Check & remove defect . |
| | | (*ii*) Fan striking insulation | (*ii*) Check and increase the clearance. |
| 9. | Motor takes too long to accelerate. | (*i*) Excessive load. | (*i*) Reduce load. |
| | | (*ii*) Low voltage. | (*ii*) Increase voltage to rated value. |
| | | (*iii*) Defective squirrel cage. | (*iii*) Replace/repair rotor. |
| 10. | Wrong direction of rotation. | (*i*) Wrong phase sequence. | (*i*) Interchange any two phases. |

segments and groove formation at brush

## Overhauling of Motors 3.6

AC motor & DC motor

**1) General Procedure for Overhauling of ac Motors :** Clean the motor compressed air and inspect the following

**a) Condition of the coupling**

- Coupling condition
- Check nut threads, fan fitness and seating.

**b) Condition of foundation legs for foot mounted motors**

**c) Rotate the motor by hand and observe the following**

- Rotor moves freely or jammed.
- If the rotor is rotating with a sound then the source of sound has to be identified. The defective bearing or fan or some other loose part touching somewhere may be responsible for the abnormal sound.

**d) Coupling Removal** : Remove the coupling by coupling puller or hydraulic jack as per standard practice adopted in the plant.

**e) Inspection** After coupling removal, inspect and rectify the following

- **Condition of the Shaft** If it is worn out then suitable repair action has to be taken.
- **Condition of the coupling and the key**. If the inner surface of the coupling bore has been worn-out then the coupling has to be replaced.
- **Condition of the keyway**. If the keyway is oversized then the same has to be repaired.

**(f) Dismantling of the Motor**

- Dismantle the motor mounted blower or air-to-water heat exchanger, where provided.
- Remove the non-driving end cover of the motor.
- Unscrew the loading screw of the fan then pull out the fan by suitable puller rod arrangement.
- Take out the outer dust seal.
- Remove the outer grease cup.
- With slight heating, the inner grease retaining ring has to be taken out
- Unscrew the fixing bolts and take out the cover.
- Before removal of rotor it has to be seen that there will be no obstruction. If there is any internal cooling fan then it has to be removed.

**(g) Removal of Rotor** Depending on the size and weight of the rotor and the facilities available, one of the following method may be applied

- Use of a balance beam and suitable ratchet hoist.
- Use of two hooks of the crane and two pipes at both the ends.
- Use of single pipe in cantilever manner with manual labour to balance the weight of the armature at one end of the pipe.
- Use of moveable screw jack.

In this process, care should be taken so that there is no rubbing of rotor with the stator core/winding. Clean the rotor, stator and all the mechanical parts thoroughly and inspect the following

**Inspection of Stator :**

The following visual inspection has to be done and suitable repair action has to be initiated

- Condition of the Stator winding - if it is burnt. Repair or replace any damaged winding.
- Looseness of the cages of the slots and stiffeners of the overhang of the windings.
- Inspect carefully the high voltage terminal board with special emphasis on the terminal bushings.
- Condition of lead - Check the insulation condition of the outgoing leads from the windings particularly with respect to brittleness.

- Condition of end cover fixing, threaded holes & lifting hooks or eye bolts. Check the condition of legs.

**Inspection of Rotor**

- Check for any rubbing marks on the body
- Check the dimensional accuracy of bearing seat and coupling seal.
- Check the rotor visually for any breakage in bars, end rings and laminated core.
- It is always preferred to conduct growler test on the rotor to ensure its soundness.
- Check looseness of balancing weights.
- Looseness of bars in the cage & condition of S.C. ring.

**(*h*) Bearing Checking** - Clean the bearing thoroughly with diesel / kerosene oil and check for its soundness. If found defective it has to be replaced with a new.

**(*i*) Checking of Cooling System** - The cooling arrangement, either a cooling box separately attached or cooling water circulation tubes in case of water cooled stators should be thoroughly checked for any leakage at joints and jacket. It is often found that the cooling water jacket is filled with mud. It is necessary to clean and flush out all the mud and other deposit thoroughly, otherwise it will give rise to rapid corrosion of the cooling tube and the jacket walls. To do this, feed continuous water along with compressed air through the jacket at the lower most part of it in a suitable manner. In this process the compressed air will agitate and loosen the mud and help it to flow out of the jacket leaving it absolutely clean in the end.

**(*j*)** Inspect the end covers for mechanical soundness with special emphasis on the bearing housing. Any groove or change of dimensions has to be suitably repaired.

**(*k*)** Inspect other parts namely grease cups, fans and other fittings for their mechanical soundness.

**(*l*) Electrical Test :** The electrical tests can be divided into two parts namely routine test and special test. Routine tests are carried out in all stators irrespective of its defect status whereas special tests are done for only repaired stator or for any specific defect.

**Routine Test**

1. **Insulation Resistance Test :** Measure the insulation value with a 500 V meggar for LT motor and with a 2.5 kV meggar for HT motor and check for the following:

I.R. value between phase to earth should be more than 50 M-ohms for HT motor and 1 M-ohm for LT motor.

Suggested Values

for 6.6 kV motor - 50 M-ohms.

for 11 kV motor - 90 M-ohms.

I.R. value between phase to phase should be more than 50 M-ohms for HT motor and 1 M-ohm for LT motor for 1 minute duration.

Absorption factor for HT motor should be more than 1.2. If I.R. value is not OK or/and the stator is dirty then the cleaning procedure has to be repeated and the motor should be dried out. Even after drying, if the insulation resistance is found to be weak, the winding should be given a coat of good insulating varnish after the machine has been dried out.

**2. Resistance Measurement (dc)** : The ohmic value of each winding should be equal to the data given by the manufacturer. If the winding resistance is unbalanced or/and abnormal then it has to be sent for rewinding.

**3. Balance Test** : Variable 3 phase low voltage (0-400 V) is applied to the stator. Measure current in each phase and check for equality.

**4. Test for Rotating Magnetic Field :** To carry out this test, a magnetic needle can be held inside the stator. The needle will rotate with rated rpm of the motor, due to the rotating magnetic field developed inside the stator.

**5. High Voltage Test :** After taking the insulation resistance with 2.5 kV megger and if the values are within permissible limits, high voltage test is to be conducted on HT motors.

For stator brought for overhauling purpose - 7 kV (for 6.6 kV motors) and 16 kV (for 11 kV motors) voltage is applied across the phase to earth for one minute.

**Table 3.7 : High Voltage Test**

| S. No. | Test Voltages | 3.3KV | 6.6KV | 11KV |
|---|---|---|---|---|
| 1 | Overhauling | 4 | 7 | 16 |
| 2 | Partially rewound with reconditioned motors | 5 | 8 | 18 |
| 3 | Complete rewound with new coils | 7 | 14 | 23 |

**6. Special Test**

(*i*) High Voltage Test for Stators Rewound with Reconditioned Coils - In case of 6 leads, apply the voltage between one phase to ground while

shorting the other two phases to ground. This process has to be repeated for three windings.

Voltage recommended - 8 kV (for 6.6 kV motors) and 18 kV (for 11 kV motors) for one minute.

In case of three leads - Apply once the required voltage to any lead.

(*ii*) High Voltage Test for Stator Rewound with New Coils - The procedure is same as (*i*) above but recommended voltage differ - Voltage recommended - 14 kV for One minute.

### (*m*) Assembly

**Pre-assembly Preparation** - It has to be ensured that the stator is electrically OK. The test has to be repeated just before assembly to ensure this. It is always preferred to assemble the stator after varnishing. All the mechanical parts have to be checked minutely for any defect and rectified or replaced if necessary. Cooling box should be thoroughly cleaned and checked. Bearings have to be inspected for any defect and under no circumstances defective bearings should be allowed for fitting. All the nuts and other fasteners have to be arranged prior to assembly so that there is no delay in this process.

(*n*) **Bearing Fitting** : Check bearing seat

(*i*) Heat the bearing uniformly in oil bath or induction heater (upto 90°C), then it has to be carefully slided on to the shaft.

(*ii*) Before putting the ball bearing or the inner cage of the roller bearing, it has to be ensured that the inner grease cup is in its position.

(*iii*) Rotor Insertion

(*iv*) Fix the non-driving end cover carefully so that there is uniform pressure around the bearing surface.

(*v*) Fit the inner grease retaining ring and locking circlip.

(*vi*) Fix the outer grease cup.

(*vii*) Shrink fit the fan on the shaft and tighten the locking bolt while it is hot. Provide locking circlip if any.

(*viii*) Fit the non-driving end cover

(*ix*) Fit the internal cooling fan if any in the driving end side shaft.

(*x*) Then fix the driving end cover on the stator and after fitting inner grease retaining ring, outer grease cup and outer dust seal has to be fixed.

(*xi*) Greasing - Required amount of grease has to be pressed in by means of a grease gun through the nipple and lubricating pipe.

(*xii*) Where motor mounted blower or heat exchanger is provided the same need to be installed prior to fixing of motor.

**(*o*) Inspection** - Before sending the motor for final testing, rotate the motor by hand and observe the following

Rotor moves freely or not.

If the rotor is rotating with a sound then the source of sound has to be identified. In case the rotor is jammed or rotating with a sound then it has to be dismantled and assembled properly.

**(*p*) Final Testing**

(*i*) Before conducting running test, I.R. value test and resistance test has to be repeated to ensure that there is no damage while assembling. In case the above tests are OK then only running test is done otherwise it has to be dismantled and repaired.

(*ii*) No load running test

**1. Low voltage running test**

— Measure the current in each phase and ensure that they are equal (balanced)

— Measure the R.P.M. of the motor and ensure rated r.p.m. is attained.

— Check for the vibration if any, and observe the bearing sound.

**2.** Rated voltage running test

After successful completion of the LV running test, motor is connected to the rated supply and same observations are made.

If all the above tests are satisfactory then the motor can be declared ready.

After the motor is declared ready, coupling can be fitted and now the motor is ready for delivery.

### (II) General Procedure for Overhauling of dc motors

Generally, large dc machines field come in two halves. Dismantling of such machines is easy. The procedure outlined here deals with dc machine having single field system.

**(*a*) Taking Out the End Cover** Before removing the end covers, remove the following parts

(*a*) Outer bearing dust seal

(*b*) Bearing cover - outer

(*c*) Inner grease retaining ring.

(*xii*) Where motor mounted blower or heat exchanger is provided the same need to be installed prior to fixing of motor.

**(*o*) Inspection** - Before sending the motor for final testing, rotate the motor by hand and observe the following

Rotor moves freely or not.

If the rotor is rotating with a sound then the source of sound has to be identified. In case the rotor is jammed or rotating with a sound then it has to be dismantled and assembled properly.

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Generally, large dc machines field come in two halves. Dismantling of such machines is easy. The procedure outlined here deals with dc machine having single field system.

**(*a*) Taking Out the End Cover** Before removing the end covers, remove the following parts

(*a*) Outer bearing dust seal

(*b*) Bearing cover - outer

(*c*) Inner grease retaining ring.

Now remove the end cover by using suitable jack puller while supporting the armature of the rotor shaft by the crane or jack. Before taking out the commutator side end cover, it is to be seen whether the rocker arm assembly is mounted on the cover or it is independent of it. Depending on the construction, the end cover has to be dismantled taking care that the brush holder do not foul and damage the commutator. In case the rocker arm is mounted on the cover, before taking out this cover, the connection of the interpole to brush holder assembly and the lead going out to the terminal board has to disconnected. This connection has to be properly marked and noted. Any reversal in this while final assembly, will lead to heavy sparking of commutator while testing and running.

**(*b*) Taking out the Armature** - Depending on the size, weight of the armature and facilities available, one of the following procedures has to be adopted, to take out the armature out of the field

(*i*) Use of a balance beam with suitable ratchet hoist
(*ii*) Use two pipes and two hooks of the crane.
(*iii*) Use of single pipe in cantilever manner with manual labour to balance the weight of the armature at one end of the pipe.

In this process, care should be taken, so that there is no rubbing of the armature with field. After removal of armature, it has to be suitably placed on ground with protection to winding, cooling fan, commutators etc.

**(*c*) Cleaning and Inspection** - First the field and armature assembly has to be cleaned by blowing compressed air. Now all parts have to be inspected thoroughly.

**(*d*) Visual Inspection** - The following visual inspection has to be done and suitable repair action has to initiated

Condition of field frame, poles, interpoles.
Pole bolts checking.
Condition of armature, commutator.
Condition of brush holder assembly.
Condition of carbon brushes.
Condition of all threaded portion
Condition of end covers with special emphasis on bearing housing

**(*e*) Bearing Checking** - After that the bearing has to be taken out from both ends of the armature and cleaned by diesel. Bearing condition has to be checked. If defective, it has to be replaced with a new one at the time of final assembly.

**(f) Cleaning** - If the field and armature is found to be very dirty then the following cleaning procedure has to be followed before electrical testing

(*i*) Blow thoroughly with compressed air, to drive out all the dust settled in winding, core holes, ventilation parts etc.

(*ii*) Orion Treatment - Orion 510 solution (Orion : Kerosene 1:6) is sprayed properly on the parts so that it takes out all the carbon dust. Then spray a suitable cleaning agent directly.

After treatment, the parts have to be kept in hot box oven with a temperature around 60 to 80°C for 6 to 8 hours for drying. Then this has to be taken out and allowed to cool before electrical testing.

**(g) Electrical Testing** - Before subjecting the field and armature to electrical testing, it has to be ensured that these are properly cleaned.

The electrical testing can be divided into two sections, namely,

**(*i*) Routine tests and**

**(*ii*) Special tests.**

Routine tests are carried out in all the machines irrespective of their defect status. Special tests are for only specific requirements because of some defects in repair work.

**(*i*) Routine Test :** The following tests come under routine test

1. Insulation value test,
2. Resistance measurement,
3. Inter turn short circuit test,
4. Drop test.

Before carrying out any test, following checking has to be done

Terminal board connections of the field should be checked for their tightness and correctness. Terminal box stud and insulation has to be checked for their soundness.

The material of terminal box, nuts and washers should be non-ferrous metal.

**1. Insulation Value Test** - Insulation value to be measured with 1000 V megger should be more than 5 Meg-ohms, for

(*a*) Field coils to earth (use 500 megger).

(*b*) Interpole (compensating winding).

(*c*) Series field to earth.

(*d*) Between shunt field/series field and compensating winding.

(e) Armature to earth.
(f) Brush assembly to earth.

2. The following resistance value has to be checked and compared to the value en by manufacturers

(a) Shunt field resistance.
(b) Interpole and compensating winding.
(c) Series field.

3. **Interpole Short Circuit Test**

(a) **For Shunt Field** - Single phase ac voltage is applied (not above rated dc ltage) across the field terminals. It is kept like that for 15 minutes and mperature rise in each field coil is observed. Any abnormal rise in temperature is used due to inter turn short circuit in the coil. Such coils have to be replaced or paired.

(b) **For interpole and compensating winding** - Similar procedure is peated, with care so that not more than 50% of rated current is passed in these indings.

(c) **For series fields** - Here also the above procedure is repeated to know efective coils.

4. **Drop Test of Armature** - This is one of the most important test of a dc achine which gives the condition of the armature. In this test, around one ampere f dc current is passed between two adjacent commutator segments and voltage drop cross these segments are measured.

(a) We should get equal voltage drop between two segments throughout the complete armature. In case of a heavy duty armature, adequate current is passed to get a measurable drop across the two segments.

(b) Less voltage drop between the two segments indicates short circuit in the armature and more voltage drop indicates loose soldering in armature. Repair Action has to be taken as per the drop test results.

(ii) **Special Tests** - Apart from conducting the routine test, the following tests are to be further conducted in each of repaired field coils:

1. **Polarity checking of shunt fields :** Around 50% of rated voltage is applied across the field and polarity of the poles are to be tested by needle.

2. **Polarity checking of interpoles and compensating winding :** Dc voltage is applied across these windings (so that current does not exceed 30% of the rated current).

**(h) Final Assembly**

**Pre-assembly Preparation** Before assembly it has to be ensured that the field and armature is electrically OK. Both the field and armature have to be varnished before fitting.

1. All the mechanical parts have to be inspected minutely for any defect and rectified or replaced if necessary.
2. Painting of inside of field frame end covers has to be done.
3. Bearings have to be inspected minutely for any defect and under no circumstances defective bearings should be allowed for fittings.

**(i) Assembly** - Before fitting

Check bearing seat.

Heat the bearing in oil bath or induction heater uniformly upto a temperature of 95°C to 100°C, then it has to be carefully slid onto the shaft.

Before putting the bearing it has to be ensured that the inner grease cup is in its position.

**(j) Armature Insertion :** Depending on the size, weight, of the armature and facilities available, one of the three procedures as adopted to take out the armature should be followed. Care should be taken so that there is no rubbing of armature with the field. After the bearing is fitted, put few drops of mobile oil in the bearing.

**(k) End Cover Fixing :** Both side end covers have to be carefully fitted with uniform pressure around the bearing. While doing so, the end cover has to be suitably supported either by a crane or by long supporting beams. In case of commutator side end cover, before fitting it, the rocker arm assembly has to be fitted in position and the lead connection made. Inner grease retaining ring is to be shrink fitted next to bearing. Fit the outer grease cup with suitable bolts. Then fix the outer dust seal.

**(l) Greasing :** Measured amount of grease as recommended by the manufacturer should be pressed in by means of a grease gun through the nipple and lubricating pipe.

**(m) Checking :** Before conducting running test of the motor, rotate the armature by hand for its free rotation and static unbalance.

After final assembly the motor mounted blower or heat exchanger if any should be installed and the following tests have to be done:

**(i) No Load Test**

1. Insulation value test
2. Resistance measurement test

3. Carbon brush bedding - Carbon brush has to be suitably grounded to proper shape and radius so that it will make good contact on the commutator.
4. Neutral Point checking - This test ensures that the brushes are fixed at magnetic neutral axis.

**(ii) No Load running test**

1. First apply dc voltage (rated) to field coils.
2. Then slowly apply dc voltage to the dc armature from a variable source and go upto the rated value.
3. No load current (Armature circuit) should be 4 to 7% of the rated current at full excitation.
4. Speed should correspond to the name plate indicated speed.
5. There should not be any abnormal vibration or bearing sound.
6. There should not be any sparking in the commutator.
7. Correct direction of the motor (sometimes it is marked in the end cover, has to be ensured with respect to field and interpole polarity.
8. This indicates the interpole connection is correct as per the rotation of the machine. Wrong interpole and connection, leads to commutation problem and requires end connection changing at the rocker arm.

If all the above tests are found satisfactory, the machine is to be sent for upling fixing and final delivery.

## 5.2 Preventive Maintenance

The purpose of preventive maintenance is to avoid breakdown during running of he plant. All motors are required to be overhauled from time to time in accordance ith the Plant Preventive Maintenance Schedule. The frequency of such overhauling nd maintenance depends on the conditions under which the machine operates and s recommended by motor manufacturer.

Prior to dismantling of large motors, the defect reports generated during nspection should be compiled and the abnormalities and defects should be properly ttended during maintenance.