INTER PLANT STANDARD – STEEL INDUSTRY		
IPSS	**CODE OF PRACTICE FOR OVERHAULING OF dc MOTORS WITH ANTIFRICTION / SLIDING BEARINGS** Corresponding IS does not exist	**IPSS: 1-03-033-03**

0. FOREWORD

0.1 This Inter Plant Standard has been prepared by the Standards Committee on Rotating Electrical Machinery , IPSS 1:3 with the active participation of the representatives of the steel plants and major consultancy organizations and was adopted in January 2003.

1. SCOPE

1.1 This Inter Plant Standard covers dc motors with antifriction bearing upto a capacity of 1000 kW.

1.2 This Inter Plant Standard covers dc motors with sliding bearing and having capacity upto 10 MW.

1.3 This standard is not applicable for fractional horse power motors.

2. DOCUMENTATION

2.1 Name plate details of the motor to be recorded in the register. If name plate is not available or illegible, details of motor to be collected from the concerned department or / and supplier's and work order.

2.2 It is very important to have proper documentation of running parameters such as armature current, excitation voltage and current. It is important to notedown winding temperature, bearing temperature, inlet air temperature, outlet air temperature and also vibration readings etc. for future reference.

3. PRE-DISMANTLING

3.1 The motor should be cleaned with dry compressed air with maximum pressure of 1.5 kg/cm^2 in a cleaning chamber. In case of sliding bearing type motor, bearing pedestals are to be cleaned. Oily dust and dirt should be blown off and removed by cotton waste / marking cloth with cleaning solvent.

3.1.1 Mark all parts to be dismantled, viz, coupling, bearing caps of both drive end (DE) and non-drive end (NDE), lock-nuts etc. The terminal markings are to be noted in the job card. This is applicable to both anti-friction/ sliding bearings".

3.2 In case of sliding bearing type motor, visual inspection and proper marking of all external parts in addition to clause 3.1.1 including oil pipe line connections and thermometer installation should be done. Also take bearing clearance wherever possible. The pre movement of oil ring may be checked before dismantling.

3.3 Check the IR value of the armature, IP and compensating winding and field circuit and record the readings. Wherever insulated bearing are there, they should be meggered and values recorded.

3.4 Make a physical inspection in respect of the following and prepare a defect list prior to dismantling.

3.4.1 Take the beating of coupling shaft.

3.4.2 Check the condition of brushes w.r.t. its remaining wearing depth, condition of pigtails, carbon brush holders, brush boxes, tension adjustors, etc.

3.4.3 Note the condition of the shaft, fan, fan cover, foundation legs, terminal board and terminals.

3.4.4 Check the air gap between main pole and armature.

3.4.5 Make a physical and schematic diagram of connection of armature, interpole, compensating winding, main pole coils.

Make a sketch of terminal board connections and their markings.

3.5 On the basis of above pre dismantling inspection/ checking, prepare a consolidated defect list to take up necessary rectification during overhauling.

4. DISMANTLING

4.1 General

4.1.1 Remove ventilation system i.e. blower, ventilation duct, if any. Disconnect the connections at the terminal board, brush holder arms, rocker assembly, etc after marking suitable identifying marks on the parts which are connected electrically i.e. bus bars/cables and are to be disconnected.

4.1.2 Proper identifying marks are put on all the parts to be dismantled so that the respective parts could be assembled as per the original assembly after repair.

4.1.3 The dismantling is to be carried out as per the following procedure :

- Take out the coupling with the help of a hydraulic puller. In some cases heating may be required. Care is to be taken not to overheat. Inspect the shaft surface, bore of coupling, key/keyway for any marks of wear & deformation.

- Open top / bottom half fixing bolts along with bearing cartridge bolts to falcilitate removal of top half of the motor field body. (This is required for split frame dc motors). The armature then is lifted up from the bottom half and placed on work bench.

- In the case of a non-split construction, the armature is required to be threaded out after dismantling the end shields on both sides.

4.2 **Dismantling of motor with anti-friction bearings**.

4.2.1 Remove ventilation system i.e. blower, ventilation duct, if any. Disconnect the connections at the terminal board, brush holder arms, rocker assembly, etc after marking suitable identifying marks on the parts which are connected electrically i.e. bus bars/cables and are to be disconnected.

4.2.2 In case of non-split construction, the armature is to be threaded out. Follow the instructions for dismantling of the motor as supplied by the machine manufacturer".

4.2.3 Wherever field system is in two halves, mark properly the interpole connections, current collecting half bus bars and rocker assembly position before taking them out.

4.2.4 Open the bearing and take out the top covers. Put proper identification. Take out top half of the bearing (if the bearing is in two halves, after marking properly). Take out labyrinths from both ends of the bearings.

4.2.5 In case of large motors, sufficient room is normally not available for threading out of the armature from the field body (non-split type) at the drive location. In this case, both armature and the stator body is to be taken out from its position and shifted to a place where EOT crane is available.

4.2.5.1 Threading out of the armature is to be done after removing the motor/generator to a place where the stools have been prepared before hand. Depending upon the situation, either the field body or the armature can be threaded out. Use of balance beam which facilitates easy thread out should be preferred. Soft gasket may be inserted in the air gap to avoid damage to core/winding.

4.2.6 In case of non-split construction, the armature is to be threaded out. Soft gasket may be inserted in the air gap to avoid damage to coir/winding.

4.2.7 In the case of split type of field body the top half and the armature is lifted one after the another and placed in suitable location for further jobs. The top half should be suitably placed so that access to cleaning/repairing is available.

4.3 **Dismantling of motors with sliding bearings**

4.3.1 Remove thermometer and oil pipeline connection to sliding bearings.

5. **POST-DISMANTLING CHECKS AND REPAIRS -** Clean the armature and field thoroughly, first by blowing with dry and clean compressed air & suitable cleaning agent or putting under vaccum where such facility exists, and then with a suitable cleaning agent to remove dust, oil and grease. In the mean time, look for any abnormality both in the armature as well as in the field body, viz, broken/missing wedges, dry solders in risers, looseness in banding, cracks in armature equalizer connections, cracks in insulators, etc and rectify. Minor repairs of these nature is to be done before it is put to oven / heat chamber for drying. If it is possible, it should be allowed to dry in furnace for a required duration to stabalize desired IR value at the specified temperature as per class of insulation. In case the dirt is too much, sometimes it is preferred to heat the armature & field before actual cleaning of armature upto a safe value is done.

5.1 **Armature**

5.1.1 Take the beating of coupling shaft.

5.1.2 Carry out mica undercutting and bevelling of commutator.

5.1.3 Carry out DROP TEST on commutator. If drop across certain pair of segments are high (greater than 5%), these are to be resoldered, cleaned thoroughly & rechecked. If the drop is low (less than 5%) then those segments are to be thoroughly cleaned by a cleaning agent, dried & re-droptested (Segments showing variation in drop test more than +5% / -5% upto a maximum limit of 5% of total commutator bars spread over the circumference can be allowed).

5.1.4 Check condition of wedges, coil insulation and bandages. If the wedges are bad, it should be changed. If the banding is not proper it should be replaced. If coils are damaged, repair or replace them. For banding purpose, resiglass banding tapes may be used with suitable no. of turns. Banding tape curing is to be done at a particular temperature & for a specified time as prescribed in the brochure.

5.1.5 *Check the Condition of Bearings* :

5.1.5.1 In case of motor with antifriction bearing, check the condition of bearings and their tightness on shaft. If loose, the damaged bearing

seating should be built up by metallising and machining. Similarly the coupling seating is to be repaired. This machining job should be carried out together with the turning of commutator.

After repair of the bearing seating, mount the bearings as per the original catalogue recommendation.

5.1.5.1.1 Filling and drain out passages in grease cups are to be cleaned and the old used grease is to be taken out. During cleaning, bearing and housing is simultaneously cleaned. Thin mineral oil should be used as solvent and should be pre-heated to around 60-70^{o}C or as recommended by the solvent manufacturer. Bearings, grease cups and accessories to be wiped clean and covered with cloth.

5.1.5.1.2 Check proper bearing clearance with feeler gauge as per the procedure laid down in the bearing catalogue.

5.1.5.2 In case of motor with sliding bearing, check the shaft journal condition. Carry out polishing of shaft journal with fine emery tapes, if the surface needs re-dressing. Otherwise for finish polishing, use coir rope for polishing using fine chalk powder.

Check the conditions of oil rings and their ovality. If required, arrange for spare oil rings.

5.1.5.2.1 Check the condition of white / babbit metal of both halves of the bearings. Touch up with a skilled hand, if required, to remove scars on the bearing surface. Clean oil passages including jacking oil passages etc.

5.1.5.2.2 Measure the internal diameter of the bearing with an internal micrometer by averaging readings taken atleast at 3 places. Note down the readings.

5.1.6 Measure the IR value, ensure healthiness and take up for varnishing measure IR the armature after ensuring healthy IR. Varnish the armature with a suitable insulating varnish/insulating enamel depending on the class of insulation of the machine mentioned in the name plate or brochure.

5.2 **Field**

5.2.1 Tighten all pole fixing bolts. Tighten all connection bolts. Tighten all compensating winding and interpole connections. Replace damaged cables. Check conditions of lugs and if required, change the lugs. Anchor all the inter-connection cables.

In case of multipolar machine (except bipolar), pole bore between different pair of segments (main pole & commutating pole) is to be compared & made as nearly equal as possible.

5.2.2 Check the looseness of coils. If necessary, give packing retape coils.

5.2.3 Test the field for ensuring correct polarity, equality of resistance, soundness of joints etc. Check field winding for inter-turn shorts wherever possible (by surge comparison method).

5.2.4 Varnish the field with suitable air drying varnish after insuring healthy IR.

5.3 For Motor with Antifriction Bearings

5.3.1 End covers shall be checked up for their proper fitment and sealing on bearings. If found loose the covers are to be fitted with a metallic sleeve and machined to size.

5.3.2 If the motor is fitted and sealing with bearing capsules, the same operation as above is to be carried out to ensure proper fitment of bearing in the capsule.

5.4 For Motors with Sliding Bearings

5.4.1 Sliding Bearings

5.4.1.1 Check babbit condition and match surfaces of lower and upper bushes of babbit bearings. Defective bearings to be replaced and matched. Bearing gaps and collar clearances to be measured.

5.4.1.2 Ovality deformation and cracks etc to be checked in oil rings.

5.4.1.3 Labyrinths are to be checked and oil grooves, holes are to be cleaned.

5.4.1.4 Rotor journal radial run out is to be checked for proper fitting & sealing. For a shaft diameter of 100 to 200 mm, the permissible radial run out of shaft journal is not to exceed 0.02 mm and that of a shaft diameter above 200 mm, it is not to be over 0.03 mm. However, in case of working armature having vibration within norm, it could be overlooked.

5.4.1.5 While fitting the bushes of journal bearings, shaft journal diameter with outside micrometer and the bush hole diameter with an internal micrometer are to be measured. Feeler gauges may be used to measure the gaps of an assembled bearing. The clearance between shaft journal and the bush must be within norm given in **Table-1**.

5.4.1.6 Oil sumps are to be cleaned after draining out the used oil. Pedestal insulation is to be checked. Oil indicating glass and reflectors are to be cleaned.

5.4.2 Other Components

5.4.2.1 Carry out inspection of insulators of rocker assembly and defective insulators to be changed. Current collecting bus bars and insulators between them should also be checked.

5.5 Spring tension of brush holders and condition of holder to be checked. Change wherever necessary.

5.6 Condition of ventilation ducts and its connection to be checked.

6. ASSEMBLY

6.1 Motor with antifriction bearings – Megger voltage to be specified.

6.1.1 Thread in the armature exactly in reverse order as that followed while dismantling.

6.1.2 Fit back end shields, grease caps, coupling, etc. Make sure the bearings, grease cups, etc are filled with initial grease (lithium based greases are preferred for motors/generators).

6.1.3 Fix back brush rocker arms, position them as accurately as possible as per the original marking, put carbon brushes into the brush boxes, check freeness of the brush w.r.t. the brush box, bed the brushes so that a minimum of 70% of its contact surface is in contact with the commutator. Check the spring tension of each carbon brush. This should conform to carbon brush manufacturer's recommendation. Ensure that brushes of same grade are put back.

6.1.4 Ensure proper connection as per the sketch.

6.1.5 Ensure free rotation of armature by rotating armature.

6.1.6 Measure IR value again and record.

6.1.7 Check neutral axis and adjust, if required.

6.2 Motors with sleeve bearings.

6.2.1 Thread in armature into the stator exactly in reverse steps as that was followed while threading out in the case of motors/generators with non-split bearings

6.2.2 For split halved motors, place back the armature and the field top half in reverse sequence as that followed during dismantling. Complete all top and bottom half connections including carbon brush rocker connections.

6.2.3 Fix back brush rocker arms, position them as accurately as possible as per the original marking, put carbon brushes into the brush boxes, check freeness of the brush w.r.t. the brush box, bed the brushes so that a minimum of 70% of its contact surface is in contact with the commutator. Check the spring tension of each carbon brush. This should conform to carbon brush manufacturer's recommendation. Ensure that brushes of same grade are put back.

6.2.4 Lift assembled motor and place it on the bed plate and locate in its original position with the help of dowels or any other reference marking done before the removal.

6.3 Ensure proper connection as per the sketch.

6.4 Check the air gap and match its uniformity/compare with original value.

6.5 Ensure free rotation of armature by rotating armature

6.6 Measure IR value again and record.

6.7 Connect the ventilation system i.e. blower, ventilation duct, if any.

6.8 Check neutral axis and adjust, if required.

7. TESTING & TRIAL

7.1 Measure IR of all components and record.

7.1.1 Take R60/R15 value of the armature and the field separately and record.

7.2 Assemble the motor.

7.3 Ensure proper connection as per the sketch.

7.4 Ensure free rotation of the armature by hand.

7.5 Measure IR value and PI (R60/R15) again and record.

7.6 Check neutral axis of the brush holders and adjust, if required as per the original mark.

7.7 No load test and if possible load test is to be carried out. Take vibration reading & Pass rated current to field and see any joint heating.

TABLE – 1

PERMISSIBLE CLEARANCES BETWEEN THE SHAFT JOURNAL AND BUSH OF A JOURNAL BEARING

Shaft Diameter (mm)	Clearances Between Shaft Journal and Bush of Journal Ring Lubricated Bearing (mm)			
	Free Running Fit for Machines Running at Upto 1000 rpm		Loose Running Fit for Machines running at 1000 rpm and Higher Speed	
	Minimum	Maximum	Minimum	Maximum
80-120	0.08	0.12	0.12	0.17
120-180	0.10	0.15	0.15	0.21
180-260	0.12	0.18	0.18	0.25
260-360	0.14	0.21	0.21	0.29
360-500	0.17	0.24	0.25	0.34

Back