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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

SCHEDULE OF TECHNICAL REQUIREMENTS FOR MECHANICAL REPAIR/ REHABILITATION OF MAGNET FRAMES OF TRACTION MOTORS FOR ELECTRIC LOCOMOTIVES

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SCHEDULE OF TECHNICAL REQUIREMENTS FOR MECHANICAL REPAIR/ REHABILITATION OF MAGNET FRAMES OF TRACTION MOTORS FOR ELECTRIC LOCOMOTIVES

1. SCOPE

The magnet frames of DC Traction Motors used on conventional Electric Locomotives (WAG7/WAP4/WAG5) on Indian Railways sometimes need mechanical repair/rehabilitation due to damages/wear out in service. The repair/rehabilitation work is got done by the Zonal Railways through repairing firms through works contracts. The Schedule of Technical Requirement (STR) mentioned hereunder is issued to serve as a guide to repairing firms (called the "firm" hereafter) and should be read in conjunction with the relevant specifications/drawings for the subject works. The firm should satisfy themselves having complied with the requirements of the specification/drawings and STR.

The technical requirements are meant to serve as guidelines only and are not exhaustive.

2. GENERAL REQUIREMENTS

2.1 The firm should have currently valid ISO-9000 certification issued by an approved agency with the activity desired clearly mentioned in the scope of certification. The firm shall have a Quality Manual indicating the extent of control over production.

2.2 A system of regular submission of rejection details of material giving rejection rate, cause of rejection, corrective action taken etc. on quarterly basis should be followed by the firm.

2.3 The firm shall have a system of documentation in respect of rejection at customer end, warranty replacement and failure of item supplied by them during service.

2.4 The firm shall have a system of recording the plant, machinery and control equipments remaining out of service, nature of repairs done etc.

2.5 The testing and measuring equipment shall be duly calibrated and the validity of calibration should be current and verified by physically checking the calibration certificate issued by the Calibration Agency from whom it was calibrated.

2.6 The firm shall have a system of easy traceability of the product from manufacturing stage to finished product stage. Stamped identification marking with serial number of beam should be used for this purpose.

3.0 QUALITY ASSURANCE PLAN (QAP)

The firm shall prepare a Quality Assurance Plan (QAP) for all items for which approval is sought and submit the same as part of compliance of this STR. The QAP shall be a comprehensive document covering the following aspects:

i) Details of Quality Control Organisation of the firm along with key personnel engaged in the QC function.
ii) Quality Assurance Process of incoming materials used for the subject items.
iii) Process Flow Chart indicating process of manufacture for an individual product or for a family of products if the process is same.
iv) Quality Assurance System – Inspection & Testing Plan including the stage inspection.
v) Calibration scheme and status of calibration of equipments used in the quality process.

Details of the above aspects are described in the following paragraphs. The QAP shall be approved by RDSO and shall form basis of approval process.

4.0 QUALITY CONTROL ORGANISATION

4.1 The complete organizational setup of the Quality control key personnel and officials along with their qualification and experience should be furnished.

4.2 The Quality Control organization should be headed by a senior level official having adequate technical qualification who shall directly report to plant in-charge.

5.0 INCOMING MATERIAL

5.1 A complete Bill of Material indicating all input material items required for manufacturing of the product, governing specification and their sources of supplies as approved by the firm in accordance with Clause 7.4.1 of ISO-9001 (2000) should be furnished.

5.2 Test results of incoming raw material with reference to Test Certificate issued by the supplier and the results of internal tests carried out by the firm for verification may be submitted as part of QAP.

6.0 PROCESS OF REPAIR/ REHABILITATION

6.1 Complete Process Flow Chart covering all steps of process of repair/rehabilitation for an individual product shall be clearly enlisted as a part of QAP.

6.2 The following details of machines used for all the steps of machining operations should be included:

- o Make and model of the machine
- o Accuracy
- o Details of machining operations

6.3 Machining process should be such that all critical dimensions are final machined on CNC machining centers, preferably in a single setting.

6.4 Details of Jigs and fixtures used during manufacture should be furnished alongwith the manufacturing process wherever used.

6.5 List of typical M & P required for repair/rehabilitation work is furnished in **Annexure- I.** The list is for general guidance only and actual manufacturing operations shall be submitted and got approved by the firm as a part of QAP.

7.0 QUALITY ASSURANCE PROCESS- INSPECTION AND TESTING PLAN

7.1 Since magnitude of work may vary from magnet frame to magnet frame as per terms of individual contracts, the QAP should include process of joint recording of scope of jobs to be done on each of the units with Railways and the firm's representatives before the start of work.

7.2 Complete Inspection and testing Chart covering all steps of process of manufacture for an individual product including final inspection should be clearly enlisted as a part of QAP.

7.3 The following details of measuring instruments/equipments/jigs/fixtures used for all the steps of measurement operations should be included:

- o Make and model of the measuring equipment
- o Accuracy
- o Quantity to be measured and acceptable value range.

7.4 Stage inspection detailing inspection procedure, inspection parameters, and method of testing/test procedure including sample sizes for destructive and non-destructive testing. Record of test results of stage inspection should be available and furnished.

7.5 The list of Testing and Measuring instruments are furnished in **Annexure-II & III** respectively for general guidance only. However the specific Testing & measuring instruments, gauges used by the firm will also form part of QAP, which shall be submitted and got approved by the firm.

7.6 Dimensional measurements shall be made on Automatic/CNC type 3D-Co-ordinate Measurement Machines on prototype and on sample lots. The firm

should have three-dimensional Co-ordinate Measurement Machines of requisite accuracy in accordance with the dimensions of the jobs to be measured. Measurements shall be included as a part of QAP.

8.0 **Heat Treatment Furnace (For Items Requiring Heat Treatment):**

8.1 A heat treatment furnace for stress relieving capable of handling the entire production must be available. The furnace should be of continuous type either Oil Fired or Electric Type.

8.2 The furnace should have multi-point automatic continuous temperature recording arrangement with digital indicators for each point. The heat treatment recorder for time-temperature graph shall have sealing arrangement.

8.3 Proper numbering and maintenance of record should be kept for items under stress relieving for traceability with time-temperature curve and date.

8.4 Proper Sealing Arrangement of heat treatment furnace doors should be available to avoid oxidation / scale formation on the surface of beams being heat-treated. There shall be positive pressure inside the furnace to avoid entry of air from outside.

8.5 Positioning of the nozzles of oil-fired furnace, if used, shall be such that the flames do not make direct contact with the beams.

8.6 The heat treatment furnace must be calibrated using thermocouples for assessing temperature at different zones at various temperature ranges. The calibration should be done at least once in a year & proper records to be maintained.

8.7 Thermocouples and temperature indicators shall be calibrated at least once in six months.

8.8 Records of heat treatment indicating charge-wise & loading serial number wise details and time-temperature graph should be available.

8.9 Shot Blasting (For Items Requiring Heat Treatment):
Shot Blasting Machine of appropriate capacity with suitable conveyor / table should be available.

ANNEXURE-I

LIST OF REPAIR/REHABILITATION FACILITIES

The following manufacturing facilities shall be available with the firm:

1. Washing Tank of capacity 1.5 metre x 1.5 metre x 2.5 metre along with compressor and heating coils to maintain the temperature at the time of cleaning with 5% caustic soda at the temperature of 80 deg.C to wash the magnet frame.

2. Pressure steam jet/water jet to clean magnet frame

3. Oil Fired, LPG Fired or Electric Heat Treatment Furnace fitted with thermocouples and pyrometer etc. with Auto cut-in and cut-off and with strip chart recorder capable to go upto 650 deg.C and with digital display.

4. Welding Transformer for Submerged Arc Welding/ MIG welding Machine

5. CNC Machining Centre Size Minimum 1250X1000 mm pallet suitable for machining min. 800 mm diameter & min. 1100 mm length with 20 micron accuracy..

6. Drilling Machine with Tapping Arrangement of sufficient bed length to accommodate the magnet frame.

7. Marking/measuring Table of suitable size

8. Crane with proper handling facility as per requirement.

9. Painting booth with Drying Arrangement

ANNEXURE-II

LIST OF TESTING FACILITIES:

1.0 Calibration of the Testing / Measuring Equipments should be done at least once in a year unless stated otherwise.

2.0 Inspection Staff conducting non-destructive testing shall be adequately trained and qualified by recognized agency and shall have adequate experience.

3.0 Staff conducting tests like Chemical Analysis and Mechanical Properties shall have adequate skill & competence and shall have under gone sufficient training. Skill of such staff shall periodically be qualified by making them carry out tests on blind samples.

Following testing facilities should be available with the firm ,alternatively can be outsourced :

METALLURGICAL AND CHEMICAL LABORATORY:

1. Availability of Emission Spectrometer with necessary standard and automatic printer shall be preferred for verification of chemical composition of material.
2. Radiography Testing facilities.
3. Magnaflux/Dye Penetrant Test (DPT) facilities for checking of surface cracks.
4. Magnetic Particle Inspection (MPI) facilities for checking sub-surface flaws.
5. Metallurgical Microscope with magnification power up to 500x & metallographic sample preparation facilities with appropriate accessories to take photographs of slides.

PHYSICAL LABORATORY:

1. Universal Testing Machine of 40 tonne capacity with graphical recording facilities for conducting tensile tests.
2. Direct reading Hardness Tester of capacity 95-500 BHN.
3. Impact Testing Machine (Charpy V-Notch) of 0-300 Joules capacity for conducting impact test with facilities for notch cutting & undertaking this test at sub-zero temperatures as per the specified standard.
4. Shadowgraph facilities for assuring correct notch profile and dimension for impact test specimen.

ANNEXURE-III

List of Measuring Instrument

Calibration of the Testing / Measuring Equipments should be done at least once in a year unless stated otherwise.

1. Co-Ordinate Measuring Machineof min size of 1000mm x 1500 mm x 800mm. with a min. accuracy of 20 microns, Vernier Calipers, Inside & Outside Calipers And All Other Gauges Required During Matching Operations And Dimensional Checks.

2. Micrometer (200-700 mm outside)

3. Bore Micrometer (one metre inside)

4. Bore Dial Gauge (100-700 mm)

5. Vernier Height Gauge (One metre)

6. Ultrasonic Thickness Gauge

7. Slip gauge.

8. Straight Edge/ surface table of minimum 2 metre, 1.5 metre for marking of magnet frame

9. Thread plug gauges for checking threading portion of magnet frame duly calibrated

10. Hard and ground pins to check accuracy of hole dia of pole shoes fixing bolts.

11. Fixtures should be available

- to check accuracy of Axle bore, co-axiality, parallelity, perpendicularity in respect of rotor fixing end shields bore along with P.E. side bore, C.E.side bore.
- To check and prove air-gap has been maintained for all the pole faces. The fixture should be fitted alongwith a dial gauge to prove the same in respect of PE side and CE side bore.

The gauges should be hard and ground to avoid any lapses of accuracy.

12. Calibrated template to check the centre of both poles.

13. Infra red thermometer for checking temperature.