Specification No. RDSO/2007/EL/SPEC/0060(Rev'0')

Government of India
Ministry of Railways

सत्यमेव जयते

Technical Specification for Shaft Mounted Zirconium Copper Stamping type Resistance Ring design of Rotor for Traction Motor type 6 FRA6068 for WAG9/WAP7 locos.

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1. Foreword

Three phase traction motors type 6FRA 6068 are used on WAG9/WAP7 class of locomotives. The performance of these traction motors has not been satisfactory primarily due to failure of rotor.

Investigation has been carried out and failures have been attributed to torsional vibrations of the short circuit ring and fretting corrosion under the short circuit ring. After careful study it has been decided to reduce the torsional vibrations as much as possible while allowing the axial thermal expansion of rotor bars thus reducing the stresses in rotor bars. Use of zirconium copper – a stronger material for rotor bars is going to add to the life of rotors.

2. SCOPE

2.1. Through this specification, it is intended to design and develop a modified design of rotor by using zirconium copper stampings similar to rotor stampings as resistance ring and zirconium copper material for rotor bars to minimize the stress in rotor bars while increasing the life of rotors .

2.2. The scope of work follows :

2.2.1. Design and development of rotors by using zirconium copper stampings similar to rotor stampings as resistance ring and rotor bars made of zirconium copper.

2.2.2. Submission of details of design with calculations, detailed dimensional drawings of rotor along with components drawings to RDSO and getting design approval.

2.2.3. Manufacturing of prototype unit, to be inspected and approved by RDSO.

2.2.4. Bulk production of the balance ordered quantity after clearance of prototype by RDSO on completion of field trials.

2.2.5. Association with RDSO and Railways for performance monitoring.

2.2.6. Investigations in case of warranty failures and taking remedial steps if any.

3. Governing Specifications

CLW specifications and drawings for materials and dimensions: Same CLW existing specifications and drawings for TM 6FRA6068 except in case of items where specific mention is given in the subsequent para of this specification.

4. Qualification Criteria for Tenderers

The tenderer must have in house design and development capability, manufacturing and testing facility for Three phase AC Traction motors.

Tenderer, not having adequate competence in this field will not be considered.

5. Technical Conditions :

5.1. Performance Parameters

As this alternate design of rotors are to be used in existing stators of 6FRA6068 traction motors, hence adequate care should be taken to see that there is no change in the performance characteristics of the traction motor with this new design of rotors.

5.2. Material specifications :

Material specifications and dimensions for all components of rotor shall be same as the existing rotors of Traction Motor type 6FRA6068 , except in case of items where specific mention is given in the subsequent para of this specs..

5.3. ZrCu Rotor Stampings

Rotor stampings shall be as per RDSO drawing no SKEL 4693 Rev '0', Alt '1'consisting of enlarged cooling duct area .

5.4. Resistance Ring

In new design, 13 number of Zirconium copper(UNS - 15000)stampings similar to core stampings shall be used in place of existing resistance ring, placed between rotor end stamping and rotor end ring plate. Resistance ring must be manufactured as per RDSO Drg. No SKEL 4738. and RDSO Spec No RDSO/2008/EL/Spec/0062(Rev'0')

5.5. End Ring Plate

An end ring plate as per RDSO Drg. No SKEL 4739 having cooling duct holes fully aligned with rotor stamping holes should be provided after copper stamping type resistance ring.

5.6. Zirconium Copper Rotor Bars

Rotor bar length shall be as per RDSO Drg. No SKEL 4740 and Spec No RDSO/2008/EL/Spec/0063 (Rev'0') to suit the modified design without affecting the required performance parameters.

5.7. Shrink Ring

Shrink ring is not needed in this design as the rotor bars are driven in side the slots of copper stampings and brazed.

5.8. Shaft

There shall not be any change in material specifications and dimensions of rotor shaft.

5.9. Brazing

Brazing of Zirconium copper rotor bars with Zirconium copper resistance ring to be done carefully from all sides. Quality of brazing shall be of paramount importance. Manufacture shall have facility for mechanized brazing. A suitable method is required to be adopted to check the quality of brazing.

5.10. Swaging of Rotor Bars

Swaging of the rotor bars to be done through out the core length using mechanized process**.**

6. Quality Assurance Plan (QAP)

6.1. The successful tenderer shall formulate and furnish a quality assurance plan (QAP) covering the details of manufacturing and testing/inspection of all components of rotor. The QAP shall be furnished to RDSO at design approval stage and got approved as part of design approval.

6.2. The QAP shall essentially contains the following information on all components of the rotor :

6.2.1. Manufacturing process specifying the type of machines used.
6.2.2. Quantum of Checks , processes, stage inspection , incoming materials and agencies for testing
6.2.3. Critical dimensions of components on which cheeks are carried out.
6.2.4. Bill of materials, governing specifications and source of supply.
6.2.5. Test on incoming materials.
6.2.6. Details of NDT methods like radiography, UST etc to be carried out on the components.
6.2.7. Gauging Scheme , Calibration Scheme and status of calibration.
6.2.8. Tests schedule on complete rotor.

7. Design clearance

The tenderer shall submit the following documents to RDSO for getting the design approval :

7.1. Details of design along with calculations.
7.2. Detailed dimensional drawings of rotor and its components.
7.3. QAP

8. Prototype clearance

Prototype unit shall be offered to RDSO along with design details ,internal test reports and drawings for proto type inspections and clearance.

9. Routine Inspections

The routine inspections shall be carried out as per test plan approved by RDSO as part of QAP by an authorized representative of Indian Railways.

10. Test Plan

Rotor has to be tested after assembling it with a healthy stator. Tenderer can collect a healthy stator of Traction Motor type 6FRA6068 from the consignee after submitting indemnity bond of the cost of the stator and will return the same after the completion of the contract along with last rotor.

The following tests are to be carried out on rotor offer assembly into healthy stator

i) Winding resistance measurement
ii) Dimensional measurement of finished rotor

iii) Short circuit test/BR
iv) Over speed list

10.1. Winding Resistance Measurement

The resistance of winding of the stator , when cold shall be measured by voltage drop method or by digital micro ohm meter . Ambient temperature should also be recorded at the time of measurement.

10.2. Dimensional Measurement

Dimensional measurement shall be carried out as per the drawing of rotor approved by RDSO.

10.3. Short circuit test

Short circuit test shall be carried out at the following set values of currents

i) At 390A
ii) At 270A
iii) At 80A

The phase to phase voltage in each case should be recorded .

10.4. Over speed test

Over speed test shall be carried out at 3250 rpm for 2 min. The rotor cage ring diameter before and after the run should be recorded.

11. Documents to be furnished by Tenderer

The tenderer shall submit clause by clause compliance of this technical specification along with the tender documents. Statements like “noted” etc shall not be treated as compliance. The tenderer should explicitly write “complied” or otherwise with comments wherever applicable.

12. Drawings and Specifications

Component	RDSO drawing no Drawing No.	RDSO’s Specification
Rotor Steel stampings with increased cooling hole dia	SKEL 4693 Rev ‘0’ Alt ‘I’	Relevant CLW Spec
Rotor Bars	SKEL 4740	RDSO/2008/EL/Spec/0063 (Rev’0’)
Copper Stamping for Resistance Rings	SKEL 4738	RDSO/2008/EL/Spec/0062 (Rev’0’)
End Ring	SKEL 4739	Relevant CLW Spec
Swaging of Rotor Bars	-	RDSO/2008/EL/Spec/0065 (Rev’0’)

13. Dynamic Balancing

Dynamic balancing has to be carried out on finished rotors on an appropriate balancing machine to the grade G2.5 of ISO-1940-1973 or IS 11723-1985.

14. Warranty

The contractors shall warrant that the rotors repaired under the contract shall be free form defects and faults in design, material, workmanship and manufacture ring. In case of any failures/defects noticed within warranty period, the rotors shall be repaired/ replaced by the contractor free of cost for 18 months from the date of commissioning or 24 months from the date of supply whichever is later.