Date: 03-12-2024

Sub: Reasoned Document of comments received from vendors against draft Specification on 3Ø AC Traction Motor for HHP Locomotives [No. MP.0.2400.52 (Rev-05)]

Comments received against draft 'TECHNICAL SPECIFICATION OF 3Ø INDUCTION MOTORS FOR USE IN FREIGHT & PASSENGER VERSION OF 4500hp HHP AC-AC *DIESEL-ELECTRIC* LOCOMOTIVES' No. MP.0.2400.52 (Rev-05) from its vendors and Railway units, which was uploaded on RDSO website www.rdso.indianrailways.gov.in vide note no. SD.EMD.4000HP.TM3 dated 03-10-2024 is as under:

Cl. No. (Pg. No.)	DRAFT Specification No. MP.0.2400.52(REV.- 05) October'2024	Firm's name	Firm's Comment	RDSO's Remarks
5.6 (9), Annexure-O (50)	The TM offered shall be of an essentially high-voltage / low current compact design, given that the weight of the TM offered (excluding roller suspension bearing assembly, gear box, gear and pinion) shall not exceed **2125 kg** .	**CGPISL**	As per clause number 5.22 S.N. 2 page No. 13 of specification No. MP.0.2400.52(REV.-05), the offered traction motor has a steel bearing component, which lets to increase weight of traction motor. Hence specified value leads in **2175± 5% kg**.	**Weight As per Type test report :** **Medha** (framed)-2123 kg **CRRC**-2130kg (with shaft) **Siemens** (framed) – 2078 kg (in manual-2150 kg) **Siemens** (frameless) – 2098 kg (in manual-2120 kg) **CGL-2138 kg** **Saini-** **EMD** (in manual)- 2078 kg **BHEL- 2220 kg** (approval given with condition to keep the weight <=2125kg) **As per Approved QAP of BHEL**: With AL end fittings 2125kg (max.) With Steel End Fittings 2120±2%. **In view of above, Weight is modified as:** **shall ~~not exceed 2125 kg~~ be 2120±2%.**
		Medha		
		BHEL		
5.19 (12)	**TM Power Cables:** The TMs shall have elastomeric cable hangouts with bolted connectors to the under frame cables conforming to the following details: **Cable length:** 90 inches (2286mm) from edge of first tapping pad on the housing to end of the lug. **Cable type:** To confirm to Sienocopy 120 (N) HXSGAFHXO 1.8kV **Cable size:** 70 mm2 **Cable coding:** Cables of the TM shall be labelled "U", "V" and "W" at motor side. Color coded heat shrinkable tubing shall be used to identify each cable as follows: U: red	**CGPISL**	**TM Power Cables:** The TMs shall have elastomeric cable hangouts with bolted connectors to the under frame cables conforming to the following details: **Cable length:** 90 inches (2286mm) from edge of first tapping pad on the housing to end of the lug. (No change) **Cable type:** It seems to be a typing error it should be SIENOPYR(120) HXSGAFHXO as per EN50264-3-1. This is similar to EDPS-304 and EMD part number 40085782 which is for 2kV voltage. Hence both option may be specified. **Cable size:** 70 mm2 (No change) **Cable coding:** Cables of the TM shall be labelled "U", "V" and "W" at motor side. Color coded heat shrinkable tubing shall be used to identify each cable as follows: U: red	Para modified as follows. **Power cable of 1.8kV of Proven make conforming to EN50264-3-1.**

	V: white W: blue		V: white W: blue (No change)	
		Medha		
		BHEL		
5.22(13)	Earlier, the TMs in service, suffer from the following problems against which following modifications have been introduced by manufacturers/RDSO:			Following additional para is added: The manufacturer should take the cognizance of these suggested modifications during design of the prototype.
1.(13)	**Breakage of rotor bars** 1. Shortening the rotor bar overhang. 2. Use of lighter material for short circuit ring. 3. Change in cross section of rotor bar	**CGPISL**	For Point No. 1 & 3 - As per the drawing number 3/DMW/M/TM-512 ALT NO. X For Point No. 2 – Material grade is UNS C 18150.	
		Medha		
		BHEL		
4.(13)	**Stator winding damage due to vibration** 1. Increased the number of clamps/bracket from 7 to 12 of appropriate length	**CGPISL**	CGPISL uses a length of 52 mm for the DE side and 91 mm for the NDE side. If the length of the clamps can be mentioned, it would be much appreciated.	Noted. Para modified as follows. Increased the number of clamps/bracket from 7 to 12 ~~of appropriate length~~
		Medha		
		BHEL		
6.3(14)	A special requirement is that the 'hot spot' temperature in stator winding shall not exceed the average of the temperature by more than 25ºC for the endurance test. Establishment of this condition may require generally a special test to be done on the traction motor during type / routine testing; the vendor shall indicate as to how they propose to establish this.	**CGPISL**	This test is performed only during type test as a part of continuous heat run test. This point need to be in type test.	Noted and agreed. Accordingly, the sub para is modified as follows. Establishment of this condition may require generally a special test to be done on the traction motor during type ~~/~~ ~~routine~~ testing; the vendor shall indicate as to how they propose to establish this.
		Medha		
		BHEL		

ANNEXURE-0					
B.ROUTINE TEST					
Cl. No. (Pg. No.)		**DRAFT Specification No. MP.0.2400.52(REV.- 05) October'2024**	**Firm's name**	**Firm's Comment**	**RDSO's Remarks**
1.0 (46 & 51)		**Measurements of Stator Resistance** Record stator cold resistance for all the three phases and ambient temperature at a cold motor. (Limits : Line to Line Resistance : 231.2 milli ohms± 3% at 20° C including motor cables)	**CGPISL**	CGPISL request resistance to have limit of ±5 % Which is also mention on the approved routine report of 6FRA6068 of WAG 9 loco.	Noted. Tolerance has been modified. (Limits : Line to Line Resistance should not exceed 231.2 milli ohms+ 5% at 20° C including motor cables). Allowed Variation within the line to line resistances of the motor should be defined by manufacturer as per their design before prototype test.
			Medha	**In MTEPL Approved plan**: Phase value of every phase. Expected value at20°C : 97.145mΩ(+/-3%). **Medha Remark:** Our motor limit is 188.46 m ohm to 200.11 m ohm	Cl. No. 8.1 and Cl. No. 8.2 allows vendor for this flexibility in respect of reduction of temperature rise limit
			BHEL		
2.0 (51)		**Measurements on Sinusoidal Voltage** The motor will run the tests without a gear unit. Cooling air flow has to be Q=1.0 m3/s.	**CGPISL**	This is a part of type test, same is also not included in CLW/RDSO approved test schedule of 6FRA6068 of WAG 9 loco. Request you to remove this point from Routine test page no. 51 & add in type test.	Noted and agreed. Accordingly, the sub para is modified as follows. . The motor will run the tests without a gear unit.. Requirement of air flow for motor cooling is optional for these short duration tests to check its working.
			Medha	Not possible to measure Q during routine test as blower is not in our scope.	
			BHEL		
2.1 (51)		**Direction of rotation.** It should be clockwise when looking from drive end (pinion) with U-V-W phase of motor connected to R, Y, B of supply.	**CGPISL**		
			Medha	**In MTEPL Approved plan**: Desired value : clockwise rotation view from DEside **Medha Remark:** OK.	
			BHEL		
2.2 (51)		**No Load Measurements. (to IEC 60349-2, 9.3.1 / Investigation Test)** Record Pinput and I_o at f1 = 20 Hz and U_o=1415 V. Reference Value : mean current value of the first 4 machines : 76.35 A Actual value : Reference Value ± 10%	**CGPISL**		
			Medha	**In MTEPL Approved plan:** No load point with sinsoidal supply at 50HzCurrent measurement range : 6A,12A,18A,24A,30A,36A & at 1830V. **Medha Remark:** Not possible. Test at 50Hz can be done.	Cl. No. 8.1 and Cl. No. 8.2 allows vendor for this flexibility of adopting alternative test procedure after being examined and approved by RDSO.
			BHEL		
2.3 (51)		**Locked Rotor Measurements. (to IEC 60349-2, 9.3.1 / Investigation Test)** Record Pinput and Ikat f1 = 20 Hz and Uk= 332 V Reference Value : mean current value of the first 4 machines : 319.2 A Actual value : Reference Value ± 5%	**CGPISL**		
			Medha	**In MTEPL Approved plan** : Locked rotor point with sinsoidal supply at 50HzCurrent measurement range : 30A,60A,90A,120A,150A,180A & at 346V. **Medha Remark:** Not possible test at 50Hz can be done.	Cl. No. 8.1 and Cl. No. 8.2 allows vendor for this flexibility of adopting alternative test procedure after being examined and approved by RDSO.
			BHEL		

<table>
<tr><td rowspan="3">2.4 (51)</td><td rowspan="3"></td><td rowspan="3">Short Time Thermal Test/ Heat run test.
Run the motor at rated voltage, rated frequency and short time current rating (i.e, max. current) on sinusoidal supply (or on converter supply) with full cooling air, i.e. 1.0 m3/s at 1600 Pascal for 3 minute.
Limits: Mean temperature rise of the stator winding after the test: ≤ 200°C</td><td>CGPISL</td><td>This is a part of type test, same is also not included in CLW/RDSO approved test schedule of 6FRA6068 of WAG 9 loco.
Request you to remove this point from Routine test page no. 51</td><td rowspan="3">As per IEC 60349 -2, this test is Optional, subject to agreement between user and manufacturer.
This test is covered in type test. Hence, based on comments, this test is deleted, which is in line with OEM’s routine test protocol.</td></tr>
<tr><td>Medha</td><td>Not possible in routine test</td></tr>
<tr><td>BHEL</td><td></td></tr>
<tr><td rowspan="3">6.0 (52)</td><td rowspan="3"></td><td rowspan="3">Vibration test mention on IEC
Measure velocity of vibration Vrms in the range n = 1000 RPM to n = 3300 RPM
in increments of 500 rpm.<table><tr><th>Speed range</th><th colspan="2">Permissible vibration value</th></tr><tr><th></th><th>Frame-less design</th><th>Framed motor</th></tr><tr><td>0 to 1800 RPM</td><td>≤ 2.8m/s</td><td>≤ 3.5mm/s</td></tr><tr><td>800 to 3600 RPM</td><td>≤ 4.5mm/s</td><td>≤ 3.5mm/s</td></tr><tr><td>Greater than 3600 RPM</td><td>≤ 6.75mm/s</td><td></td></tr></table></td><td>CGPISL</td><td>CGPISL request confirmation that this test should be the part of type test of the motor, same is also not need to be done in CLW/RDSO approved test report of 6FRA6068 of WAG 9 loco.
Limits to be are as per IEC 60349-2</td><td rowspan="3">Noted. The para is modified in line with OEM’s routine test scheme as follows.

Measure velocity of vibration Vrms at n = 1800, 2600, 3300 RPM ~~Vrms in the range n = 1000 RPM to n = 3300 RPM in increments of 500 rpm.~~<table><tr><th>Speed range</th><th colspan="2">Permissible vibration value</th></tr><tr><th></th><th>Frame-less design</th><th>Framed motor</th></tr><tr><td>0 to 1800 RPM</td><td>≤ 2.8mm/s</td><td>≤ 3.5mm/s</td></tr><tr><td>800 to 3600 RPM</td><td>≤ 4.5mm/s</td><td>≤ 3.5mm/s</td></tr><tr><td>Greater than 3600 RPM</td><td>≤ 6.75mm/s</td><td></td></tr></table></td></tr>
<tr><td>Medha</td><td>Not possible Only at 1500rpm can be done.</td></tr>
<tr><td>BHEL</td><td></td></tr>
<tr><td rowspan="3">3.0 (52)</td><td rowspan="3"></td><td rowspan="3">Over speed Test. (to IEC 60349-2, 9.4)
Over speed test with n = 4550 rpm for 2 min. The subsequent High Voltage. Test to clause 4 must be passed.</td><td>CGPISL</td><td></td><td></td></tr>
<tr><td>Medha</td><td>Not possible in routine test</td><td rowspan="2">Not Agreed</td></tr>
<tr><td>BHEL</td><td></td></tr>
<tr><td rowspan="3">4.0 (52)</td><td rowspan="3"></td><td rowspan="3">Dielectric Test. (to IEC 60349-2 , 9.5)
Apply Ut = 6.2 kV, 50 Hz for 1 min.</td><td>CGPISL</td><td></td><td></td></tr>
<tr><td>Medha</td><td>In MTEPL Approved plan: At 6.2kV, 50Hz for 1min
Medha Remark: Ok.</td><td></td></tr>
<tr><td>BHEL</td><td></td><td></td></tr>
<tr><td rowspan="3">5.0 (52)</td><td rowspan="3"></td><td rowspan="3">Insulation test.
Measure the insulation resistance with U = 1000 V DC megger.
Reference value ≥ 10 MΩ</td><td>CGPISL</td><td></td><td></td></tr>
<tr><td>Medha</td><td>In MTEPL Approved plan: At 1kV DC, for 1min
Minimum value : >165MΩ
Medha Remark: Ok.</td><td></td></tr>
<tr><td>BHEL</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Stator impedance test with sinusoidal supply at 50Hz.
In MTEPL Approved plan: Expected value: 2.70 to 3.00 Ω between U-V, V-W, W-U.</td><td rowspan="2">Medha</td><td rowspan="2">In addition to above tests, we also conduct these tests on traction motor as per our regular practice & to ensure that there should not be any issues in field.</td><td rowspan="2">Noted. The test mentioned in Routine Test in the specification is minimum requirement. Additional test offered by firm for Quality Assurance of their ACTM is also permissible.</td></tr>
<tr><td></td><td></td><td>Check of smooth run.
In MTEPL Approved plan: At 1910V, 50Hz.
Check for noise and vibrations.</td></tr>
</table>

		Polarisation index test. **In MTEPL Approved plan**: Voltage : 1000v DC, for 10mins Minimum value : 2			

PART- B				
MACHINERY & PLANT REQUIRED FOR MANUFACTURING				
Pg. No.	**DRAFT Specification No. MP.0.2400.52(REV.- 05) October'2024 PART-B**	**Firm's name**	**Firm's Comment**	**RDSO's Remarks**
54 -55	1. MIG welding plant suitable for 3 phase traction motor.	**BHEL**	1. MIG welding facility.	Agreed
	2. Varnish Spray booth.	**BHEL**	2. Paint/Varnish Spray booth.	Agreed
	4. Shot Blasting (Required for Heat treatment).	**CGPISL**	As we are procuring our raw material of casting from the Proven source. Hence this facility at motor manufacturers work is not required. However we can submit the report of the vendor if required.	Noted. Outsourcing of the process may be permissible subject to declaration of the process and outsourced firm's name in QAP. The credential of such outsourced firm should also be submitted.
	7. Portable MIG welding machine.	**BHEL**	~~7. Portable MIG welding machine.~~	Agreed
	16. Coil winding machine, Coil Spreading Machine, Coil Moulding press Machine, Automatic Coil forming, looping & tapping for 3 phase Traction motor.	**BHEL**	16. Coil winding machine, Coil Spreading Machine, Coil Moulding press Machine, ~~Automatic~~ Coil forming, looping & tapping ~~for 3 phase Traction motor~~.	Agreed
	23. Induction heater for Stampings & bearings fitment with temperature control.	**CGPISL**	Heating of rotor stamping is done through oven Induction heater is not required. However bearing is heated through induction heater.	**Agreed : suitably modified as under:** **Induction heater for ~~stamping &~~ bearing with temperature control.**
		BHEL	23. Induction heater for ~~Stampings &~~ bearings fitment with temperature control.	Agreed
	24. Heat treatment furnace fitted with Thermocouple and Pyrometer etc. with Auto cut in and cut off and with strip chart capable to go up to 650° C and with digital display.	**CGPISL**	This is a part of manufacturing process & to be done at sub-vendors of motor manufacturer. Hence this facility at motor manufacturers work is not require.	Noted. Outsourcing of the process may be permissible subject to declaration of the process and outsourced firm's name in QAP. The credential of such outsourced firm should also be submitted. In such case, the M&P should be available at outsourced firm.
	25. Templates, Jigs and Fixtures for cutting plates as per required geometry.	**CGPISL**	This is a part of manufacturing process & to be done at sub-vendors of motor manufacturer. Hence this facility at motor manufacturers work is not require.	Noted. Outsourcing of the process may be permissible subject to declaration of the process and outsourced firm's name in QAP. The credential of such outsourced firm should also be submitted. In such case, the M&P should be

				available at outsourced firm.
	26. Facilities for stamping of identification marking as per specification.	**BHEL**	26. Facilities for stamping of identification marking ~~as per specification~~.	Agreed
	29. Facility for Annealing of leads.	**CGPISL**	Lead cleaning is the process required in DC motor, So this is not required for AC motor.	Agreed
		BHEL	~~29. Facility for Annealing of leads.~~	Agreed
	31. Induction brazing machine for leads connection.	**BHEL**	~~31. Induction brazing machine for leads connection.~~	Agreed. Equipment at SN-20 of M&P list has been repeated
	LIST OF MEASURING INSTRUMENTS 1. Open Bridge type Co-ordinate measuring machine. 2. Micrometer 3. Bore micrometer 4. Bore dial Gauge. 5. Vernier Height Gauge 6. Ultrasonic Thickness Gauge. 7. Straight edge /Surface table of minimum 2 meter X 1.5 meter for marking. 8. Infrared thermometer for checking temperature. 9. Megger 10. Micro Ohm meter 11. Oscilloscope.	**BHEL**	6. ~~Ultrasonic Thickness Gauge.~~ (not being use at present)	6. Agreed

Note : The M&P listed above is required to be complied by the firm. The alternate/additional M&P having better technology for manufacture of AC TM may also be acceptable.

2. Corrections made based on internal review of specification

Cl.No./ Pg. No.	**Existing**	**Proposed correction**	**Remarks**
8.1.1	In case, the traction motor offered has been employed on traction duty successfully in WDG4/WDG4D/WDP4B/WDP4D locos (in the part),	In case, the traction motor offered has been employed on traction duty successfully in WDG4/WDG4D/WDP4B/WDP4D locos (in the past),	Spelling correction
8.3 (16)	He will furnish a copy of such QAP documents as per RDSO"s standard format along with his offer.	A copy of such QAP as per RDSO"s standard format advised at Annexure-A7 of ISO Document no.: QO-F-8.1-7 Version No.: 1.8 or latest shall be furnished along with his offer.	In compliance to guidelines available as RDSO's Apex Documents at website.
8.4 (16)	**Field trial:** A vendor, who has offered the traction motors for application for the **first time**, shall supply **03 prototype motors** which will be fitted on a locomotive along with 03 existing (OEM make) motors. These TMs	**Fitment and Performance Trail for Prototype Clearance ~~Field trial~~ :** A vendor, who has offered the traction motors for application for the **first time**, shall supply **03 prototype motors** which will be fitted on a	Qualifying criteria of prototype equipment revised since there is no

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<td>will be tested in actual operation for at least 3 months. Upon successful field trial of these TMs, further clearance shall be given for supply of 06 more TMs which will be subjected to a further field trial of upto 6 months on a single locomotive.

Clearance for further supply of the ordered quantity (of TMs) shall be given after successful field trial detailed above. For this, field trial performance feedback shall be obtained in following format:

<table>
<tr><th>Shed/Z. Rly.</th><th>Loco No.</th><th>TM Sl. No.</th><th>Make</th><th>DOC</th><th>DOF</th><th>Cause of failure *</th><th>Remarks</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
* Failure data downloaded from equipment/system (if available) should be invariably made use of.

In case, the behavior of the motor is not found suitable as per IR requirements, the vendor at his cost may incorporate changes in the traction motors and which shall be subject to further field trial of 3 months as stipulated above in each case (or as decided by IR). The firm shall obtain permission for the proposed modification from IR. May also refer Clause 5.8 of this specification.</td>
<td>locomotive along with 03 existing ~~(OEM make)~~ motors of approved/developmental vendor. These TMs will be tested in actual operation for at least 3 months. ~~Upon successful field trial of these TMs, further clearance shall be given for supply of 06 more TMs which will be subjected to a further field trial of upto 6 months on a single locomotive.~~

Clearance for further supply of the ordered quantity (of TMs) shall be given after successful ~~field~~ performance trial detailed above. ~~For this,~~ ~~field~~ Trial performance feedback shall be obtained in following format:

<table>
<tr><th>Shed/Z. Rly.</th><th>Loco No.</th><th>TM Sl. No.</th><th>Make</th><th>DOC</th><th>DOF</th><th>Cause of failure *</th><th>Remarks</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
* Failure data downloaded from equipment/system (if available) should be invariably made use of.

In case, the behaviour of the motor is not found suitable as per IR requirements, the vendor at his cost may incorporate changes in the traction motors, ~~and~~ which shall be subject to further ~~field~~ performance trial of 3 months as stipulated above ~~in each case~~ (or as decided by IR). The firm shall obtain permission for the proposed modification from IR. May also refer Clause 5.8 of this specification.</td>
<td>new locos in production and the procurement of new TMs has reduced drastically <u>from 1890 nos.</u> (=approx. requirement in 2016-17 for 315 hhp locos received from BLW) <u>to 83 nos</u> (=procurement by BLW & PLW in last 5 years as per Data available at UDM)</td>
</tr>
<tr>
<td>8.5 (17)</td>
<td>Qualification required for approval: After successful prototype testing and field trials evaluation, the firm shall qualify to supply the TMs in restricted numbers till qualifying quantity laid down by IR is achieved. Regular supplies of TMs may be accepted on submission of the work test certificate (WTC) to BLW after approval of the firm as developmental vendor.</td>
<td>Qualification required for approval: ~~After successful prototype testing and field trials evaluation, the firm shall qualify to supply the TMs in restricted numbers till qualifying quantity laid down by IR is achieved. Regular supplies of TMs may be accepted on submission of the work test certificate (WTC) to BLW after approval of the firm as developmental vendor.~~
As per RDSO’s ISO Guidelines.</td>
<td>In compliance to guidelines available as RDSO’s Apex Documents at website.</td>
</tr>
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