2947266/2024/O/o PED/TRACTION/RDSO

सत्यमेवजयते

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No. EL/3.2.3 **Dated**: As signed.

Principal Chief Electrical Engineer,

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3. East Central Railway, Hajipur, Bihar-844 101
4. South Central Railway, Rail Nilayam, Secunderabad-500 071
5. East Coast Railway, Chandrashekharpur, Bhubaneswar-751 016
6. South East Central Railway, Bilaspur- 495 004
7. Eastern Railway, Fairlie Place, Kolkata-700 001
8. South Eastern Railway, Garden Reach, Kolkata-700 043
9. North Central Railway, Subedarganj, Allahabad-211 033
10. Southern Railway, Park Town, Chennai-600 003
11. Northern Railway, Baroda House, New Delhi-110 001
12. South Western Railway, Hubli-580 024
13. North Eastern Railway, Gorakhpur-273001
14. West Central Railway, Jabalpur-482 001
15. North East Frontier Railway, Maligaon, Guwahati-781 011
16. Western Railway, Churchgate, Mumbai-400 020
17. Chittaranjan Locomotive Works, Chittaranjan-713 331

SPECIAL MAINTENANCE INSTRUCTION No RDSO/2006/EL/SMI/0240(REV. '1')

1.0 Title:

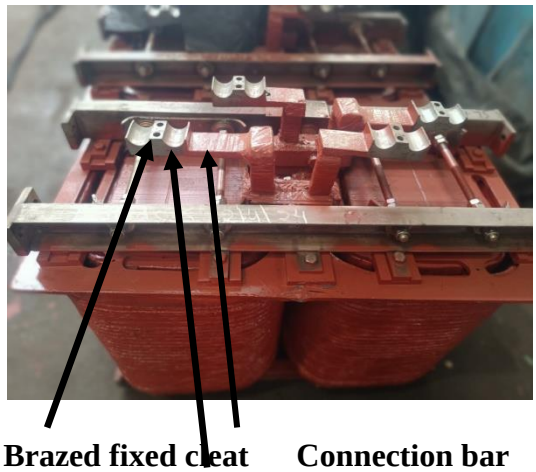
Measures to improve the quality of smoothing reactors (SL-42/30) during manufacturing /maintenance.

2.0 Brief History:

Recently a fire incident took place in one locomotive due to detachment of brazed fixed terminal cleat from connection bar attached with smoothing reactor coil end. Detached SL cable cleat was hanging inside SL cover leading to occasional shorting with other SL coil end. Henceforth, to avoid such incidences, the clause of resistance measurement has been modified and measurement of milli-volt drop has been introduced in addition to number of measures taken by the Railways to avoid failures of smoothing reactors. The measures, identified on the basis of failure analysis by the RDSO, for improving the quality are briefly summarized below:

Sl No.	RDSO Guidelines/ Activity	Improvements/ Standard for SL-30/42
1	Modification Sheet no.WAM4/147 dt. 11.09.1985 for Cable Connecting Cleats	• Increase the thickness of cleats from 18 mm to 23 mm. • The existing blind holes to be drilled through 13mm dia.

		holes in both the cleats • Both the cleats to be cadmium plated. • Replace the existing screws by high tensile cadmium plated M-12 bolts and nuts. • Existing copper bus bar connecting the fixed cleats to the winding to be replaced by Brazing 50mm wide copper bar as shown in the drawing No.SKEL-3845.
2	RDSO Modification Sheet no.WAG5/15 dated 24.4.94 with Amendment no.1 dated 26.3.3002 (As per ISO, number changed as MS no. ELRS/MS/228) on improvement measures for smoothing reactors SL-42/SL-30.	• Ensure proper control on dimensions and tooling to achieve specified air gap at corners between inner coil and core. In case, a clear gap of at least 2mm at the corners cannot be achieved, increase the dimension of- – Change Inner dimension of the inner coil from 267± 0/1mm to 277± 0/1mm. – Change the Gap between insulated core and inner coil from Max 4.0 mm to Max 6.0 and Min 2.5 mm to Min 4.0mm. – Change the Gap between inner coil and outer coil from Max 23mm to Max 15.6 and Min 21 mm to Min 14.1 mm. • Use two coats of anti-tracking varnish F93 on the coil. • Use of Glass Epoxy Material (SRBGF) conforming to IS 10192 Gr. EP3 for insulating boards, support blocks and sleeves for bolt fixing cleats in place of laminated boards conforming to IS 2038 Gr 'F'. • Use SRBGF cleats for cable support to avoid rubbing of cable with terminals.
3	RDSO Technical Circular no. 42 dated 23.06.99 for retention of SL-42 while converting WAM4 locos to 6P combination of traction motors.	Change the material of cross bar assembly and stud from mild steel to stainless steel.
4	Measurement of coil resistance and milli-volt drop with fixed terminal cleat brazed on connection bar (161X50X10 mm thick) and	The measurement of resistance of each coil with connection bar having brazed fixed terminal cleat on

	connection bar with external coil end. Coil-1 Coil-2  **Brazed fixed cleat Connection bar Brazed joint** Picture showing fixed terminal cleat brazed on connection bar (161X50X10 mm thick) and connection bar with external coil end.	connection bar (161X50X10 mm thick) and connection bar with external coil end shall be made at ambient temperature through V/I method by injecting the rated direct current (1350 Amp for SL-30) through the coil. The measured resistance shall be corrected to reference temperature 115°C as per following formula: $R\ 115 = \frac{Ra \times 349.9}{234.5 + ta}$ Where, R115 is corrected resistance at 115°C. Ra is the resistance at ambient temperature and ta is ambient temperature. R115 shall be 3.645 ± 0.056 milli-ohm **The milli-volt drop corrected at 115°C = 4.92 ± 0.076 Volt.**
5.	Provision of one additional steel mesh over fibre cover as per Zonal Railway recommendation. 	The cover of SL is made of fibre which is sometimes found broken and foreign material are found stuck in SL, therefore Zonal Railways may provide one additional steel mesh to restrict the entry of foreign material in SL and to avoid damage due to external hitting.

In the recent past there had been number of cases in which the smoothing reactor have failed, coil burnt and flashed primarily due to lesser gap between inner and outer coil. During quality audit of SL as well as scrutiny of data submitted by one of the Railways for about 100 number of SLs revealed that-

a) There are about 14% SLs in which the gap between core and inner coil at corner is less than 2 mm.
b) The dimension of support plates are not to the drawings and blocking the air passage resulting less cooling of coils.
c) The SRBGF material used for spacers, support plate should be of fire retardant and is not being tested frequently.
d) Mild steel cross bar assembly and stud are still being used instead of stainless steel.
e) Stage inspection of coil for maintenance of appropriate gaps at different locations during manufacturing is not being carried out.

f) The fixing arrangement of SL is not standardized during manufacturing. The fitment problems have been reported by the Railways during replacement of SL.

g) The dimension of the spacers provided in between core to inner coil and inner to outer coil are not checked frequently for ensuring specified gaps at different locations.

3.0 Object:

To improve the quality of smoothing reactors during manufacturing as well as maintenance to avoid smoke emission/over-heating/flashing and burning of SLs.

4.0 Instruction:

In addition to the various instructions issued by RDSO and briefly contained in para 2.0 above, the following should also be followed.

4.1 For CLW:

4.1.1 The support plates provided with the SL is not to the drawings and blocking air passage between core and coil and between inner and outer coil. These need to be checked and modified to the standard drawings. Dimensional checks as well as shape are required to be checked frequently before assembly.

4.1.2 The dimension of the spacers provided in between core to inner coil and inner to outer coil is to be checked and modified/revised to ensure specified air gaps at different locations.

4.1.3 The SRBGF material used for spacers, support plate should be fire retardant and is to be tested frequently. The material should conform to IS 10192 Gr. EP3 and procured from CLW/RDSO's approved sources.

4.1.4 The quality of Electrolytic copper conductors (strips) purchased from various CLW/RDSO's approved vendors are to be tested frequently. Dimensional checks are also required for maintenance of proper gaps.

4.1.5 There is no stage inspection of coil for maintenance of appropriate gaps at different location. The inspection is carried out on finished product wherein it is not possible to check the dimensions at critical location. CLW to ensure proper control on dimensions and tooling to achieve specified air gap at corners between inner coil and core and introduce stage inspections.

4.1.6 The cross bars and studs of Stainless steel ae to be provided with SLs as per RDSO's technical circular no.42 issued on 23.06.1999. CLW to develop sources for these items.

4.1.7 The fixing arrangement of SL for the loco is not standardized. The SL is fitted first on frame and then it is mounted in the locomotive under frame. The dimension of the frame is checked in shop floor. CLW Drg. No.OTWD.075.001 and 2TWD.073.021 do not provide centre to centre distance of hole and it may vary from SL to SL causing problem during replacement/cannibalization by the Railways during scheduled/unscheduled maintenance of SL CLW to standardize the mounting arrangement of SL in the locomotive under-frame.

4.1.8 The pressure mandrel block is old one, de-shaped/deformed with the result coil shape also gets d-shaped and the gaps may not be uniform. CLW to modify/rectify/replace mandrel block.

4.2 Railways:

4.2.1 Besides periodical maintenance of SLs as laid down in the maintenance manual Railways to change the cross bar assembly and studs from mild steel to stainless steel to be purchased from CLW approved sources during TOH/IOH/POH. The procedure for the same is given below-

SN	STEPS	CONTENTS
A	Top side channel	
1	Dismantling	• Remove deposits of varnish inside threads of all the Studs. • De-tightening of Stud bolt inner side (08 nos.) as provided on larger portion of the Studs. • De-tightening of outside channel bolts (08 nos.) as provided on both the top channels. • De-tightening of Middle bolt for disconnection of cleats from the channel. • Removal of both the channels one by one by hammering. • Removal of Epoxy moulded blocks (08 nos.) as provided on bottom side between the bottom side channel and the coils by lifting both sets of coils slightly one by one. • Now both sets of coils would rest on the bottom side channels having gap at topside for fitment of new channels.
2	Fitment of new Cross Bar Assembly (channels) & studs (Tie rods)	• Replace & placement of stainless steel studs in place of old (Mild steel) studs with new bush and washers in position in the core for fitment of new channels. • Provide the new channels to the Studs along with bushes and washers and tighten the inner side stud bots for both the channels one by one. • Tighten the outside channel bolts on both the channels one by one to fix them in position.
3	Tilting of SL	Placement of SL in tilted position (i.e. lead end at bottom side) on two wooden blocks.
B	**Bottom side channel**	
4	Dismantling & fitment of new channels & Studs	Repeat the process as given at as S No.1 to 2 for removal of old Channels & fitment of new Channels along with new Studs, bushes & Washers.
5	Positioning of coil sets between both side channels	• Insertion of 08 nos. Epoxy moulded blocks along with washers in between coils & channels. • Press the set of coils 1 & 2 one by one by way of tightening the bolts provided with the channels.
6	Tilting of SL	• Placement of SL keeping its lead end at the topside. • Tightening of top cleats by way of Tightening of the middle bolt.

Note:- The above exercise is likely to take one & a half working days engaging two staff(one skilled & one un-skilled).

5.0 Application:
All Conventional Electric Locomotives.

6.0 Agency of Implementation:
CLW and all Electric Loco Sheds.

7.0 Periodicity:
TOH/IOH/POH.

8.0 Distribution:
As per standard mailing list.

(Sanjay Kumar Tiwari)
ED/RS
for Director General/Std./Elect.(I)

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Encl: Nil .