2947284/2024/O/o PED/TRACTION/RDSO

सत्यमेव जयते

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

Principal Chief Electrical Engineer,

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2. North Western Railway, Jaipur-302 006
3. East Central Railway, Hazipur, 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/2017/EL/SMI/0304 (REV.‘1’)

1.0 Title:

Special Maintenance Instruction for maintenance of Smoothing Reactor (SL) in Tap-Changer Electric Locomotives especially for testing of SL.

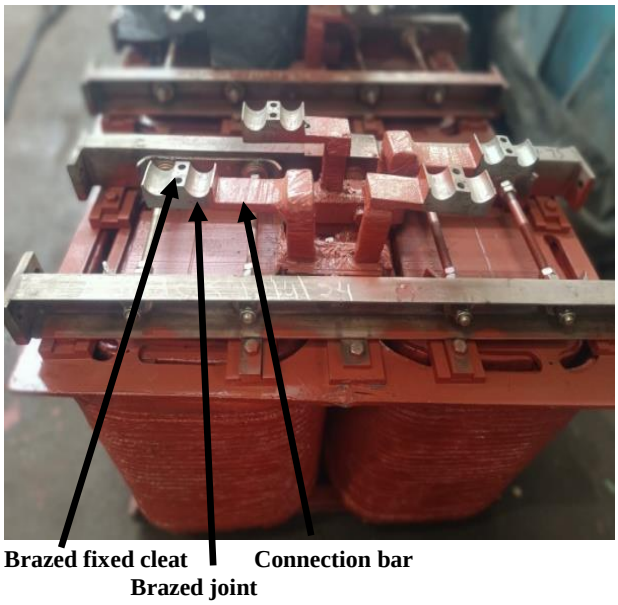
2.0 Brief History:

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. Further, the existing SMI no. RDSO/2017/EL/SMI/0304(REV. ‘0’) titled as measures to improve the quality of smoothing reactors (SL-42/30) during manufacturing/maintenance does not cover the requirement of testing of SL to check the various parameters of SL before same is being fitted in locomotives. As such, POH shops are not able to verify the stipulated technical parameters in the governing specification of Smoothing Reactor (SL).Therefore, POH shops are following different procedure/process/tests in maintaining the SL and in doing so they are not carrying out all the process/tests on SL before fitment.

3.0 Object:

To provide standard and uniform maintenance instruction for Smoothing Reactor (SL) in tap-changer electric locomotives indicating the standard tests/ process / measurements.

4.0 Activities to be done during maintenance of Smoothing reactor (SL)

SN	Activity	Standard for SL 30
1.	Check complete SL visually for any insulation damage.	No damage
2.	Pre-heating of SL in an oven for 2 hrs. 100^0C	Stipulated time & temperature shall be followed.
3.	Baking of complete assembly in an oven for 12 hrs at 140 ^{0}C. This shall be done after varnishing.	Shall be followed.
4.	Measurement of coil resistance and milli-volt drop with fixed terminal cleat brazed on connection bar (161X50X10 mm thick) and 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	The measurement of resistance of each coil with connection bar having brazed fixed terminal cleat on 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, R 115 is corrected resistance at 115°C. Ra is the resistance at ambient temperature and ta is ambient temperature.

		R 115 shall be 3.645 ± 0.056 milli-ohm **The milli-volt drop corrected at 115**°C **= 4.92 ± 0.076 Volt.**
5.	Check the impedance (Z) at 50Hz, Z = V/I	---
6.	Check Inductance at 50Hz (can be calculated from impedance & resistance) $L = (\sqrt{Z^2 - R^2}) / 314$ Z=Impedance in Ohm R=Resistance in Ohm The R is negligible as compared to Z; and therefore same may be neglected & not required to be measured if facility is not available. In that case L = Z / 314	3.35 ± 0.3 mH at 10V AC, 50 Hz
7.	Check the secondary insulation sleeve between core supporting rods and bracket	Condition shall be good otherwise replace the same.
8.	Tinning of terminal	shall be done
9.	Check the insulation resistance with 1kV Megger between terminal & earth.	IR ≥ 100MΩ
10.	HV testing by giving 2.5 kV AC for one minute between terminal & body. (Short all the windings of SL and connect them to the high voltage testing set. Connect the frame/cores to the earth terminal of the reactor) - The reactor shall successfully withstand the applied voltage. - Record the leakage current.	 - Reactor withstood the applied voltage (Yes/No). - The leakage current shall be ≤ 10mA
11.	Tap all the thread holes and ensure good condition of threads	To be done on condition basis.
12.	Check the SL cover for any crack and damage	No crack or damage
13.	Check the frame holes for ovality.	No oval holes.
14.	Clean the iron particles available in the air gaps and core and in between coils at final stage by magnetic rod.	
15.	Check the gap between inner coil & core at all four corners	To be as per SMI 240
16.	Check the gap between flat portion of core & coil	To be as per SMI 240
17.	Provision of one additional steel mesh over	The cover of SL is made

	fibre cover as per Zonal Railways recommendation. 	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.

5.0 Testing of Smoothing Reactor(SL)

5.1 Measurement of Inductance

(i) Calculate the Impedance by measuring current, applying 10V AC, 50 Hz voltage across each coil & record the results. Average value of the three impedance values shall be measured and inductance value of one coil calculated from it shall be 3.35 ± 0.3 mH. During measurement of current, voltage across each coil shall be applied for at least five minutes then switch off. Use non-contact type thermometer/ thermal imager to detect any hot spot on each turn on the outer surface. Hot Spot will indicate inter turn short. Reject the equipment for repair if any inter-turn short is detected.

(ii) The resistance shall be measured by injecting the rated direct current (1350 Amp for SL-30) through the coil as per SN-4 of above table.

(iii) Finally; the inductance shall be calculated as under:

$L = (\sqrt{Z^2} - R^2) / 314$

Z=Impedance in Ohm

R=Resistance in Ohm

The R is negligible as compared to Z; and therefore same may be neglected & not required to be measured if facility is not available. In that case L = Z / 314

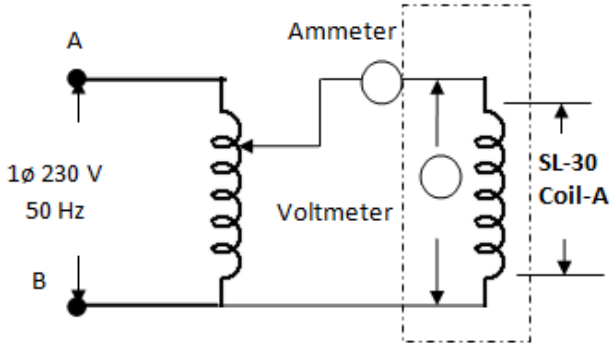
Testing Equipment:

(i) 1-Ø /3 Ø Variac of suitable rating which can feed supply of 10V AC, 50Hz to reactor

(ii) Digital Clamp meter

(iii) Suitable Resistance Meter/Micro- ohm meter

Measurement of Inductance of SL by applying 10V AC 50Hz



5.2 **Insulation Resistance Measurement**

The Insulation resistance measurement shall be done at ambient temperature with 1000V Megger between

(i) Earth & Coil 1
(ii) Earth & Coil 2
(iii) Earth & Tie rod of the cross bar &
(iv) Earth & all bolts.

The IR values shall be ≥ 100MΩ.

Testing Equipment:

Megger of 1000V rating.

5.3 **HV testing**

Apply 2.5kV for one minute between winding/coils and frame/cores. The reactor shall successfully withstand the applied voltage as above & record the leakage current.

Testing Equipment:

Suitable HV Test kit which is able to apply 2.5 kV for one minute.

6.0 Application

All Conventional Tap-changer Electric locomotives

7.0 Agency of Implementation:

POH/MTR shops carrying out POH/MTR of Tap Changer Electric Locomotives.

8.0 Periodicity of Implementation:

During POH/MTR schedules and any other unscheduled maintenance as per need.

9.0 Distribution:

As per standard mailing list.

Encl: Nil

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

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