Government of India
Ministry of Railways
Research, Designs & Standards Organisation
Manak Nagar, Lucknow - 226 011

No. EL/3.2.1/3 Dt:19.1.1995

SPECIAL MAINTENANCE INSTRUCTIONS NO. RDSO/ELRS/SMI/158 CODE OF PRACTICE FOR MAINTENANCE OF TRANSFORMER OIL IN SERVICE

1. OBJECT

1.1 Varying practices are being followed by Railways for maintenance of transformer oil in service. Also. the oil in the locomotive transformer is being replaced during POH irrespective of whether the condition permit its use for some more time. In order to ensure optimum utilisation of the transformer oil. it is necessary to monitor its condition periodically and replace it only when further treatment by way of filteration does not restore its characteristics within permissible limits. In this context guidelines for tests to be carried out on the transformer oil. The periodicity of these tests and interpretation of the test results have become necessary.

1.2 These guidelines alongwith the work to be carried out in various schedules have been covered in these instructions.

1.3 This SMI supersedes the instruction contained in SMI No.127 regarding condition monitoring of transformer oil in service.

2. INSTRUCTIONS

2.1 Tests to be carried during various schedules. The interpretation of the test results and action to be taken:

I.C. SCHEDULE:

(i) Draw a sample of the oil from the transformer as per the method given in IS:6855-1973 or IS:9434-1979 depending upon the characteristics to be evaluated the quantity of oil drawn should be 4 litres instead of 2 litres prescribed in these standards.

(ii) Check the oil characteristics for tests given at S. No. 1 to 5 and 7 in Annexure1.

(iii) If the colour of the oil has become dark brown which is indicative of presence of dissolved copper. change the oil with new filtered oil meeting characteristics given in Annexure 1.

iv) For interpretation of results of dissolved gas analysis follow the instructions given in RDSO SMI No. 138.

(v) If dielectric strength and water content are beyond the permissible limits given in Annexure-I. the oil is likely to be cloudy with acrid smell and it should be filtered under vacuum as per IS:10028 (ii) 1981.

Filteration of EHV grade oil to be carried out at a vacuum level of 98% at a temperature of 60 °C and of inhibited oil at a pressure of 0.15 torcillie at a temperature of 60 °C. provided the specific resistance is within limits. Filteration should continue till such time the oil is completely dried. Check the filtered oil sample for electrical strength and water content and if these parameters are within the limits. the oil is fit for use and if not repeat filteration till Electrical strength and water content are within limits.

(vi) If the specific resistance is beyond permissible limit, replace the oil with new filtered oil meeting characteristics given in Annexure 1.

AOH SCHEDULE

(i) Same as S. No. (1) of IC schedule.

(ii) Check the oil characteristics for tests given at S.No. 1 to 8 and 11 in Annexure-I. Compare the results with the earlier results done on the same oil during earlier major schedule. Any abrupt change in the value of an parameter is indicative of unhealthiness of the transformer. The transformer should be opened for detailed internal inspections for any incipient fault.

(iii) Same as S.No. (iii) of IC schedule.

(iv) Same as S.No. (IV) of IC schedule.

(v) If the specific resistance, total acidity and dielectric dissipation factors are within limits and either electrical strength. water content or sludge are beyond the permissible limits, follow the instructions at s. No. (v) of IC schedule.

(vi) If either of the parameters is specific resistance, total acidity and dielectric dissipation factor are beyond the permissible limits, replace the oil with new filtered oil.

(vii) Measure and record the inhibiter content in the oil (if inhibited).

IOH-SCHEDULE

(i) Same as s. no (i) of IC schedule.

(ii) Check the oil characteristics for tests given at s. Nos. 1 to 11 in the Annexure 1. Compare the results with the earlier results recorded during earlier schedule on the same oil. Any abrupt change in the value of the parameters is indicative of the unhealthiness of the transformer. The transformer should be opened for detailed internal inspection for any incipient fault. However, if the flash point falls by 15 °C from its initial value. Replace the oil with new filtered oil with out opening the transformer.

(iii) Same as S. No. (iii) of IC schedule.

(iv) same as S. No. (iv) of the schedule.

(v) If the flash point interfacial tension, specific resistance total acidity and dielectric dissipation factor are within limits and either the electrical strength water content and sludge are beyond the permissible limits proceed as in s. No. (v) of IC schedule.

(vi) If either of the parameters i.e. flash point. interfacial tension. Specific resistance, total acidity or dielectric dissipation factors are beyond the permissible limits. replace the oil with new filtered oil.

(vii) Measure and record the inhibiter content in the oil, if inhibited.

POH SCHHEDULE

(i) Same as S. No. (i) to (vii) of IOH schedule except that the oil to be replaced if acidity exceeds 0.25 mg KOH/gm so that oil can last upto next AOH.

(ii) Record all the characteristics as is done during IOH. Collect the oil characteristics of the same oil from the homing shed recorded during earlier schedule. Results of the tests on the same oil to be given to the sheds for records and condition monitoring.

3. PERIODICITY:

As per instructions at 2 above.

4. INSTRUCTION DRAWING: NIL.

5. APPLICATIO ON CLASS OF LOCOMOTIVES:

All A.C. electric locomotives and EMUs.

6. **<u>AGENCY OF IMPLEMENTATION :</u>**

Electric loco/EMU sheds and POH shops.

7. **<u>DISTRIBUTION:</u>** As per list enclosed.

(R. N. LAL)
for Director General

(Elect).

Encl: as above

ANNEXURE I

SL No.	Tests	Test methods	Periodicity	Permissible limits	Reqmt of new filtered oil
1.	Visual inspection	--	IC/AOH IOH/POH		--
2.	Dissolved Gas Analysis	SMI-138	IC/AOH IOH/POH	As per SMI 138	--
3.	Electrical strength (Break down voltage)	IS:6792-72	IC/AOH IOH/POH	30KV(rms) (Min)	60KV(rms)
4.	Water content(PPM)	IS:335-1983	IC/AOH IOH/POH	35 PPM(max)	25 PPM (max)
5.	Specific resistance at 90 degree C (ohm-cm)	IS:6103-71	IC/AOH IOH/POH	0.1x10 ohm cm(min)	35x10 ohm cm(min)
6.	Dielectric dissipation factor (Tan delta)at 90 degree C	IS:6262-71	IOH/AOH /POH	1.0 (max)	0.002 (max)
7.	Total acidity	IS: 1448-67	IC/AOH/IOH /POH	0.5mg KOH/ gm (max)	.03mg KOH/ gm
8.	Sediments and perceptible sludge	IS:1866-83 Appendix-A	IOH/AOH POH	0.05 bv wt.	No sediment or perceptible sludge shall be detected.
9.	Flash point	IS: 1448-1970	IOH/POH	125 deg. C (min)	140 deg.C (min)
10	Interfacial tension at 27 deg. C	IS: 6104-71	IOH/POH	0.018 N/m (Min)	0.04 N/m (min)
11.	Oxidation inhibitor	IS: 335-1983 Appendix `D`	AOH/IOH/ POH	0.3% by mass Max	0.3% by mass (max)