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

No.EL/3.2.1/3/J6 Dated:27thApril 85

# SPECIAL MAINTENANCE INSTRUCTIONS NO RDSO/ELRS/SMI/127

I. PPROCUREMENT SPECIFICATION FOR INSULATING OIL
For loco and EMU transformers only.

II. CONDITION MONITORING OF INSULATING OIL.

## 1. OBJECT

**1.1** The railways have so far been using in their loco/EMU transformers, insulating oil conforming to IS:335-83. Service experience on locomotive and EMU indicates progressive increase in the acidity of the transformer oil with use and also excessive sludge formation. Beyond a certain point, the rate of increase in acidity is very sharp and the deterioration becomes faster. Certain EHV (extra high voltage) grade transformers oils have recently been developed in the country. These have got superior properties and are expected to have much less deterioration with usage. With a view to improve the reliability of transformers in service, it is proposed that EHV grade oil should be used for loco and EMU transformers.

**1.2** It is also necessary to keep a close watch on the condition of oil in service and decide on filtration to improve these conditions, if possible and where improvement can not be achieved to decide on replacement of the oil. Certain guidelines have become necessary for POH shops and sheds for the condition monitoring of oil. The specification for EHV grade oil as well as the guide lines for condition monitoring of oil are covered by this SMI.

## 2. SPECIFICATION:

Transformer oil shall be procured to the following description:-

"New insulating oils for transformers and Switchgear"- complying with IS: 335 -83, except that in regard to the following parameters the oil should have better characteristics than those specified is IS:335 as indicated against each:-

| **Characteristics** | **Requirements as per IS:335-83** | **Requirements for EHV grads oil** |
|---|---|---|
| 1. Electric strength (break down voltage with 2.5 mm gap),(min.)<br>a) New unfiltered oil<br>b) After filtration | 30 KV (rms)<br>If the above value is not attained, the oil shall be filtered : 50KV(rms) | 30 KV (rms)<br>If the above value is not attained, the oil shall be filtered : 60KV (rms) |
| 2. Dielectric dessipation factor (tan delta) at 90 °C (max) | 0.005 | 0.002 |
| 3. Specific resistance (resistivity) (min)<br>a) at 90 °C<br>b) at 27 °C | $30*10^{12}$ ohm cm<br>$500*10^{12}$ ohm cm | $35*10^{12}$ ohm cm<br>$1500*10^{12}$ ohm cm |
| 4. Oxidation stability<br>a) Neutralisation value after oxidation (max)<br>b) Total sludge after oxidation(Max.) | 0.4 mg KOH/g<br>0.10 percent by weight | 0.2 mg KOH/g<br>0.05 percent by weight |
| 5. S.K. Value | Not specified | 6 to 8 percent |
| 6. Aging characteristics after accelerated aging test (open beaker method)with copper catalyst)<br>I) Specific resistance (resistivity) (min)<br>a) at 90 °C<br>b) at 27 °C<br>ii) Dielectric dessipation factor (tan delta) at 90 °C (max)<br>iii) Total acidity (Max)<br>iv) Total sludge (Max.) | <br><br><br>Not specified<br>-do-<br>Not specified<br><br>Not specified<br>Not specified<br>Not specified | <br><br><br>$0.2*10^{12}$ ohm cm<br>$2.5*10^{12}$ ohm cm<br>0.2<br><br>0.05mg KOH/g<br>0.05 percent by weight.<br>0.05 percent by weight |

**NOTE:** (a) Insulating oil conforming to the above requirements is generally known

as "EHV grade oil".

(b) Oil procured to this specification should not be mixed with the oil procured to IS: 335-83.

**3.0 GENERAL INSTRUCTIONS FOR USE OF TRANSFORMER OIL.**

**3.1** These instructions will apply equally to the transformer oil procured as per IS: 335 and EHV grade oil to be procured as per specification given in para 2.0 above.

**3.2** While transferring new oil from the stock to the transformer tank, it should be ensured that the oil is filtered and the dielectric strength of the oil transferred is raised. The dielectric strength of the oil being filled in the transformer tank should not be less than 50 KV/60KV, as appropriate to the grade of oil used.

**3.3** Old and new transformer oils should not be mixed.

**3.4** Reclaimed oil should no be used in locomotive/EMU transformers.

**3.5** During POH, the old transformer oil should be replaced totally with new oil.

**3.6** The transformer oil is to be procured only from one of the following RDSO approved suppliers:-

**i)** M/s Savita Chemicals Private Limited,
6th Floor, 766-767, Nariman Bhavan,

Bombay-400 021.

**ii)** M/s Madras petro Chemicals Limited,
Manali, Madras-600 063.

**iii)** M/s Apar private Limited,
(Special oil Refinery)
Mohal, Trombay, Bombay 400 074.

**4. 0 CONDITION MONITORING OF OIL IN SERVICE:**

**4.1** Loco and EMU sheds shall keep a close watch on the condition of the oil in service through samples taken during AOH schedules and once in between AOH schedules. In other words, periodicity of the tests on oil in service will be once in 6 months. tests to be done and guidelines to be followed are given in Annexure to this SMI. Records of test results should be maintained.

**5. PERIODICITY:**

i) Replacement of old oil-POH

ii) Tests- Every six months.

**6. INSTRUCTION DRAWING**

NIL.

**7. APPLICATION OF CLASS OF LOCOMOTIVES/EMUs**

All a c Electric Locomotives and a c EMUs.

**8. AGENCY OF IMPLEMENTAION**

All the a c Electric Loco Sheds, a c EMU Sheds and Workshops holding ac Locos/ ac EMUs.

**9. DISTRIBUTION**

As per list enclosed.

This SMI supersedes Special Maintenance Instructions No. RDSO/ELRS/SMI /120 and No. RDSO/ELRS/SMI/121.

Encl: Annexure

(ARUN SHRIVASTAVA)

For Director General (Elec).

Annexure to SMI No. 127

**TESTS RELATED TO CONDITION: MONITORING OF TRANSFORMER OIL IN SERVICE**

1. Tests on oil samples from each transformer are to be done in Shop every six months.

2. Decision as to whether

   (a) The oil is good enough to be continued in service as it is, or

   (b) The oil requires filtration, or

   (c) The oil is so bad as to warrant replacement, should be taken, on the basis of guidelines given below:-

      **i)** Test for Neutralisation value (Total acidity) of oil, as per test method given in Appendix B of IS:1866-83.

      **ii)** For now oil, the specified value as per IS is 0.03 mg/KOH per gm(max.) and for oil in service, the upper limit is 0.5 m KOH/gm.

      **iii)** If the neutralisation value of the oil sample tested is higher than 0.5 mg KOH/gm replace this oil with new oil.

      **iv)** If the neutralisation value of the oil sample tested is 0.5 mg KOH/gm or less, proceed with tests given in table below:

      **v)** If the minimum acceptable values indicated in the table above are met with for the oil sample tested, no action is required and the oil may be continued to be used as it is.

**vi)** If an of the characteristics for the oil sample tested is not good enough to meet the above acceptable limits, filter the oil and retest.

**vii)** If the oil sample tested after filtration, meets with the acceptable value, the filtration may be treated to be effective and the oil can continue to be used. It may become necessary, at the times, to do repeated filtration to achieve this requirement.

**viii)** If, however, inspite of repeated filtration any of the specified values are not achieved on the oil sample tested, replace the oil. However judgement should be used and desision taken at appropriate level before deciding on total change of oil.

**3.** The discarded oil may be reclaimed but shall not be used in loco/EMU transformer. It can, however, be used in less critical application for example distribution transformers etc.

| S. No | Characteristics | Test method | Specified values for new oil | | Acceptance value for oil in service. |
|---|---|---|---|---|---|
| | | | ISL335 | EHV | |
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1. | Dielectric strength (break-down voltage with 2.5 mm gap) | IS: 6792-72 | 50KV(Min) (after filtration | 50KV(Min) (after filtration | 50 KV or higher |
| 2. | Water content | IS: 335-83 Appendix E | 50 ppm (max.) | 50 ppm (max) | 50 ppm or less |
| 3. | Specific resistivity at i) 27°C ii) 90°C | IS: 6103-71 | $500x10^{12}$ ohm cm (min) $30x10^{12}$ ohm cm (min) | $1500x10^{12}$ ohm cm (min) $35x10^{12}$ ohm cm (min) | $1x10^{12}$ ohm cm or higher at room temperature. |
| 4. | Dielectric dissipation factor (Tan delta) at i) 27 °C ii) 90 °C | IS: 6262-71 | 0.005 (Max.) | 0.002 (Max) | 0.1 or less at room temperature. |
| 5. | Interfacial tension at 27 °C | IS:6104-71 Appendix D | 0.04N/M (min) | 0.04N/m (Min) | under consideration. |
| 6. | Dissolved gas analysis | ----------Under consideration---------- | | | |