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

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SPECIAL MAINTENANCE INSTRUCTIONS NO. RDSO/ELRS/SMI/128.

1. TITLE :

Tan delta (Dissipation factor) measurements on Traction Motor armature.

2. APPLICATION :

All types of Traction Motors in use on Indian Railways.

3. OBJECT :

3.1 The measurement of tan delta(dissipation factor) of the insulation system is generally carried out for the evaluation of quality of insulation on high voltage machines. It is seen that there are no national or international standards laying down the values for tan delta as applicable to Traction Motors.

3.2 It is understood that Nasik, Kanpur and Kancharapara shops have already procured equipment for tan delta measurement, It has, thereafter become necessary to lay down guidelines for tan delta measurement on Traction Motors so that all shops follow a standard procedure. This will help us in analysing the data generated by different shops on a common base and relating the values of tan delta with the quality of insulation.

3.3 It is known that the value of tan delta change with frequency and amplitude of applied voltage and temp. of the objects. However, for the evaluation of the strength of insulation of machines, only voltage versus tan delta measurements are carried out. Details of such measurements carried on motors type TDK 5620A for BG DC EMUs and Fuji's GGR 125ZY for BGAC EMU's are enclosed at Annexure-I for insulation.

3.4 This SMI is applicable for Traction Motor armature only and guidelines for tan delta measurements on stators field coils will be issued at a later stage.

4. INSTRUCTIONS REQUIRED :

Any suitable tan delta measuring instrument satisfying the guidelines given here under

5. METHOD OF MEASUREMENT :

5.1 For Traction Motor Rewinding Shops

5.1.1 The tan delta measurements on armatures should be conducted (after vacuum pressure impregnation) during final testing of the armature. This armature should be properly baked and cooled to room temperature before the measurements are carried out.

5.1.2 The measurements should be carried out between the commutator (with all the segments shorted by a copper wire) and the armature shaft.

5.1.3 The test voltage shall be at power frequency and varied between 500Vac and 300V ac in steps of 500 volts.

5.1.4 The interpretation of tan delta values obtained and corrective actions required are given below :

a) The insulation of the armature is considered to be healthy if

i) The tan delta value at 1kv does not exceed 2 %

OR

ii) The difference between tan delta at 3 kv and tan delta at 1 kv does not exceed 2% subject to tan delta at 3kv does not exceed 4%.

In case either of the above conditions are not satisfied, the armature should not be baked again and tan delta measurements should be repeated.

b) If tan delta values at 1kv and 3v exceed 4 % or 6% respectively, the armature should be impregnated and baked again and tan delta measurements should be repeated.

NOTE : Even if there is no improvement in the tan delta values after the corrective actions suggested in (a) and b), the armature may be permitted for service but should be kept under observation.

5.2 FOR RUNNING SHEDS :

5.2.1 The measurements of tan delta should be carried out on all armature, which undergo complete overhauls, during final testing. It should be ensured that the armature shall be thoroughly baked and cooled to the room temperature before tan delta measurements are made.

5.2.2 Same as 5.1.2

5.2.3 Same as 5.1.3

5.2.4 The interpretation of tan delta values obtained and the corrective action required are as given below:

a) If the values of the tan delta at 1kv and 3 kv are less than 4% and 6% respectively, the armature is considered healthy.

b) If either of values in (a) above exceed the limits, the armature should be baked again and tan delta measurements should be repeated.

NOTE : Even if there is no improvement in the tan delta values after the corrective action, the armature may be permitted for service but should be kept under observation.

6.0 MAINTENANCE OF RECORDS FOR TAN DELTA MEASUREMENTS :

The armature history cards which are being maintained in all rewinding shops and sheds include the delta on tan delta measurements in the format given below :

Type of armature----------Armature No.----------

? ?

Date Temp.	Humidity Type of attention Rewind Repair Over -haul	Impregnation DIP/VP Type of varnish	value of Remarks Tan delta At 1000V 3000V

7. DISTRIBUTION :

As per attached sheet list.

(N.V.Chandurkar)
for Director General/Elect.

ANNEXURE - I

ENSULATION EVELUTION USE FOR TRACTION MOTORS

Temperature verses ten delta test at 1000 V :

Temp Degree C	TDK 5620A		Fuji GGR 125 Zy	
	Armature	Stator	Armature	Stator
185	38	61.4	-	
155	19.1	36.1	-	
120	9.8	13.2	1.357	
110	-	-	1.357	
108	-	-	-	9.5
105	-	-	1.344	-
104	3.08	-	-	-
100	-	-	1.219	6.12
95	-	3.28	-	-
90	-	-	0.980	2.83
80	-	-	0.769	1.78
77	1.08	-	-	-
70	-	-	0.610	1.41
64	-	1.05	-	-
60	-	-	0.532	1.28
50	1.02	1.0	0.519	1.17
47	-	-	-	-
43	-	-	-	1.12

Voltage versus tan delta at room temperature :

Voltage	TDK 5620A		Fuji GGR 125 ZY	
	Armature	Stator	Armature	Stator
500	0.39	0.65	-	-
1000	0.39	0.65	0.455	1.02
1500	0.49	0.66	0.455	1.02
2000	0.64	0.69	0.463	1.03
2500	0.94	0.75	0.427	1.05
3000	1.12	0.86	0.740	1.20
3500	-	-	1.07	1.64
3000	-	-	0.798	1.27
2500	1.03	0.76	0.610	1.05
2000	0.84	0.70	0.470	1.03
1500	0.58	0.68	0.455	1.03
1000	0.40	0.68	0.452	1.03
500	0.40	0.68	-	-