

SPECIFICATION FOR
INDUCTIVE SHUNT (SJ)
FOR ELECTRIC LOCOMOTIVES



TENDER PURPOSE

15.6.07

15.6.07
DRN.
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FOR ELECTRIC LOCOMOTIVES

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19/6/07
DY.CEE/TMD.

CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL
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ALTERATION SHEET

SHEET NO.2 OF 9

ALT. NO	AUTHORITY	DESCRIPTION	INITIAL	DATE
3	Dy. CEE/TMD	Complete specification revised and retyped Ref. CLW/TM/7100, Dt. 26-12-2006	<i>Wishy</i> 19/6/07	19-06-2007
SPECIFICATION FOR INDUCTIVE SHUNT (SJ) FOR ELECTRIC LOCOMOTIVES		<i>Wishy</i> 19/6/07 DY.CEE/TMD.	CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL 4.TES.133.001 DATE - 30-12-2006	

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1.0 FORWARD

The Inductive Shunt covered by this specification are required for using on WAP and WAG class of tap changer controlled electric locomotives being manufactured by chittaranjan locomotive works. The WAP & WAG class of above locomotives are fitted with Traction Motor type:HS-15250A.

2.0 Scope

This specification covers the design construction, performance and test requirements of natural air cooled Inductive Shunt (SJ) which is connected in series with the field weakening resistors and the combination is connected in parallel with the field coil of the Traction Motor. It restricts the by-passing of pulsating current through field weakening resistances to achieve the designed performance from the traction motor. The field weakening will increase the speed of traction motors. This also reduces the wear on the finger contact of the field weakening shunting contactors due to arcing. Each unit will consist of two shunt coils.

3.0 Service conditions

3.1 The Inductive Shunt shall be of robust design and construction to withstand severe mechanical loads of shock and vibration and harsh environment conditions like high temperature upto 55°C ambient, high relative humidity (about 100%) and dusty atmosphere. It is especially rugged to withstand electro magnetic shocks.

4.0 Technical requirements

4.1 The inductive Shunt shall have two identical coils wound on its central core and each coil is conforming to following technical parameters:

- i) Rated voltage : 1270V
- ii) Insulation class : 180°C
- iii) Cooling : Natural ventilation
- iv) Permissible max. temperature rise : 160 °C
- v) Continuous rating : 550 Amperes-duration of test limited to 6 hours

- one hour rating : 650 Ampers (starting cold)

- Tempopary overloads rating :

a) with the initial temperature of 100° C : 680 Amps for 10 minutes

b) with the same initial temperature of 100° C : 650 Amps for 20 minutes

vi) Coils

- Number of coils - 2 connected in series
- Number of turns per coil - 16
- Conductor - 3 In parallel of size 2.24 x 31.5 mm ϕ 0.8 mm
- Total weight of bare copper - 80 Kg (Approx.)
- Cold resistance of each coil - 1.6911 m - Ohm $\pm 10\%$ at 20° C
- Resistance of coil at 110° C - 2.3 m - Ohm $\pm 10\%$
- Inductance of one coil - 2.75 mH $\pm 10\%$ at power frequency.

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vii) Dielectric strength - 3 KV for 1 minute between each winding and ground at 50 Hz in cold condition.

viii) Insulation resistance - 10 Meg - Ohms with 1000 V Megger.

ix) Weight of Inductive shunt complete - 330 Kg. (Approx.)

5.0 Construction

5.1 The Inductive Shunt shall be of robust construction as per CLW Drg.No.2 TWD.133.021 (latest version) suitable for mounting and comprises of two coils wound on a central core and surrounded by outer core assembly and armature core assembly.

5.2 The core shall be made of cold rolled non-oriented magnetic steel sheets/strips to Specn. No. 4TMS.096.053(latest version) .The lamination shall be pressed under hydraulic press and secured with bolts and nuts and spring washers. All the bolts shall be suitably insulated from the lamination using insulating tubes and washers. Coils supporters in the form of spring plates are inserted between the coils. Insulating shims shall be inserted between the coil and the core for protection of coil insulation.

5.3 The coil assembly shall be made of strip conductor of bare electrolytic copper of one length,adequately insulated with class -180°C interturn insulation and ground insulation . The copper strip and the coil assembly shall be wound with silicone varnish impregnated Nomex tape as inter- turn insulation and glass Mica glass Silicone Tape for ground insulation for class 180°C insulation.The coil formation shall be such that neighter hot-spots are generated nor the coil develops crack. Besides the part list in the assembly drawing, class 180°C insulating and antitracking varnish and class 130°C non-asbestos putty shall be used.

5.4 The unit shall have cleat arrangement on the body to grip the external connecting cables and also for the copper coil terminals.

6.0 Main drawing for reference

Sl.No.	Description	Drawing/ Specn. No.
i)	Inductive Shunt assembly	2TWD.133.021(latest version)
ii)	Coil assembly	0TWD.133.023 (latst version)
iii)	Assembly of Magnetic Core	1TWD.133.022 (latest version)
iv)	Clamping piece -Upper	2TWD.131.006 (latest version)
v)	Clamping piece -lower	2TWD.133.0249 (latest version)
vi)	Laminations	3TWD.133.019 (latest version)
vii)	Spring plate assembly	2TWD.131.012 (latest version)
viii)	G.M.G.S Tape	SPECN.NO. 4TMS.092.014, (latest version)
ix)	F.G. Tape	IS: 5352'99 TYPE- I
x)	4 FT- NA	SPECN. NO. A0124 (latest version)

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6.1 Raw material details : Important items i.e Copper Bars, Laminations, Insulating items sheets and tubes, hardware items etc. To be procured from CLW approved sources only. Firm have to furnish proof of purchase.

6.2 Manufacturing Instructions

Ensure the following parameters for the core manufacture of Inductive shunt.
(Drg. Ref: 1TWD.133.022)

SN.	Activity	Parameters		
		outer core	Armature core	Central core
1	Stacking Load	22 $\pm$ 2 ton.	9 $\pm$ 1 ton.	10 $\pm$ 1 ton.
2	Stack height under pressure	300 $\pm$.5 mm.	300 $\pm$.5 mm.	300 $\pm$.5 mm.
3	Varnish for core	class -H varnish		

6.2.1 Do the winding of the coil with inter turn insulation using asbestos or impregnated nomex silicon paper in three layer and varnish with insulating varnish class 'H' and braze the terminal ends.

Copper conductor size: 2.24 x 31.5 mm. No. of turns - 16

6.2.2 Do the first moulding of coils by placing coils in fixture and press in press machine under 120 $\pm$ 5 ton approximate. Then tighten the screw of fixture. Place it in oven bake the coil for 1 1/2 hrs. $\pm$ 15 mts. At 250 $^{\circ}$ C $\pm$ 10 $^{\circ}$ C.

6.2.3 Remove excess varnish insulation by buffing with rotary wire brush connected with pneumatic grinding machine.

6.2.4 Check dimension and test inter turn insulation.

6.2.5 For manufacturing terminals of shunt coil to cut copper strip to pieces and chamfer ends and dress, braze at three places of terminals & drill hole of 16 mm. Dia. then debur and clean hole.

6.2.6 Brazing of two terminals to the coils with Rupatum foils and rod of 2mm Dia. Prepare putty with asbestos powder and 'H' class varnish like ELMOTHERM H-71 A of Beck india, and fill up voids on coils. Bake the coils as per manufacturers data for the type of varnish used, for H71 it is 4 hrs. at 120 $^{\circ}$ C + 8 hrs at 150 $^{\circ}$ C and allow to cool down at room temperature.

6.2.7 Ground insulation of coils as per Drg.No. 0TWD.133.023 with insulating tape/sheet with varnish and dry it in air for 24 Hrs.

G.M.G.S Sheet - 0.4 mm Thk.
4 FTNA Tape - 0.038 x 25 mm - 1 layer.
G.M.G.S. Tape - 0.13 x 25 mm - 3 layer
G.F. Tape - 0.08 x 25 mm - 1 layer

6.2.8 Mount the coils in baking fixture tighten screw and place it in oven for baking at 220 $^{\circ}$ C $\pm$ 10 $^{\circ}$ C for 13 hrs. $\pm$ 30 minutes.

6.2.9 Remove coils from fixtures, remove excess insulation from surface of coils and dress. Apply anti-tracking finishing varnish class 'H' on surface of the coil and place in oven and dry for 1 1/2 Hrs. $\pm$ 15 minutes at 160 $^{\circ}$ C $\pm$ 10 $^{\circ}$ C and then cool the coil.

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6.2.10 Coils - H.F. & DE Test.

6.2.11 Dimensional check for SJ coil.

Name of coil	Dimensions after inter turn insulation to be checked randomly (1 in 50)	Finished coil
SJ	Core Gap - $134 \pm 0.5 / + 0$ mm. Gap between leads - 130 mm.	130.8 mm. 126 mm. (minimum)

6.2.12 Final assembly (as per Drg.No.0TWD.133.021)

Complete SJ coil finishing with red anti-tracking varnish.

6.2.13 Testing of coil

Type of coil	Test after inter turn insulation & baking	Final test of finished coil
SJ	a) H.F. test at 3000 cycles/sec. for 2 to 5 sec.	a) H.F. Test at 3000 cycles/sec. for 2 to 5 seconds b) D.E. Test at 7.5 KV. for 1min.

6.2.14 Stage inspection:

The following stage inspections to be carried out by the CLW's authorised inspector in manufacturer's premises followed by final inspection:

- i) Coil formation
- ii) Coil insulation
- iii) Testing

7.0 Tests

Prior to bulk manufacture & inspection, documents for procurement of raw material along with test certificates, wherever applicable, should be furnished to the inspection authority for checking.

7.1 The Inductive Shunt shall be subjected to the following tests generally as per IEC publication -60310 :

Sl.No.	Name of test	Type tests	Routine tests
i)	Visual & dimensional check (clause 7.2)	Yes	Yes
ii)	Measurement of winding resistance (clause 7.3) at 5% rated D.C current	Yes	Yes
iii)	Measurement of impedance at power frequency (clause 7.4)	Yes	Yes
iv)	Measurement of inductance at power frequency (clause 7.4) at 10% rated load current	Yes	Yes
v)	Temperature rise test (clause 7.5.1)	Yes	NO.
vi)	One hour rating test (clause 7.5.2)	Yes	NO.

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Sl.No.	Name of test	Type tests	Routine tests
vii)	Starting cycle test (clause 7.6)	Yes	No.
viii)	Insulation resistance measurement (clause 7.7)	Yes	Yes
ix)	Dielectric test (clause 7.8)	Yes	Yes
X)	Measurement of weight (clause 7.8)	Yes	Yes

7.2 Visual & dimensional check

The unit shall be checked for physical dimensions as per drawing (latest version) and also for physical damages, terminal markings, polarities and particulars on the rating plate etc.

7.3 Measurement of winding resistance

Resistance of each coil of the unit shall be measured by Vxl method by passing approximately 5% of the rated direct current through the coil. Average resistance values are calculated at 3 different currents around the above range and the respective voltage drop across the coils. The resistance value computed with the reference to ambient temperature 20°C shall be within 3.3823 m. ohm $\pm 10\%$ for two coils in series.

7.4 Measurement of impedance & inductance

7.4.1 Impedance value of each coil of the inductive Shunt shall be measured based on the voltage drop at about 10% load by Vxl method by connecting the Inductive Shunt coils to Auto-transformer of adequate capacity. Average values of three impedance values measured at the above currents and Inductance value of the coil calculated from it shall be 2.75 mH $\pm 10\%$ at power frequency.

7.4.2 The inductance of each coil may be evaluated at various values of the D C starting from 50% of rated values in steps of 10% rising and upto saturation limit. This is to determine the characteristics of Inductive Shunt upto saturation.

7.5 Temperature rise test

7.5.1 First cold resistance of the coils are determined as per clause 7.3. The test shall be conducted by passing rated D C of 550 Amperes continuously through both the coils connected in series till the temperature stabilisation is reached. Hot resistance of individual coil at every 15 seconds after switching off the supply is measured, alternatively by measuring the voltage drop across each coil separately for the same current passing through them. The maximum temperature rise allowed for 550 Amperes continuous rating is 160°C. It is adequate if about five readings are taken for each coil.

7.5.2 One hour rating test

This may be carried out before the temperature rise test on rated load. A current of 650 Amperes D C is passed through the unit for one hour and the temperature rise is measured by resistance method as indicated in 7.5.1. Maximum temperature rise allowed for 650 Amperes for one hour rating is 130°C.

7.6 Starting cycle test

After the temperature rise test at 7.5.1, while the unit is still hot (say 10 minutes after the conclusion of this test) a current of 720 Amps is passed through the unit for 25 seconds and reduced to 382 Amps for 100 seconds followed by zero Amps for 30 seconds.

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This cycle is repeated four times and at the end temperature rise of the winding is measured. Also check for any abnormality in core/coils fastening.

7.7 Measurement of insulation resistance

IR value measured with 1000V megger between the coils shorted together and the body before and after dielectric test, shall not be less than 10 Mega-ohms.

7.8 Dielectric test

The test shall be conducted by applying 3KV rms 50Hz for 1 minute between each coil and the body and the leakage current shall be recorded.

7.9 Weight measurement

The weight of the unit shall be measured and recorded.

7.10 Field Trial:

After passing type test, one unit of SJ will be subjected to field trials for a period of at least six months, which will form the basis of acceptance of prototype. The performance of SJ shall be monitored jointly by user Railway, RDSO and supplier.

8.0 Submission of tender and information to be furnished

8.1 The tenderer shall submit the offer in duplicate with the following informations:

- Clausewise comments on the specification alongwith deviation statement.
- Sufficient information on machinery, testing facilities, quality control set up etc to prove that tenderer's works has adequate facilities to manufacture and supply.
- Name and address of manufacturers and suppliers of raw materials such as laminations, electrolytic copper strips, insulating materials etc.
- Design data.

8.2 The tender is likely to be rejected if it is not submitted with the above information.

9.0 Approval of sample

9.1 Before offering the prototype for testing, the successful tenderer shall submit the following informations:

- Details of conductor, laminations.
- Details of insulating materials and varnishes.
- The results of tests conducted on prototype by the supplier.

9.2 The prototype shall be offered for evaluation at the works of tenderer to RDSO.

9.3 The bulk manufacture shall only commence after the approval of prototype and constructional improvements/deviations if any found necessary to improve the performance and reliability during the prototype evaluation, are duly incorporated in series production.

9.4 The supplier shall offer the units of series production to the inspecting official as per stipulation in the purchase order. All the testing facilities shall be provided to the inspecting official.

10. Guarantee

All the components and the equipment as a whole shall be guaranteed against any defect due to manufacture/material as per IRS conditions of the contract.

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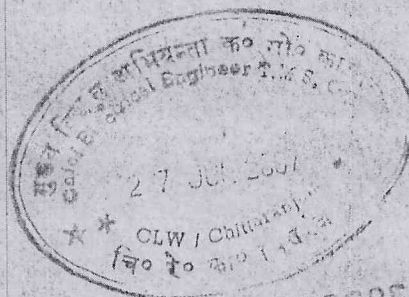
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11. Marking and packing.

11.1 Rating plate of the Inductive Shunt made of anodized aluminium containing the following information shall be fitted to the unit in a visible location when mounted in position in the locomotive:

- i) Manufacturer's name
- ii) Serial Number/ Batch No. of unit
- iii) Date of manufacture
- iv) Rated current
- v) Inductance

11.2 The complete equipment shall be securely packed to avoid damage during transit. Handling provision of the packing may be kept in view.



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