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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

SPECIFICATION AND TEST SCHEDULE

FOR

HEADLIGHT VOLTAGE STABILIZER TRANSFORMER

FOR

A.C. ELECTRIC LOCOMOTIVES

(First Revision)

JULY, 1972

ISSUED BY

RESEARCH DESIGNS AND STANDARDS ORGANISATION

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SPECIFICATION OF THE VOLTAGE STABILISER TRANSFORMER

0. FOREWORD

0.1 This specification was first issued in April 1970 and the first draft revision was circulated to Railways and manufacturers in August 1971.

0.2 Assistance has been taken for the preparation of the specification from BS:171-1970 - Power Transformers.

0.3 The materials used in the manufacture of the unit shall comply with the following latest Indian Standard Specifications:-

IS:3024-1965	Electrical sheet steel (Oriented)
IS:1271-1958	Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.
IS:4800(Part V)-1968	Enamelled round winding wires for elevated temperatures.

0.4 Any deviation from this specification calculated to improve the performance, utility and efficiency of equipment, proposed by the manufacturer, will be given due consideration, provided full particulars with justification thereof, are furnished in the tender.

1.0 SCOPE

1.1 This specification covers the requirements of voltage stabiliser provided in ac electric locomotives to give a steady output voltage of 24 V for instrument lighting and 32 V for headlights with supply from arno-converters at a nominal voltage of 380 single phase at 50 Hz. The voltage stabiliser shall be of the voltage transformer type with multiple windings and capacitors.

1.2 The unit should be of simple and robust design, capable of being easily maintained and should be free from undue vibrations.

2.0 SERVICE CONDITIONS

2.1 The headlight voltage stabiliser covered in this specification shall be suitable for service in ambient temperatures varying from 0°C to 60°C with maximum relative humidity of 100% in altitudes upto 1000 metres above mean sea level and in dusty atmospheric conditions.

2.2 The headlight voltage stabiliser and its mounting arrangement shall be of robust design for traction duty and shall withstand satisfactorily the vibrations and shocks normally encountered in service as indicated below :-

a) Maximum vertical acceleration - 4.0 g

b) Maximum longitudinal acceleration - 3.0 g

c) Maximum transverse acceleration - 0.5 g

('g' being acceleration due to gravity)

3.0 RATING

3.1 The supply voltage from the arno converter at a nominal voltage of 380 V would normally vary from 290 to 460 V, single phase, 50 Hz; with ± 1% frequency variation, the voltage may, however, be as high as 500 V for half-an-hour.

3.2 The output voltage of the voltage stabiliser transformer shall be 32± 0.5 V and 24 ± 0.5 V at 50 Hz for the above input voltage under full load conditions. The two outputs shall be continuously rated at 11 A and 4 A respectively. Under no load conditions, the output voltages shall not exceed 34 V and 26 V respectively.

4.0 NORMAL DUTY

4.1 The voltage stabiliser transformer shall be designed for continuous operation or intermittent switching of either or both windings at full load. The stabiliser shall also be able to operate continuously under no load conditions.

5.0 CLASS OF INSULATION

5.1 B class.

6.0 COOLING ARRANGEMENT

6.1 The unit shall be naturally cooled. Louvres/openings in the outer casing of the stabiliser for dissipation of heat from all its parts may be generously provided including the capacitors.

7.0 TEMPERATURE RISE

7.1 The maximum temperature rise, measured by resistance method, permissible on the windings shall not be more than the value specified below :-

B Class insulation - 60°C

8.0 TERMINAL BOARD

8.1 All the terminals of the unit shall be brought out on a suitable terminal board. The input and output terminals shall be legibly and indelibly marked on the plate. In addition, an earthing terminal shall be provided. The terminal

arrangement shall be subject to approval of the indenting officer, prior to manufacture.

8.2 Suitable spring washers and nuts for external connections shall be provided on all the terminals including earth terminal.

8.3 All components, including bolts, nuts, washers, screws etc, of the voltage stabiliser shall be suitably protected against corrosion and rust.

9.0 FINISH

9.1 The headlight voltage stabiliser shall be finally finished and painted light grey in accordance with *IS:1650-1960

10.0 MOUNTING

10.1 Mounting arrangement shall be subject to approval of the indenting officer, prior to manufacture.

11.0 RATING PLATE

11.1 A rating plate in anodised aluminium shall be provided in the unit to show the rating, insulation, method of connection with necessary circuit diagrams, etc. The following particulars shall be clearly and indelibly marked on the rating plate :-

(a) Name or trade mark of the manufacturer

(b) Manufacturer's serial number

(c) Year of manufacture

(d) Rated nominal input voltage/voltage range

(e) Rated output voltage/voltage range for each winding

(f) Rated frequency (with permissible variation as a percentage)

(g) Rated output in amperes/voltamps/watts for each winding

(h) Input power factor (minimum and maximum)

(j) Class of insulation

(k) Condenser value and rating (if used)

(*) Colours for building and decorative finishes.

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12.0 DRAWINGS

12.1 Drawing No. (to be indicated by CLW), giving the overall limiting dimensions is attached herewith.

13.0 TECHNICAL DOCUMENTS

13.1 The manufacturer shall supply technical documents and maintenance instructions as desired by the purchaser.

14.0 TOOLS

14.1 The supplier shall supply a complete set of tools for maintenance with each batch of 20 sets of equipments supplied. The list of tools to be supplied shall be furnished alongwith the tender.

15.0 SCHEDULE OF PARTICULARS

15.1 The schedule of particulars of the voltage regulator to be furnished with the tenders are included in Appendix A.

16.0 TESTS

16.1 Tests are classified as type tests and routine tests. Type tests shall be carried out on one equipment for a batch of 20 sets of equipment supplied.

16.1.1 The following tests shall be carried out on headlight voltage stabiliser:-

a) Type tests -

Measurement of resistance (cold)
No load voltage ratio test
On load temperature rise test
Open circuit temperature rise test
High voltage test
Leakage current and power factor test
Measurement of weight

b) Routine tests -

Measurement of resistance
No load voltage ratio test
On load temperature rise test
High voltage test
Leakage current and power factor test

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16.2 Type tests

16.2.1 Measurement of resistance (cold)

The resistance of each of the windings, when cold, shall be measured either by bridge or voltage drop method. Record method of test, voltage, current, resistance values and the temperature, for each winding.

In case of voltage drop method, the current shall be limited to 50 per cent of the rated current of the windings.

16.2.2 No load voltage ratio test

The primary supply voltage should be varied from 290 to 500 V in steps of 40 V and the secondary output voltages on no load shall be measured at the two output terminals. The primary input current and power factor shall also be recorded.

16.2.3 On load temperature rise test

With the input primary voltage as 290 V, 380 V, 460 V and 500 V, the output secondary voltage and total losses shall be measured for the load currents :-

		Amperes
(i)	32 V tapping	11
	24 V tapping	4
(ii)	32 V tapping	11
(iii)	24 V tapping	4

Continuous temperature rise of the windings shall be measured at all the above voltages as specified in Note at clause 16.2.4.

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16.2.4 Open circuit temperature rise test

Immediately after the test specified in 16.2.3 at 500 V, the secondaries should be open circuited and the temperature observed after 10 minutes. If the temperature has increased from that found in test at 16.2.3 then temperature measurement shall be made every 10 minutes till a steady state is reached. If there is no further rise in temperature after 10 minutes of switching off of the secondaries, the test may not be continued. Record the temperatures and the method of test.

Note: Correction factor in temperature rise shall be applied as per clause 41.9.2 of BS:171-1970 and the firm shall indicate the load loss/kg for applying the correction.

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16.2.5 High voltage test

An overvoltage test of 2 kV rms, 50 Hz, with respect to earth, shall be made for one minute on the primary winding and condenser winding with condenser short circuited. The secondary windings shall be tested at an overvoltage of 500 V by a megger. This test shall be done at the prevalent ambient temperature of the test site. The insulation resistance of the stabiliser shall also be measured before and after the high voltage test and the value shall not be less than 5 mega ohms.

16.2.6 Leakage current and power factor test of capacitor

If a capacitor is used in the system, as in the case of a saturable core stabiliser, the capacitor shall be tested independently in firm's works and its maximum rated voltage and its leakage current and power factor recorded. The capacitor shall conform to IS:2834-1964 - Specification for shunt capacitors for power systems - and shall be suitable for operation under service conditions stipulated in clause 2.0.

16.2.7 Measurement of weight

Record the weight of the stabiliser in working order.

16.3 Routine tests

16.3.1 Measurement of resistance

16.3.1.1 The resistance of each of the windings, when cold, shall be measured as specified in clause 16.2.1.

16.3.1.2 The value of resistance recorded shall not differ from the corresponding type test values by more than ± 10%, after making temperature corrections, if necessary. An average value for 5 units shall be considered as the typical value.

16.3.2 No load voltage ratio test

A test shall be conducted as specified in 16.2.2 but at 290 V, 380 V and 460 V only.

16.3.3 On load temperature rise test

The temperature rise shall be computed as under:-

With the input primary voltage of 380 V, the output secondary voltage and total losses shall be measured for the load currents stipulated in clause 16.2.3 and values compared with type test results. The temperature rise so computed shall be indicated. The temperature rise during routine test shall not exceed 8% of the value recorded during type test.

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16.3.4 **High voltage test:**

Test shall be conducted as specified in clause 16.2.6.

16.3.5 Leakage current and power factor test of capacitor

Test shall be conducted as specified in clause 16.2.7.

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Schedule of performance, technical and other particulars

A1 Name of the manufacturer

A2 Type, make and model

A3 Continuous maximum rating for specified cooling, temperature rise and ambient temperature

A4 Number of phases

A5 Volts: Input and Output (range of variation)

A6 Full load current at the rated input voltage: Input and Output

A7 Details of insulation (including drawings)

A8 Method of ventilation

a) for transformer winding
b) for capacitors

A9 Maximum temperature rise in windings by resistance over maximum ambient temperature of 60°C with test conditions specified in clause 16.2.3 of the specification

A10 Maximum temperature rise of core

A11 Efficiency at full load at nominal voltage of 380 V

A12 Winding data

a) Type of winding

b) Number of turns on

i) 380 V winding
ii) 32 V winding
iii) 24 V winding
iv) Stabilizing winding

c) Winding conductor size and current density for

i) 380 V winding
ii) 32 V winding
iii) 24 V winding
iv) Stabilizing winding

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d) Insulation covering on conductors (indicate specification to which they comply)

e) Type of joints in the winding, if any

f) Resistance of windings at (20°C)

i) 380 V winding

ii) 32 V winding

iii) 24 V winding

iv) Stabilizing winding

g) Details of varnish for impregnation and impregnation procedure

h) Insulation resistance of

i) 380 V winding

ii) 32 V winding

iii) 24 V winding

iv) Stabilizing winding

A13 Core Data

a) Maximum flux density in core (furnish magnetisation curve)

b) Thickness of iron stampings

c) Insulation between core laminations (material)

d) Type of joint between the core limbs and yoke

e) Number of stampings of each type

A14 Type and particulars of terminal box and cable entry (furnish drawing)

A15 Type, make and model of capacitor

A16 Manufacturer/Supplier's name for capacitor

A17 Capacitor rating

A18 Number and arrangement of capacitors

A19 Performance test certificate for capacitor

A20 Dimensions of the assembled unit

a) From base to topmost point

b) Overall breadth

c) Overall length

d) Bolting dimensions

A21 Total weight of the unit in kg.

A22 Details of proposed mode of packing

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