INDIAN RAILWAY
STANDARD SPECIFICATION
FOR
Transformer 230/110V - 1 KVA to 5 KVA

Serial No.S: 72-88

0. FOREWORD

0.1 This specification is issued under the fixed serial No.S-72-88, the final number indicates the year of original adoption as standard or in the case of revision, the year of latest revision.

0.2 This specification requires reference to the following Indian Railway Standards (IRS) and Indian Standards (IS) specifications:

IRS:S 23	Electrical Signalling & Interlocking Equipment.
IS: 6297	Pt. I & II - Transformers and Inductors (Power, Audio, Pulse & Switch for electronic equipment).
IS: 9000	Basic environmental testing procedures for electronics and Electric items.
IS: 4800 (Pt.II)	Enamelled round winding wires part-1 Conductor data.

0.3 Whenever in this specification, any of the above mentioned specifications is referred, it shall be taken as a reference to the latest issue of that specification, otherwise the particular year of issue referred to has to be taken as reference.

0.4 This specification is intended chiefly to cover the technical provisions and the provisions relating to the supply of materials and does not include all the necessary provisions of a contract.

1. SCOPE

1.1 This specification covers the equipment for 230/110V 50 Hz single phase, 1 KVA, 2 KVA, 3 KVA, 4 KVA & 5 KVA transformers used for power supply in colour light signalling installations.

2. TERMINOLOGY

2.1 The terminology, referred to in the specification is covered by the definitions given in the IRS specification no. IRS:S 23.

2.2 The terms referred to in this specification but not covered by IRS:S 23 are defined in the relevant clauses.

3. REQUIREMENTS

3.1 General

3.1.1 The transformer shall conform to the drawing given in sketch SDO/RE 36 so far as 1 KVA transformer is concerned for transformer of 2 KVA to 5 KVA capacities, necessary changes will be made as specified by the purchaser.

3.1.2 The transformer shall be air-cooled and so constructed as to provide adequate protection against outdoor weather conditions.

3.1.3 The transformer shall be manufactured in accordance with best engineering practice.

3.1.4 All the materials used in the manufacture of the transformer shall be suitable for tropical use.

3.1.5 All exposed metal parts of the transformer including laminations shall be protected against corrosion.

3.1.6 Terminals & associated screws shall be of brass, and shall be of the top screw pillar type securely fixed.

3.1.7 The transformer shall be double wound and shall conform to category 3 (Clause 3.1) of IS: 6297 (Pt. I) - 1971 and Grade II (Table 1) of IS: 6297 (Pt. II) of 1973. Clause 'B' insulating material shall be used. The transformer shall be vacuum impregnated and Copper wires conforming to IS: 4800 (Pt. IV) shall be used for winding of the transformers, unless otherwise specified.

3.2 Electrical

3.2.1 The rated input of the transformer shall be 230V AC.

3.2.2 The transformer shall have separate input and output windings.

3.2.3 The primary of the transformer 230/110V shall have tappings at 0, 200, 220 and 230 Volts. The secondary winding shall have tappings at 0, 110, 120 & 130 Volts, being nominal voltage on no load.

3.2.4 The continuous rated output of the transformer shall be as specified by the purchaser.

3.2.5 The transformer shall be designed for a standard frequency of 50 Hz.

3.2.6 The size of the core shall be as small as possible commensurate with the electrical characteristics required by this specification.

3.2.7 The core of the transformer shall be such that its electro-magnetic property will not be effected due to ageing.

3.2.8 The body of the core is required to be earthed and one earth terminal shall be provided for this purpose.

3.2.9 The efficiency of the transformer at rated load with nominal input shall not be less than 85%.

4. MARKING

4.1 The appropriate voltage shall be legibly & indelibly engraved near the input and output terminals.

4.2 Suitable marking shall be made near the earth terminal.

4.3 A rating plate, clearly and indelibly marked with the following information shall be firmly and conspicuously fixed on the outside of the transformer / case.

a) Name or trade mark of the manufacturer
b) Serial number and year of manufacture
c) Input and output voltages
d) Rated power output in VA.
e) Rated frequency.
f) Any other details as agreed to between the purchaser and manufacturer.

5. TESTS AND PERFORMANCE REQUIREMENTS

5.1 Unless otherwise specified, all the tests shall be carried out under prevalent ambient atmospheric conditions.

5.2 Type test

5.2.1 The following shall constitute type tests.

A minimum number of three samples are required for type tests to be carried out in the sequence below.

a) Visual inspection	(Clause 5.5)
b) Applied high voltage test	(Clause 5.6)
c) Insulation resistance test	(Clause 5.7)
d) Open circuit test	(Clause 5.8)
e) Voltage regulation test	(Clause 5.9)
f) Temperature rise test	(Clause 5.10)
g) Induced high voltage test	(Clause 5.11)
h) Short circuit test	(Clause 5.12)
i) Climatic severity test	(Clause 5.13)

5.2.2 All samples shall successfully pass all the tests given in Clause 5.2.1 for proving conformity with the requirements of this specification. If any of the samples fails in any of the type tests, the purchaser or his nominee at his discretion may call for fresh samples not exceeding twice the original number and subject them again to al the tests. The failure shall be permitted in the repeat test.

5.2.3 Type approval shall be accorded if the samples pass the above tests. Such approval once given shall be valid for a period of three years, provided there is no change either in the quality of material used or in the method of manufacture.

5.3 Acceptance tests

5.3.1 The following shall constitute the acceptance tests and shall be carried out in the sequence given below.

a) Applied high voltage test (Clause 5.6)
b) Insulation resistance test (Clause 5.7)
c) Open circuit test (Clause 5.8)
d) Voltage regulation test (Clause 5.9)
e) Temperature rise test (Clause 5.10)

5.3.2 Acceptance tests shall be carried out on transformers selected at random as per the sampling plan given in the table below. N1 is the size of the first sample. In case the number of transformers failing in one or more tests is loss than or equal to the corresponding acceptance number (C1), the lot shall be considered as conforming to the requirement. If the number of failure is greater than or equal to rejection number (C2), the lot shall be rejected. If the number of failures is between C1 and C2 further samples or N2 pieces shall be taken and subjected to all the tests. If the total number of failures in the two samples is less than C2, the lot shall be accepted, otherwise, the lot shall be rejected.

Table

Lot size	First sample N1	Second sample N2	Combined sample N1 + N2	Acceptance No. C1	Rejection No. C2
Under 25	3	6	9	0	2
25-50	7	14	21	0	3
51-100	10	20	30	0	3
101-200	13	26	39	0	5
201-300	20	40	60	1	5
301-500	25	50	75	1	6
501-800	35	70	105	2	7
801-1300	50	100	150	3	10

5.4 Routine test

5.4.1 The following shall constitute routine tests

a) Applied high voltage test (Clause 5.6)
b) Insulation resistance test (Clause 5.7)
c) Open circuit test (Clause 5.8)
d) Voltage regulation test (Clause 5.9)

5.4.2 The manufacturer shall certify that all the routine tests have been successfully carried out on all the transformers offered for inspection. He shall produce these test results at the time of inspection.

5.5 Visual inspection

5.5.1 The transformer shall be visually inspected to ensure compliance with the requirements of clause 3 & clause 4 of this specification.

5.6 Applied high voltage test

5.6.1 The transformer shall withstand for one minute without puncture application of sinusoidal AC 2000V (rms) at frequency of 50 Hz applied between each winding and the core/case. The winding not under test shall be connected to the core/case. The test voltage shall be raised gradually at an approximate rate of 500V/Sec.

5.7 Insulation resistance test

5.7.1 The test shall be carried out

a) Before the high voltage test
b) After the high voltage test
c) After induced high voltage Test
d) After the temperature rise test
e) After the climatic tests have been completed

The measurement shall be made at a potential of not less than 500V DC. The insulation shall be measured between

a) AC line input terminals and earth.
b) AC input terminals and AC output terminals.
c) AC output terminals and earth.

When measured at a temperature of 40 deg. C and relative humidity of 60% the value of insulation resistance shall not be less than 100 megohms. There shall not be any appreciable change in the measure value of insulation resistance before and after applied high voltage test and after induced high voltage test. When measured after the temperature rise test, the insulation resistance shall not be less than the limit mentioned above. Similarly, when the test is repeated after the climatic test, the insulation resistance shall not be less than 50 megohm when measured at a temperature of 40 deg. C and relative humidity of 60%.

Note: In case the prevalent values of temperature and relative humidity at the time of measurement are different from those specified above, the IR values shall be obtained from Table 'A' (Cl. 5.7.2).

5.7.2 Table 'A'

Value of insulation resistance at different temperatures and relative humidity.

RH (%)	25ºC (M.ohms)	30ºC (M.ohms)	35ºC (M.ohms)	40ºC (M.ohms)
60	100	100	100	100
65	100	90	85	80
70	80	70	65	60
75	60	53	47	43
80	42	36	33	30
85	29	25	22	18
90	20	16	13	10
95	15	10	7	5
100	10	6	3	1

Note:

1. The value of insulation resistance has been taken as 100 M.ohms at a temperature of 40 deg.C and RH of 60% values of IR at different temperature and RH may be obtained from the table.
2. To obtain the value of IR corresponding to 500 M.ohm or 1000 M. ohms or 50 M.ohm at 40 deg. C & 60% RH, a multiplying factor of 5.0, 10.0 & 0.5 respectively may be used.
3. The value of insulation resistance for extreme conditions of temperature and humidity shall not be less than 1 M.ohm even if the value at 60% RH and 40 deg. C temperature is less than 100 M.ohm.

5.8 Open circuit test

5.8.1 230V AC at 50 Hz shall be applied on primary side between terminals '0' and 230V and the voltages across different tappings on the secondary side shall be measured, which shall be within ± 1.5% of the nominal value.

5.8.2 The open circuit secondary voltage and the primary no load current of the transformer shall be measured with the primary winding connected to 230V, 50 Hz supply and the secondary winding open circuited. The open circuit secondary voltage at different tappings of the secondary windings shall be within 1.5% of the nominal values. The primary no load current shall not exceed 10% of the rated full load primary current for all transformers of ratings from 1 KVA to 5 KVA.

5.9 **Voltage regulation test**

5.9.1 A resistive load to draw 9.2 XN Amps current shall be connected to the secondary terminals 0V and 110V (X is the KVA capacity of the transformer). The primary voltage shall be adjusted such that secondary voltage across the load is 110V. The load shall be disconnected and the voltage 'V' across the same terminals of secondary winding shall be measured. The percentage voltage regulation when calculated by $\frac{V-100}{V}$ X 100 shall not be more than 5%.

5.10 Temperature rise test

5.10.1 This test shall be carried out at the prevailing room temperature. The transformer shall be mounted so as to be protected from draughts and shall not be subjected to radiation from warmer objects.

5.10.2 The cold resistance (R1) of the winding shall be taken as reference temperature (T1).

5.10.3 A resistive load shall be connected to the secondary, keeping the secondary voltage ± 110V as given in clause 5.8. The transformer shall be kept energised for a period of six hours. The hot resistance ® shall be measured within one minute after the completion of test run.

5.10.4 The temperature rise of the transformer shall be computed using the formula.

$$\frac{R1}{R2} = \frac{1 + a\,T1}{1 + a\,T2}$$

Where a = Temperature coefficient of the material of winding wire.
R1 = DC resistance at ambient temperature T1.
R2 = DC resistance at the end of test run at temperature T2.

5.11 Induced high voltage test

5.11.1 The transformer shall withstand without break down the application of 440V at a frequency of 100 Hz applied to the primary winding, with secondary winding open-circuited. The voltage shall be raised from one third of the maximum value to value as rapidly as is conistent with accurate reading of the indicating instrument. The full test voltage shall be maintained for one minute and shall then be reduced to the one third of the value before being switched off.

5.11.2 At the end of the test, the transformer shall be tested for the following.

a) Insulation resistance (Cl. 5.7) (It shall not be less than the minimum value specified in Clause 5.7).
b) Open circuit test (Cl. 5.8) (The no load current shall be within the value specified in Clause 5.8)

5.12 **Short Circuit Test**:

5.12.1 The transformer shall withstand without any damage short circuit of secondary windings for 5 secs. When primary is fed with 230V AC at terminals 0V and 230V.

5.12.2 Applied high voltage test as per clause 5.6 shall be repeated after this test.

5.13 **Climatic severity test**:

5.13.1 The climatic severity test shall be done in accordance with IS 9000 as per the sequence and severity indicated below.

Climatic Cycle	Severity		Test to be done	Required result
	Temperature	Duration		
Dry heat	70 ± 2ºC During exposure the transformer shall be loaded as per clause 5.9	16 hrs.	1. Applied high voltage test (Cl. 5.6) 2. Insulation resistance test (Cl. 5.7)	Shall withstand Shall be greater than 10 mega ohms
First damp heat (accelerated)	55 ± 2ºC RH 90 - 95%	16 hrs	Insulation resistance test (Cl. 5.7)	Shall be greater than 100 mega ohm.
Cold	- 10º c	2 hrs	-do-	-do-
Two cycles of damp heat	55 ± 2ºC RH 90 - 95%	16 hrs (2 hrs each)	-do-	Shall be greater than one mega ohm. After recovery period of 24 hrs insulation resistance shall be greater than 10.

6. **Conditions of supply**:

6.1 The manufacturer shall submit two samples to enable type test be carried out for assessing the conformity to the specification and get them approved before taking up bulk manufacture.

6.2 Facility shall be available at the manufacturer's premises to conduct the acceptance tests given in Cl. 5.3.

7. **Packing:**

The transformer units shall be packed in suitable boxes/crates, strong enough, without additional packing to prevent damage or loss to the unit during transit. Loose space inside the box/crate shall be filled up with suitable packing material.

Each box shall be legibly marked at one end with Code nos., contents, quantity and name of the manufacturer / supplier.

Appendix 'A'

Information to be supplied by the purchaser

(i) KVA rating.
(ii) Size of the casing, overall dimensions of the unit in case it is of rating more than 1 KVA (Clause 3.1.1).

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