

You are requested to apply "on-line" for fresh vendor registration and develop the 9 KVA, 750V/415V/190V and 15KVA, 750V/415V/190V, 3-phase dry type transformer for LHB type Non-AC EOG coaches as per RDSO's specification no. RDSO/PE/SPEC/TL/0158-2010(Rev-0) Copy enclosed).

Thanking you

Yours faithfully

(प्रफुल्ल चन्द्रा)

निदेशक(टी.एल एवं ए.सी सिस्टम डिजाइन)
कते महानिदेशक/वि.आ. एवं ई.एम.यू

DA: As above

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सत्यमेव जयते

भारत सरकार
रेल मंत्रालयGOVERNMENT OF INDIA
MINISTRY OF RAILWAYSअनुसंधान अभिकल्प एवं मानक संगठन
रेल मंत्रालयRESEARCH DESIGNS AND STANDARDS ORGANISATION
MINISTRY OF RAILWAYS

उपरोक्त प्रकार के मानक ए.सी. ई जो वी डिजाईन में प्रयुक्त होने वाले 9 कंवालीटर
750/415/190 वोल्ट एवं 15 कंवालीटर 750/415/190 वोल्ट, 3 फेज वितरण ट्रांसफार्मर की
विशेषताएं

SPECIFICATION FOR 9 KVA, 750 V/415V/190 V, and 15 KVA, 750 V/415V/190 V,
3- PHASE DRY TYPE DISTRIBUTION TRANSFORMER FOR LHB TYPE NON-AC
EOG COACHES

आर.डी.एस.ओ./पी.ई./एस पी ई सी/ए.सी./0158 -2010,(संशोधित)
RDSO/PE/SPEC/ AC/0158 -2010 (Rev.0)

S. No.	Date of amendment	Revision	Reason

अनुमोदित
APPROVED

3.1/18
कार्यकारी निदेशक/पी एस एंड ई एस डी
ED/PS & EMU

Prepared by Am.Elect/Sec Checked by [Signature]

DSECT-AC System Design

SPECIFICATION FOR 9 KVA, 750 V/415V/190 V, AND 15 KVA, 750 V/415 V/190 V, 3-PHASE DRY TYPE DISTRIBUTION TRANSFORMER FOR LHB TYPE NON-AC EOG COACHES.

FOREWORD

This is required for providing power to LHB type EOG non-air-conditioned coaches. The power supply of 750 V AC shall be provided by power cars and routed throughout the rake through suitable inter vehicular coupler.

1.0 SCOPE

The specification covers the design, manufacture, test, supply requirements of following two types of transformer:

1. Type I- 9 KVA, 750V/415V/190V AC, 3 phase, Star-Star-Star (Yyy), dry type, and air cooled power distribution transformer for the Train lighting load (6.5KVA-415VAC+2.5KVA-190VAC).
2. Type II- 15 KVA, 750V/415V/190V AC, 3 phase, Star-Star-Star (Yyy), dry type, air cooled power distribution transformer for the Pantry Car load and the Train lighting load (12.5KVA-415VAC+2.5KVA-190VAC).

The transformer shall be installed on the under frame of the coach on LHB type non-AC coaches working with EOG system.

2.0 SCOPE OF SUPPLY

- 2.1 The scope of supply of each transformer shall include the following:-

FOR 9 KVA TRANSFORMER

- | | | | |
|------|--|---|-----|
| i) | 9 KVA, 3 Phase, Star-Star-Star (Yyy), 750V transformer including terminal Board assembly consisting terminal Stud etc. | 1 | Nos |
| ii) | Anti vibration mountings (loose supply) | 4 | No. |
| iii) | HT HRC fuse 3.3 KV, 20 Amps | 3 | No. |
| iv) | LT HRC fuse 500 V, 16 Amps | 6 | No. |

FOR 15 KVA TRANSFORMER

- | | | | |
|------|---|-----|-----|
| i) | 15 kVA, 3 Phase, Star-Star-Star (Yyy), 750V transformer including terminal Board assembly consisting terminal Stud etc. | 1 | No. |
| ii) | Anti vibration mountings (loose supply) | 4 | No. |
| iii) | HT HRC fuse 3.3 KV, 32 Amps | 3 | No. |
| iv) | LT HRC fuse 500 V, 32 Amps & 16 Amps | 3+3 | No. |

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3.0 SERVICE CONDITION

- 3.1 The transformer shall be sturdy and suitable for the following service conditions normally encountered on the Railway rolling stock, under climatic conditions existing throughout India.

Ambient	-4 to 55 deg C
Average ambient	35 deg. C
Train speed	200 Km/h
Relative Humidity	Up to 95%
Altitude	Max 1200 m above sea level
Atmosphere	Extremely dusty and desert weather and desert terrain in certain areas. The dust contents in the air may reach as high value as 1.8 mg/cubic meter.
Annual rain fall	Very heavy in certain areas: between 1750 to 6250 mm.
Coastal area	The equipment shall be designed to work in humid salt laden and corrosive atmosphere. The maximum values of the condition shall be as under : <div style="display: flex; justify-content: space-between;"> <div>Maximum pH value</div> <div>8.5</div> </div> <div style="display: flex; justify-content: space-between;"> <div>Sulphate</div> <div>7 mg/liter</div> </div> <div style="display: flex; justify-content: space-between;"> <div>Max. concentration of chlorine</div> <div>6 mg/liter</div> </div> <div style="display: flex; justify-content: space-between;"> <div>Max. conductivity</div> <div>130 micro siemens/CM</div> </div>
Shocks and Vibration	The transformer shall withstand satisfactorily vibrations and shocks normally encountered in service as indicated below: <div style="display: flex; justify-content: space-between;"> <div>a) Min. vertical acceleration</div> <div>- 3.0 g</div> </div> <div style="display: flex; justify-content: space-between;"> <div>b) Min. lateral acceleration</div> <div>- 3.0 g</div> </div> <div style="display: flex; justify-content: space-between;"> <div>c) Min. longitudinal acceleration</div> <div>- 3.0 g</div> </div> <p>(‘g’ being the value of acceleration due to gravity)</p>

4.0 GOVERNING STANDARDS / SPECIFICATIONS:

- 4.1 Reference shall be made to following standard / specifications

UIC 564-2	Regulation relating to fire protection and fire fighting measures in passenger carrying railway vehicles or assimilated vehicles used on international service
IEC 60529	Degree of protection provided by enclosures
IEC-61373	Railway applications-Rolling stock equipment-shock and vibration tests
IS:2082-1999	Steel for general structure purpose.
IS:2026 (PART-I)	Specification for power transformers: General
IS: 2026 (PART-II)	Specification for power transformers: Temperature Rise
IS: 2026 (PART-III)	Specification for power transformers: Insulation level and dielectric tests
IS: 2026 (PART-IV)	Specification for power transformers: Terminal marking, tapping and connections

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IS: 11171	Specification for Dry type Power transformers
IS: 1885 (Pt. XXXVIII)	Electro-technical vocabulary for transformers
IS: 1271-85	Thermal evaluation and classification of electrical insulation.
IS: 2551-1982	Danger Notice Plate
IS: 13730, Pt 13 - 93	Part 13, Polyester or polyesterimide over coated with polyimide-imide enameled round copper wire, Class 200.
IS: 13730, Pt. 29	Specification for particular types of winding wires Part 2, Polyester or polyesterimide over coated with polyimide-imide enameled rectangular copper wire, Class 200.
IS: 3024-1997	Specification for electrical steel sheet (oriented). CRGO
IS: 1363-84 (Part II)	Hex. Hd. Screws (M5-M36)
IS: 649-1997	Method of testing steel sheets for magnetic circuits of power electrical apparatus
IS: 6911-92	Stainless steel plate, sheet and strips

Note: Latest version of the above specifications/standards shall be applicable and should be available with the manufacturer/supplier.

- 4.2 Any deviation from this specification proposed by the firm to improve upon the performance, utility and efficiency of the transformer shall be given due consideration, provided full particulars of the deviations with justification are furnished. In case of any contradiction between the provisions of above standards, the details mentioned in this specification shall prevail.

5.0 SUPPLIER'S RESPONSIBILITY:

- 5.1 The transformer shall be suitable for rugged service conditions normally to be met within Railway Rolling Stock, where coaches are expected to run upto a maximum speed of 200 kmph in varying climatic conditions existing throughout India, as mentioned in clause 3.0 of this specification.
- 5.2 The supplier shall be fully responsible for ensuring that all equipments forming part of the supply is entirely fit for the purpose and no part of this specification shall in any way remove or reduce this obligation in this respect. In addition, it is the supplier's responsibility to underwrite the complete design and ensure that it is compatible with and will, in no way, compromise the design and performance of transformer of his supply.
- 5.3 The supplier shall provide "In the field" service support during the guarantee period.
- 5.4 The supplier shall supply any purpose built or special tools or equipment that may be necessary for the correct operation, servicing, testing or installation of the transformer.
- 5.5 The supplier shall provide assistance, both material and technical, in the installation of the system as a whole to ensure that when it is installed as part of the integrated vehicle system, the performance of the transformer meets or exceeds the requirements specified.

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- 5.6 Should the transformer fail to achieve the requirements, then it shall be modified at the supplier's expense and within a time scale to be agreed with purchaser/consignee/RDSO.

6.0 TERMINOLOGY:

- 6.1 For the purpose of this standard, the definition as given in IS: 1885 (Pt. XXXVIII) (Electro-technical vocabulary for transformers) shall apply.

7.0 TECHNICAL REQUIREMENTS:

- 7.1 The technical requirement of the transformer shall be as under:

9 KVA TRANSFORMER	
kVA Rating	9 kVA
Nominal input voltage	3 Phase, 3 wire, 750 V \pm 5% (line to line), 50Hz \pm 3%, THD 10%
Nominal output voltage	3 Phase, 4 wire, 415 V \pm 5% (line to line), 50Hz \pm 3%, 6.5KVA 3 Phase, 4 wire, 190 V \pm 5% (line to line), 50Hz \pm 3%, 2.5KVA
Nominal input line current	6.92 A at 750V
Nominal output current	9.00 A for 6.5 kVA winding at 415 V 7.60 A for 2.5 kVA winding at 190 V
Class of insulation	H
Efficiency	>96% from half load to full load
Noise level	<80db at 1.0 m distance
Maximum % impedance	
UCC overall impedance	"4% (max.)"
Protection level	
Stainless steel housing and terminal box	IP-67
Vector configuration	Star -Star -Star(Yyy)
Winding wire	Super enameled copper winding wire as per to IS: 13730 Pt. 13, 13730 Pt. 29
Max. temp. rise	115°C
Total weight	200 kg (maximum)
15 KVA TRANSFORMER	
kVA Rating	15 KVA
Nominal input voltage	3 Phase, 3 wire, 750 V \pm 5% (line to line), 50Hz \pm 3%, THD 10%
Nominal output voltage	3 Phase, 4 wire, 415 V \pm 5% (line to line), 50Hz \pm 3%, 12.5 kVA 3 Phase, 4 wire, 190 V \pm 5% (line to line), 50Hz \pm 3%,

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2.5 kVA	
Nominal input line current	11.50 A at 750 V
Nominal output current	17.40 A for 12.5 kVA winding at 415 V 7.6 A for 2.5 kVA winding at 190 V
Class of insulation	H
Efficiency	>96% from half load to full load
Noise level	<80db at 1.0 m distance
Maximum % impedance	
UCC overall impedance	*4% (max.)*
Protection level	
Steel housing and terminal box	IP-67
Vector configuration	Star-Star-Star(Yyy)
Winding wire	Super enameled copper winding wire as per to IS: 13730 Pt. 13, 13730 Pt. 29
Max. temp. rise	115°C
Total weight	200 kg (maximum)

8.0 CONSTRUCTION:

- 8.1 Over all dimensions, construction and mounting of the transformer shall confirm to 60 KVA transformer enclosure RCF drawing no. CC71216 Alt-b with latest alteration. Terminal board of the transformer shall be as per RCF drawing no. CC71073.
- 8.2 The manufacturer shall take prior approval of enclosure & terminal board drawing, which shall be in line with RCF drawing mentioned above.
- 8.3 The enclosure shall meet the requirement of water immersion and dust ingress test as per IP 67 protection level to IEC60529.
- 8.4 Anti-vibration mountings 4 Nos. of Resistoflex/Dunlop/Metalleastic or other make with prior approval of RDSO. Shore hardness of AVM shall be 60 and to be supplied loose with the transformer. Mounting holes of the anti-vibration mountings shall match with the foot print of RCF drawing no. CC71216 Alt-b.
- 8.5 Housing shall be made of stainless steel to grade no. SS-304 (2.0 mm thick) of IS: 6911.
- 8.6 The manufacturer shall take prior approval of the manufacturing drawing from RDSO before developing prototype of the transformer.
- 8.7 The suitable clearance between the terminal stud shall be kept. In this regard, firms shall furnish the detailed drawing of terminal board indicating the dimensions.
- 8.8 The clearance and creepage distance shall be maintained as per IS: 13547-1993 with pollution degree 3 for material group -II.
- 8.9 Acoustic noise level has to be recorded during no load test at a distance of 1.0 meters in all four directions without having nearby moving electrical appliances like

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fans, exhaust fan etc. It should not be more than 60 dB, when measured as per NEMA standard-2"

- 8.10 The terminal board shall be made of Fibre Glass Reinforced Plastic from sheet moulding compound (FRPSMC) of 25% glass content with self extinguishing grade having the following properties:

S.NO.	PROPERTIES	TEST METHOD	UNITS	SPECIFIC VALUE
1.	Specific gravity	ASTM D 792	MPa	1.75 to 2
2.	Tensile strength	ASTM D 638	MPa	60 min.
3.	Cross breaking strength	ASTM D 790	MPa	150 min.
4.	Compressive strength	ASTM D 795	MPa	150 min.
5.	Izode impact strength	ASTM D 256	Joules/meter	450 min.
6.	Water absorption	ASTM D 570	Percentage	0.2 max
7.	Insulation Resistance after immersion in water (immersion in water for 24± 1 hr)	IS: 1998	M ohms	1000 min.
8.	Dielectric strength	ASTM D 149	KV/min	11.0 min.
9.	Tracking Index (V/50 drops)	IS:2824	Volts	1000 min.
10.	ARC resistance	CIPET Method	Seconds	180 Min.

- 8.11 Complete primary & secondary windings shall be done with polyester or polyesterimide over coated with polyimide-imide enameled round/rectangular copper wire, class 200 as per IS: 13730 pt. 13 & IS: 13730 pt. 29 respectively.
- 8.12 Separate coil each for 190V and 415V shall be provided in 9KVA & 15KVA transformer.
- 8.13 The current density of the 750 V winding wire shall not be more than 1.0 amp/mm² and 415 & 190 V winding shall not more than 1.45 amp/mm². Firm may use any other current density but prior approval of RDSO is mandatory in such case. LV winding shall be near the core and HV winding shall be out side. The gap between LV to core shall be minimum 5mm provided by SRBGF separators.
- 8.14 A copper foil shall be provided between primary and secondary winding of the transformer. This foil shall be earthed with the enclosure of the transformer.
- 8.15 Over both primary and secondary winding 'H' class varnish impregnation shall be provided to protect winding from effect of moisture, dirt and also impact of mechanical stress. Impregnation shall be done by FT 2005/500EK of Dr BECK by vacuum pressure impregnation method.
- 8.16 The joint of external cable with the winding wire of the transformer shall be made by crimping ferrules on lead and winding wire. On crimped joint apply soldering material and then apply fire retardant RTV sealant and then wrap it with glass tape. It should then be impregnated with varnish. The termination on terminal board shall be with proper anti-loosening arrangement so that terminal connection should not loosen in service. The drawing of anti-loosening arrangement shall be furnished by firm.

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- 8.17 Flexible connecting lead shall be covered with flexible insulated fibre glass sleeve with coating of fire retardant silicon elastomer applied by extrusion or multidip process having temperature index of 180 deg.C as per BS: 2848 type 1/80 Tb having wall thickness of 0.9 mm and capable to withstand minimum B.D.V at star point of 5 KV for one minute. The lead shall be of RDSO approved make as per BS: 6195. On soldered joint apply RTV silicon sealant and overlap with two layers of half lap glass tape. Cover the soldered joint with Nomex 410, mil thick and impregnate the joint.
- 8.18 PMA or equivalent make Grommet/PG coupler of adequate size shall be provided to hold the cables firmly, passing through the holes. Grommet/PG coupler shall have fire retardant property grade V0 when tested as per UL94.
- 8.19 Material of the core shall be of CRGO as per IS: 3024 of 0.27 mm thickness. Firm will submit a test certificate complying with IS: 3024-1997 from NABL accredited laboratory. To avoid the transfer of weight through core stampings the bottom holding angle of the core shall be rigidly tightened with the top angle by four nos. stainless steel head bolts of 8.0 mm dia of suitable size with adequate strength. Stacking of the stampings shall be of good quality and evenly arranged.
- 8.20 The lamination structure shall be interleaved and mitered/lap joints arrangement.
- 8.21 Hardware used for clamping of core and mounting arrangement of complete assembly shall be of high tensile steel only. Only TVS, Unbrako & LPS make hardware of minimum 10.9 grade shall be used.
- 8.22 The cable ends shall be provided with suitable size of crimping socket. Crimping socket/lug shall be duly crimped and fire retardant heat shrinkable sleeve over lug shall be provided. Dowells make crimping socket shall only be used. Prior approval of RDSO is required for any other make socket/lug.
- 8.23 'H' class insulating material shall only be used in manufacturing of transformer.
- 8.24 Core & winding and primary & secondary winding shall be separated by insulated separator made up of SRBGF material conforming to IS:10192-1992 with EP3 grade. The separator provided shall not be loose, so as not to fall during service.
- 8.25 All the material used in the equipment shall be fire retardant and shall fulfill the requirement of UIC-564-2.
- 8.26 Two numbers cable entry holes shall be provided i.e. one on left side and one on right side in the housing of transformer for incoming and outgoing power cables as per RCF drawing No. CC 71216 Alt.b.
- 8.27 Two numbers of earthing bolts of stainless steel with thread size of M10 shall be provided diagonally opposite as shown in RCF drawing No. CC 71216 Alt.b.
- 8.28 'H' class winding wire shall meet the requirement to IS: 13730 Pt. 13 & pt. 28. Winding wire shall be got tested from any NABL recognized laboratory in addition to OEM test certificate.
- 8.29 The temperature rise at the top of enclosure of transformer shall not exceed 70 deg.C above ambient. The temperature rise of the terminal of the transformer shall not exceed 25°C above ambient inside the enclosure.

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8.30 An anodized aluminum plate showing the wiring diagram of connections of the transformer shall be riveted on the inside of the cover of the terminal box.

8.31 A danger notice plate of suitable size conforming to IS: 2551 indicating danger voltage 750 V ac shall be riveted on the outside of the terminal box.

9.0 MARKING:

9.1 The following data shall be marked on the nameplate. The data shall be screen printed in permanent nature on the name plate.

1. Manufacturers name
2. Serial number
3. Year and month of manufacture
4. Capacity/Rating & % impedance
5. Primary & Secondary voltage & current and Frequency
6. Connection diagram (Primary & Secondary)
7. Vector symbol
8. Weight
9. Specification No.

10.0 TESTS:

10.1 Only after the drawings and the design have been approved and the clearance given to this effect, the manufacturer shall take up the manufacture of the prototype. It is to be clearly understood that any changes, required to be done in the prototype or any additional tests other than specified herein are required to be conducted on the prototype unit or its components, they shall be done expeditiously. During the process of manufacture of the equipment, if the purchaser so desires, he may conduct/repeat any of the routine or additional tests to satisfy himself that the quality of the product being manufactured is of the required standards.

10.2 The type tests shall be carried out by RDSO representative on prototype unit either totally or in part under the following conditions without any additional cost:

- (a) A manufacturer undertakes to manufacture for the first time.
- (b) An important change in design details of machine has been introduced.
- (c) Specification is modified necessitating the re-designing of equipment.
- (d) Unsatisfactory performance reported from user Railways.
- (e) Resumption of production after an interruption of more than two years.

Investigation tests are intended to obtain additional information regarding performance of the production. They shall be specially requested either by the user or by the manufacturer.

RDSO may conduct surprise check on manufacturing process and quality control along with any of the tests to ensure quality of product and its conformance to RDSO specification.

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10.3 The suitability of the transformer shall be ascertained by inspection, bench test at the firm's works, in the stationary coach and during service of the unit on the coach.

10.4 Because of inevitable difference in basic material and variation in manufacture, as well as measurement error, the value obtained on test may differ from the calculated value and tolerances on guaranteed value necessary. The table 7 to IS:2026 (Pt.I) gives tolerances to be applied to certain rated quantities when they are the subject to manufacturer guarantees referring in IS:2026 (Pt.I) where the tolerances in one direction is omitted, there is no restriction on the value in the direction.

10.5 The transformer shall be considered as complying with the standard when the quantities subject to tolerances are not out side the tolerances given in table 7 to IS: 2026 (Pt.I).

10.6 Test format for recording of test results during routine & acceptance test shall be available with the firm.

10.7 Type test:

10.7.1 All the type tests mentioned in Clause 10.10.1 shall be carried on a prototype unit. The firm manufacturing for the first time shall get prototype approved from RDSO. Before offering the prototype for type testing, firm will submit internal test results along with drawings of transformer indicating over all, mounting, thickness of sheet/channel & other important dimensions to RDSO for approval.

10.8 Acceptance Test:

10.8.1 Acceptance tests mentioned in clause 10.10.1 shall be carried out by an inspecting authority nominated by the purchaser at the works of the manufacturer on the sample picked up as per sampling plan by the inspecting authority

10.9 Routine test:


10.9.1 Routine tests mentioned in Clause 10.10.1 shall be carried out on each unit by the manufacturer at his premises to ensure compliance with the specification and drawings. These test results shall be produced before Indian Railway representative, if demanded.

All the tests shall be carried out at firm's premises at manufacturer's cost. Inspecting officer shall witness the tests on each unit. A copy of these internal tests conducted by the firm shall be supplied to the inspecting/purchasing authority. Notwithstanding above, RDSO reserves the right to have these equipments also tested as per this specification at any reputed test house in India at firm's cost.

10.10 Tests description:

10.10.1 Test mentioned in table below shall be carried out as per respective clause:-

SN	Description	Type test	Routine test	Acceptance test	Remarks
1.	Visual inspection and dimensional checks	Yes	Yes	Yes	Clause 10.12

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2.	Measurement of winding resistance	Yes	Yes	Yes	16.2 of IS:2026 (Pt-I)
3.	Measurement of voltage ratio and check of voltage vector relationship	Yes	Yes	Yes	16.3 of IS:2026 (Pt-I)
4.	Measurement of impedance voltage/short circuit impedance and load loss at 75 deg.C	Yes	-	Yes	16.4 of IS:2026 (Pt-I)
5.	Measurement of NO load loss and current at 75 deg.C	Yes	Yes	Yes	16.5 of IS:2026 (Pt-I)
6.	Measurement of insulation resistance	Yes	Yes	Yes	16.6 of IS:2026 (Pt-I)
7.	Dielectric test	Yes	Yes	Yes	16.7 of IS:2026 (Pt-I) and Clause 10.13
8.	Induced overvoltage withstand test	Yes	Yes	-	11.1 & 11.2 of IS:2026 (Pt-III)
9.	Temperature rise test	Yes	-	Yes *	16.8 of IS:2026 (Pt-I) Temperature rise test
10.	Measurement of zero-sequence impedance	Yes	Yes	Yes	16.10 of IS:2026 (Pt-I)
11.	Short circuit test	Yes	-	-	18.11 of IS:2026 (Pt-I)
12.	Measurement of the harmonics of the no load current	Yes	-	-	16.13 of IS:2026 (Pt-I)
13.	Vibration and Shock test	Yes	-	-	IEC 61373 and Clause 10.14
14.	Degree of protection test (IP-67)	Yes	-	-	Clause 10.16 and IEC-60529
15.	Efficiency test at one forth, half, three forth and full load at 75 deg.C	Yes	Yes	Yes	To be computed from load loss test at S.No.4*
16.	Fire retardant test for terminal board	Yes	-	-	Clause 10.15
17.	Measurement of acoustic noise level	Yes	-	Yes	16.12 of IS:2026 (Pt-I)
18.	Testing of Core/stamping material	Yes	-	-	Clause 10.17

*Note: During acceptance test, temperature rise test shall be carried out on one transformer of each offered lot of twenty transformers.

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