भारत सरकार - रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
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संख्या/No. RDSO-TI0LKO(PSI)/19/2020-O/o PED/TI/RDSO **दिनांक/Date: As signed.**

1.	M/s Meiden T&D (India) Limited, SEZ, Menakuru, SPSR Nellore District, Naidupeta Andhra Pradesh – 524126	gagandeep.tandon@meiden.in
2.	M/s Toshiba Transmission & Distribution Systems (India) limited, 1104, Surya Kiran building, 19, K. G. Marg, Cannaught Place, New Delhi-110001	rajib.chaudhary@toshiba-ttdi.com
3.	M/s Hitachi Energy India Limited Power Transformer Factory, Maneja Works Vadodara, Gujarat - 390013, India	sukhamnder.singh@hitachienergy.com, shailendra.p.sing@hitachienergy.com
4.	M/s CG Power and Industrial Solutions Ltd., Power Transformer Division T-3 29, 31-32 New Industrial Area, Mandideep Raisen, Madhya Pradesh - 462046, India,	akhilesh.gupta@cgglobal.com, nidhi.tiwary@@cgglobal.com,
5.	M/s Kanohar Electricals Limited, Rithani, Delhi Road, Meerut-250103	jagbir.singh@kanohar.com
6.	M/s Bharat Heavy Electricals Limited, P. O. BHEL, Jhansi (UP)-284129	rodbhellko@hotmail.com
7.	M/s Siemens Limited, Plot No.-78, JIL Jagatjit Industrial limited, Shaheed RIPON, Katyal marg sector, Gurugram Haryana -122015	debraj.choudhary@siemens.com
8.	M/s Vishvas Power Engg. Services Pvt. Ltd., Plot No. K-5, Five Star Industrial Area MIDC, Butibori, Nagpur Nagpur, Maharashtra - 441122, India	vishvaspowercmc@gmail.com
9.	M/s High – Volt Electricals Pvt. Limited, J-46 /J-47, MIDC Tarapur Industrial Area, Boisar, Distt. Palghar, Maharashtra – 401506	viraldesai@highvolt.in
10.	M /s TMC Transformers India Private Limited, Sur.No.26 1/2, Part B, Village Khandiwada (ASOJ), Vadodara-Halol Highway VADODARA,Gujarat - 391510	tkmohan@tmc-india.com
11.	M/s Shree Abirami Enggineering Works Private Limited, SAEW Unit-2, Survey No 22/1 & 22/2, Sriperumbudur Kodambakkam High Road, Kanchipuram, Tamil Nadu -602105,	md@abiramiengg.com
12.	M/s Technical Associates Limited, B-7 Eldeco Sidcul Industrial Park Sitarganj U.S. Nagar Uttarakhand Sitarganj, Uttarakhand - 262405, India	eproc@techasso.com
13.	M/s Transformers & Rectifiers India Limited, Survey No. 427 P/3-4 and 431 P/1-2, Sarkhej- Bavla Highway, Village Moraiya, Taluka Sanand, Dist. Ahmedabad Gujarat - 382213, India	Siddharth.dixit@transformerindia.com

विषय/Sub: Standard of Transformer Oil to be used in Traction Transformers of Indian Railways.

संदर्भ/Ref: (i) This office letters of even no. dated 02.12.2024 & 13.12.2024.
(ii) Core letter no. CORE-HQ0ELEC(MP)/4/2022-O/o CAO/CORE/PRYJJ dated 14.11.2024.

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Vide letters referred above, it was advised to refer the Standard of Transformer Oil to be used in Traction Transformers as 'Type A of IEC: 60296', appearing in the **CLW vendor directory** with **item ID**: **2100653**. Accordingly, the vendors appearing in the CLW Vendor Directory against this item, are to be referred for the sources of Transformer Oil.

2. Further, following A&C slips of the respective specifications of the Transformers w.r.t. change in standard of Inhibited Mineral Insulating Oil, are also enclosed herewith, for reference.

SN	Specification No.	Description of Specification	A&C Slip No.
i.	TI/SPC/PSI/AUTOTR/1200	Specification for 8 MVA, 12.5MVA & 16.5MVA 55kV/27.5kV Autotransformer	A&C slip No. 01
ii.	TI/SPC/PSI/TRNPWR/4200	Specification for 21.6MVA & 38/53/63MVA Single Phase Dual LV Winding Traction Power Transformer	A&C slip No. 01
iii.	TI/SPC/PSI/TRNPWR/ 5200	Specification for 54MVA & 60/84/100MVA Scott	A&C slip No. 02

	with A&C slip No. 01	Connected Traction Power Transformer	
iv.	TI/SPC/PSI/TRNPWR/3201	Specification for 13.5/18.9 MVA, 21.6/30.24 MVA, 30/42MVA & 40/56 MVA Single Phase Traction Power Transformer	A&C slip No. 01
v.	TI/SPC/PSI/AUTOTR/0091	Specification for 50/75/150 MVA, ONAN/ONAF/ OFAF, 220/ 132 kV, 3-Phase Oil Immersed Type Auto Transformer.	A&C slip No. 01
vi.	TI/SPC/PSI/CT/0210	Specification for Current Transformers for Railway AC Traction Substation	A&C slip No. 01
vii.	TI/SPC/PSI/PT/0210	Specification For 220kV or 132kV or 110kV or 66kV or 25kV Potential Transformer	A&C slip No. 01
viii.	ETI/PSI/15	Specification For 5kVA, 10kVA, 25kVA & 50kVA Auxiliary Transformer.	A&C slip No. 01
ix.	ETI/PSI/15A with A&C slip No. 01	Specification For 100kVA Auxiliary Transformer.	A&C slip No. 02

2. This is for your information and further necessary action at your end, please.

This is issued with the approval of the Competent Authority (PED/TI).

Digitally Signed by
Jitendra Kumar
Date: 30-12-2024 17:42:21
Reason: Approved

(Jitendra Kumar)
Director/TI-3
For Director General (TI)

संलग्नक: As stated above.

Copy to:

The Principal Chief Electrical Engineer,

- **i.** Central Railway, Statin Building, Mumbai CST – 400 001.
- **ii.** Eastern Railway, Fairlie Place, Kilkata-700 001.
- **iii.** East Central Railway, Hajipur-844 101.
- **iv.** East Coast Railway, hubaneshwar-751 023.
- **v.** Northern Railway, Baroda House, New Delhi - 110 001.
- **vi.** North Central Railway, Prayagraj-211 015.
- **vii.** North Eastern Railway, Gorakhpur-273 012.
- **viii.** North Frontier Railway, Mailgaon - 781 011.
- **ix.** North Western Railway, Jaipur – 302 017.
- **x.** Southern Railway, Park Town, Chennai- 600 003.
- **xi.** South Central Railway, Railnilayam, Secunderabad-500 371.
- **xii.** South Eastern Railway, Garden Reach, Kilkata-700 043.
- **xiii.** South East Central, Railway, ilaspur-495 004.
- **xiv.** South West Railway, DRM's Office, Hubli-580 028.
- **xv.** Western Railway, Churchgate, Mumbai-400 020.
- **xvi.** West Central Railway, Jabalpur- 482 001.
- **xvii.** Konkan Railway, Belapur Bhavan, Sectir-11, CBD Belapur, Navi Mumbai 400614.

2. Chief Administrative Officer, CORE, Prayagraj-211001, e-mail: ceehq.core@gmail.com

3439568/2024/O/o PED/TI/RDSO

Addendum & Corrigendum Slip No. 02 to the RDSO's Technical Specification No. ETI/PSI/15A (07/1982) for 100kVA Auxiliary Transformer.

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1. Standard of Insulating Oil mentioned as "IS 335:1972" at Para No. 7.3, 11.1 and 12.1 (a) is replaced with "IEC: 60296 (Type A)".

2. New Para 11.2 is added as, "For the Sources of Insulating Oil, refer CLW Vendor Directory (item ID: 2100653) available on IREPS website".

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(Pramod Sahu)	(Ramesh Kumar Pal)	(Jitendra Kumar)
SSE/TI	ADE/TI-3	DTI-3

SPECIFICATION NO. ETI/PSI/15 A (7/82)

SPECIFICATION
FOR
25 kV 230 VLT. SUPPLY TRANSFARMER, 100 kVA
FOR
RAILLWAY a.c. TRACTION SUBSTATIONS

RESEARCH DESIGN & STANDARDS ORGANISATION
MINISTRY OF RAILWAYS
GOVERNMENT OF INDIA
LUCKNOW 226011

Addendum/Corrigendum Slip No. 1-Sept.1989 to Technical specification No. ETI/PSI/15A (7/82) for 25 kV/230 Volt L.T. supply transformer 100kVA.

S.No.	Clause No. and Description	As amended
1.	Top Cover	Read the title of specification as under: "Specification for 25kV/ 240V L.T. supply transformer, 100kVA for Railway a.c.traction sub-transformer".
2.	Page -1 Title	Read the title as follows: "25kV/ 240 Volt L.T. supply transformer100kVA."
3.	Page -1 Clause -1.1 1st line	Read "25kV/ 240 Volt" in place of "25kV/ 230 Volts."
4.	Page -2 Clause -4.1 (iii)	Read in place of existing entry as under: "Rated secondary voltage –240 Volts."
5.	Page-9 Clause-13.3	Read the existing "Clause-13.3" as "Clause-13.4" and add new Clause -13.3 and 13.5 as follows: "13.3 :- Before giving the call to RDSO/The Chief Electrical Engineer for inspection and testing of the prototype of the System , the manufacturer shall submit a detailed test schedule consisting the schematic circuit diagrams for each of the test, venue of the test and the duration of each test and the total number of days required to complete the test ant one stretch. Once the schedule is approved, the test shall invariably be done accordingly. However during the process of type testing or even later, RDSO representative reserves the right to conduct any additional test (s) besides those specified herein, on any equipment/sub system or system so as to test the system to his satisfaction or for gaining the additional information and knowledge. In case any dispute or disagreement arises between the manufacturer and RDSO/ The Chief Electrical Engineer during the process of testing as regards the type test results, it shall be brought to the notice of the Director General (Traction Installations), RDSO/The Chief Electrical Engineer as the case may be, whose decision shall be final and binding." "13.3 : Only after clear written approval of the results of the tests on the prototype is communicated by RDSO/Purchaser of the manufacturer, of the equipment-which shall be strictly with the same material and process

		as the adopted for the prototype. In circumstances shall material other than those approved in the designs/drawings and/or the prototype be used for the bulk manufacturer on the plea that they had been obtained prior to the approval pf the prototype."
6.	Page-10, Clause-15.1:	Read the clause-15.1 in place of existing as follows" "15.1: Tenderer shall furnish guaranteed performance data and other technical particular for the equipment offered in the proforma attached at annexure –A. The information furnished in schedule of guaranteed technical performance data and other particulars shall be complete in all respects. If there is nay entry like "shall be furnished later" or blanks are left against any item, the tender is not likely to be considered as such omissions causes delays in finalising the tender." Add the following "Clause-15.4" after "Clause 15.3." "15.4: Only after all the designs and drawings have been approved and clearance given by RDSO to this effect, the manufacturer shall take up manufacturer of the prototype for RDSO inspection. It is to be clearly understood that any changes required to be done in the prototype-as required by RDSO shall be done expeditiously."
7.	Drg. No. ETI/ PSI/ 0312 Mod. 'A'	Replace "Drg. No. ETI/ PSI/ 0312 Mod. 'A' attached with specification by the enclosed "Drg. No. ETI/ PSI/ 0312 Mod. 'B'."

SPECIFICATION NO. ETI/PSI/15 A (7/82)

25kV/230/Volt LT Supply Transformers, 100 kVA

1.0 SCOPE :

1.1 This specification applies to 100 kVA, 25kV/230 Volts, 50Hz, single phase LT Supply Transformers for installation at 25kV, single phase a.c. traction sub-stations.

1.2 The transform shall be complete with all parts and accessories for their efficient operation.All such parts or accessories shall be deemed to be within the scope of this specification whether specifically mentioned or not.

2.0 Service Conditioned:

2.1 The transformers shall be suitable for outdoor use inb coastal area and heavily polluted atmosphere. They are intended to be either pole-mounted or floor-mounted at traction substations for supplying station loads and oil filtration plant loads. The transformers would also be subjected to vibrations on account of trains running on the railway tracks nearby.

2.2 Weather Conditioned:

Max. temperature of air in the shade	-	45°C
Min. temperature of air in the shade	-	0°C
Max. temperature attainable by an object exposed to sun	-	65.5°C
Max. relative humidity .	-	100%
Average annual rainfall	-	1750 to 6250mm
Number of thunder storm days per anum	-	85 days Max.
Average number of dust-storm days per annum	-	35 days Max.
Number of rainy days per annum	-	120 days Max
Maximum wind pressure	-	200 kg/sq.metre
Altitude	-	Not exceeding 1000 meters.

2.3 One of the two terminals of the 25kV primary winding shall be brought out through out suitable HV bushing for connection to the substation overhead equipment , and the other terminal brought out through a 3.3kV class bushing and connected to the tank externally through a link .the tank will be connected to earth during service .

3.0 Governing specification :

3.1 The transformers shall, unless otherwise specified, conform to IS:2026-1977 (with latest amendments) and the Indian Electricity Rules wherever applicable.

3.2 In case of any conflict between the above standards and the stipulations of this specification, the latter shall apply.

3.3 Any deviation from this specification,calculated to improve the performance and efficiency of the equipment, proposed by the tenderer shall be given to consideration if full particulars with justification therefore are given.

3.3.1 In such a case the Tenderer shall quote according to this specification and the deviations proposed by him shall be quoted as an alternative.

4.0 Rating and other particulars:

4.1 The transformers shall have the following rating and other particulars:

i.	Type	: double wound, single phase, oil immersed, natural air , step-down transformer for outdoor installation.
ii.	Rated primary	:25kV. The primary voltage may however vary from 19 kV to 27.5kV voltage in service.
iii.	Rated secondary voltage	:230 Volts
iv.	Rated frequency	:50Hz
v.	Rated output (at all tap positions)	:100kVA
vi.	Tappings voltage .	: Off-circuit to be provided to give the rated secondary variation of plus 5%to minus 15% in steps of 5%.tappings may be provided either on HV or LV side to suit manufacturer's convenience. All tappings shall capable of carrying full load current continuously
Vii.	Polarity	: subtractive
viii.	Temperature	: See clause 13.1
ix.	Impedance at 75°C	: 5%
x.	Efficiency	: Max. at 50% rated output
xi.	Type of cooling	: 'ON'

5.0 Transformer Tank:

5.1 The tank shall be constructed of mild steel with a single tier construction so shaped as to reduce welding. The tank shall withstand standard atmospheric pressure under 95% vacuum for one hour without any leakage or deformation. The tank shall also be tested for oil tightness for an additional pressure of half atmosphere. Certificates in compliance with these tests shall be furnished.

5.2 The transformer shall be provided with two channels at the bottom of the tank in order to make it suitable for pole mounting as shown in the general arrangement drawing No.

ETI/PSI/ 0312 attached to this specification. The disposition of conservator, HV bushing, and preferably LV bushings, shall be as shown in this drawing. The fixing hole distances and slot dimensions on the transformer base channels shall be rigidly complied with uni-directional rollers shall also be provided on the transformer base channels.

6.0 Core:

6.1 The core shall be built up of high grade cold rolled grain oriented silicon steel laminations, conforming to BS:601(Pt. II). The transformer shall be suitable for over fluxing upto 20% on any tapping without injurious heating. The maximum flux density in any part of the core under such conditions shall exceed 1.9 Tesla on the basis of M4, M5 and M6 grades as per BS:601-part II.

6.2 All laminations used shall be level, free from waves, deformations, scaling of core plating insulation or signs of rust and coated on both sides with suitable insulation capable of with standings tress relief annealing. A core clamping frame shall be electrically connected to the frame and tank for providing earthing to drain off any electrostatic potential that may be built up.

6.3 The core bolts and parts of the core clamping frame shall be insulated from the core laminations and be capable of withstanding 2500V a.c. (rms) for one minutes.

6.4 Adequate provision shall be made to prevent movement of the core and winding relative to the tank, during transport and installation or while in service .

7.0 Windings:

7.1 Class 'A' insulation as per IS:1271-1958 shall be used. Wood insulation shall be well-seasoned and treated .

7.2 The windings shall have the following insulation levels:

	HV	LV
a.) Rated voltage (kV)	25	0.230
b.) Rated short duration power frequency withstand voltage (kVrms)	105	2.5
c.) Rated lighting impulse withstand voltage (kV peak)	250	-

7.3 The winding assembly shall be dried in vacuum and impregnated under vacuum with tested insulating oil conforming to IS:335-1972. uniform insulation shall to provided for both HV and LV windings.

7.4 The windings shall be designed to reduce to a minimum the out-of- balance forces in the transformers at all taps. The windings shall be suitably designed and braced to withstand without damage the thermal and dynamic effects of external shorts circuits. All leads and connections shall also be mechanically strong, protected and rigidly clamped to withstand dynamic stresses due to terminal short circuits.

8.0 Bushings and terminal arrangements:

8.1 Bushings:

8.1.1 The transformer bushings when type tested according to IS:2099-1973 shall withstand the following test voltages:

	HV (winding bushing (line end)	HV (winding bushing (earth end)
Rating (kV)	52	3.6
i. One minute wet withstand power frequency voltage (kV r.m.s.)	105	21
ii. 1.2/50 microsecond impulse withstand voltage (kV peak)	250	45

The successful tenderer shall furnish the certificates for the bushings in compliance of the above requirements as well as the other requirements specified in IS:2099-1973.

8.2 Thermal arrangements:

A high voltage porcelain bushing of appropriate rating satisfying the requirements in para 8.1 shall be used for the winding at the coming line end. The other end of the HV winding shall be brought out through a 3.6 kV class bushing and connected externally by means of a suitable tin coated copper link to the tank. The whole arrangement of the 3.6 kV bushing and connection of the link to the tank shall be housed in a sheet steel enclosure welded on to the tank and having a bolted cover. The thermal stem of HV Bushing shall be of copper alloy 20 mm dia metric threaded. The LV bushing (1.1 kV) shall be suitable for connection of 2-core 300mm^2 PVC aluminum cable and provided with air-filled cable box with necessary glands.

9.0 Fittings and Accessories:

9.1 The following fittings and accessories shall be supplied with each transformer:

i. Rating plate with diagram of connections indicating he type.

ii. Earthing terminals one of each base channels 12mm diameter metric threaded, with nut and locknut.

iii. Lifting lugs for the whole transformer and also lifting lugs for core frame and winding.
iv. Drain plug for the drain
v. Silicagel breather
vi. Oil level indicator with minimum marking
vii. Thermometer pocket
viii. Oil filling hole and cap for tank
ix. Conservator with oil filling hole, cap and drain plug.
x. Air release device for the tank
xi. Top and bottom filter valves with plug
xii. Pressure relief vent
xiii. 'Off-circuit'/and tap changing device with locking arrangement & tap position indicator.
xiv. Plain rollers
xv. Single gap arcing horns adjustable between 180mm and 250mm.
xvi. HV terminal connector- as shown in the drawing attached.
LV terminal connectors-to suit 300mm^2 PVC aluminum cable.

10.0 Painting:

10.1 All steel surfaces which are in contact with insulating oil shall be painted with heat resistant, oil insoluble insulating varnish. All steel surfaces which are exposed to wheater shall be given a primer coat of zinc chromate, and two coats of light grey paint.

11.0 Drying out of the transformers:

11.1 The transformer shall be supplied complete 'under oil' as per IS:335-1972 after being dried out under vacuum at the manufacturer's work, ready for commissioning.

12.0 Tests on tank during manufacture:

12.1 The following tests shall be carried out during manufacture of the transformer:
i. Oil leakage test:

(a) All tanks and oil filled compartments shall be tested or oil tightness by being completely filled air/oil of viscosity not greater than that of the insulating oil to IS:335 at ambient temperature and subjected to a pressure equal to the normal static oil heat including atmospheric pressure plus 35kN/m^2 (0.35 kg/cm^2) measured at the base of the tank. This pressure shall be maintained for a period of not less than 12-hours for oil and 1-hour or air, during which time no leakage shall occur.

(b) Air pressure test:

The tank of one transformer together with all its fittings including bushing in position shall be subjected to a pressure test as laid down in clause 21.5 of IS:1180(PT.I)-1981.

(c) Vacuum test:

The tank of one transformer shall be tested for an interval pressure of 38mm of Hg for one hour. The permanent deflection of voltage after release of vacuum shall not exceed the value specified below.

Length of plate	Deflection
Upto 750mm	6mm
750 to 250mm	6mm

12.2 A certificate of compliance with the above tests shall be furnished by the manufacturer for each transformer. However, if considered necessary by the purchaser, the above test of one of the unit shall also have to be arranged by the manufacturer in the presence of the purchasers representative.

13.0 Type tests:

13.1 The following type tests shall be carried out on once prototype:

i. Temperature:

This test shall be carried out as per clause 4 of IS:2026 (Pt.II)-1977. The temperature rise under full load at the lowest tap or the minimum HV voltage shall no exceed the limit given below:

a. Winding - 55ºC (by resistance method)
b. Insulating oil - 45ºC (by thermometer)

ii. Impulse voltage withstand test:

1.2/50 microsecond impulse voltage voltage of 250kVcrest value shall be applied as per clause 11 & 12 of IS:2026 (Pt.III)-1977 to the HV winding live end, the other HV terminal being earthed and the winding connected to the core and earth. Osciollograms for the voltage as well as neutral current shall be recorded curing impulse test.

iii. Short circuit test:

The short circuit test shall be done in accordance with clause 16.11 of IS:2026-1977 with the following proviso:

"Three tests each shall be conducted at normal tap and -15% tap. Of these three tests, one shall be with full asymmetry and two with no assymmetry."

After the tests the winding shall be dismantled and carefully examined for signs of damage or coil distortion.

13.2 In addition to the above, all routine tests detailed in clause 14 below shall also be carried out on the first prototype.

13.3 If a prototype transformer conforming to this specification has already been approved in connection with previous supplies to the Indian Railway, fresh prototype testing of the transformer may be waived if it had passed the prototype tests earlier and no changes in the design or material used have been made.

14.0 Routine tests:

14.1 All transformer shall be subjected at the manufacturer's works to the routine tests detailed below (as per relevant paras of IS:2026-1977)

i. Voltage ratio on all tap positions and checking of polarity and terminal markings.

ii. Resistance of windings at test bed temperature and calculation for corresponding value at 75ºC.

iii. Impedance voltage at rated current at test bed temperature on principal tapping and lowest tapping and calculation for corresponding value at 75ºC.

iv. Measurement of load losses at rated load at normal and lowest tap and test bed temperature and calculated of the same at 75ºC.

v. Measurement of no-load excitation current referred to HV winding at rated voltage and frequency and no-load losses at normal tap and lowest tap.

vi. Insulation resistance between (a) LV winding and earth and (c) between HV and LV windings. These shall be tested with a 1000V megger.

vii. Induced voltage test:

The secondary winding shall be fed at a convenient frequency, so as to obtain 105kV between the HV terminals which shall be kept open circulated with one terminal earthed.

viii. Applied high voltage test:

LV winding: 2500V hall be applied for one minute between the secondary winding and earth.

15.0 Technical data and drawings:

15.1 Tenderer shall furnish guaranteed performances data and other technical particulars for the equipment offered in the proforma attached at Annexure-'A'.

15.2 Successful tenderers shall be required to submit detailed dimensioned drawings including reproducible copies as per Railways' standards in sizes of 210x297 mm or any integral multiple thereof. The drawing shall contain the guaranteed particulars and detailed of the transformer together with the position of varies accessories as outlined in the above clauses. Fully dimensioned cross-sectional views of the following shall be included.

i. HV & LV bushings
ii. Transformer tank as a whole showing details of the winding connections inside the tank.
iii. Untanked details
iv. Primary earthing terminals
v. Rating-cum-diagram plate
vi. Terminal connections
vii. Mounting details of the transformer

15.3 The tenderer shall indicate his compliance or otherwise against each clause/subclause of this specification. Wherever the tenderer deviates from the provision of any of the clause or subclause, he shall furnish full details of each deviation together with justification for the same. Any deviation from this specification, if not clearly brought out in the schedule of deviations, will not be considered as a valid deviation.

ANNEXURE – 'A'
to Specn. No. ETI/PSI/15 A (7/82)

SCHEDULE OF GUARANTEED PERFORMANCES/ TECHNICAL AND OTHERS PARTICALURS.

1. Name of the manufacturer:
2. Country of origin:
3. Standards specification on which the performance data are based .
4. Continuous rating for specified cooling, temperature and ambient temperature. (HVA)
5. Rated temperature rise under normal operating conditions over a maximum ambient of 45ºC. ºC
   a. Of oil by thermometer. ºC
   b. Of winding by resistance. ºC
6. Rated primary voltage. kV
7. Rated secondary voltage at all the tap positions on the primary/secondary winding. V
8. Exiting current referred to HV and at $50H_Z$ at 100% rated voltage. A
9. Power factor of excitation current at 100% rated voltage 50 H_Z. %
10. Iron loss at 50 H_Z and 100% rated voltage. W+%
11. Copper loss (at 75ºC) at rated load. W+%
12. Total loss. W+%
13. Resistance voltage (at 75ºC) at full load condition of:
    a. HV %
    b. LV %
    (All values shall be referred ti the HV)
14. Reactance voltage (at 75ºC) at full load (referred to the HV) %
15. Impedance voltage (75ºC) at full (referred to the HV) %
16. Resistance of HV winding (at 75ºC) ohms
17. Resistance of LV winding (at 75ºC) ohms
18. Regulation at full load (at 75ºC) unity 0.8 power factor %
19. Efficiency at unity and 0.8 power factor (at 75ºC) %

    100% load %
    75% load %
    50% load %
20. Withstand time without injury with dead short circuit at the terminals Seconds
21. 'Ideal heating time' or the thermal time constant of winding. Minutes
22. a. Type of core
    b. Flux density in the core at rated voltage and 50 H_Z. Tesla
    c. Thickness of iron stampings.
    d. Insulation between the core laminations (material)
23. a. Type of windings

	HV	LV
b. Size of conductors.		mmsq.
c. Current density in:		
i. HV winding		per mm

ii. LV winding on per mm

d. Insulation xxxxxxxx on/ those copper.

e. Insulation withstand strength of winding with 1.2/50 micro-second: HV

i. Impulse full wave. KV

ii. Impulse chopped wave. KV

f. Applied voltage test LV KV

g. induced voltage test HV KV

h. Minimum flashover distance to earthing through oil between:

i. LV and core mm

ii. HV and yoke mm

1. Estimated switching surge withstand. KV

24. Tap charger:

a. Type of tap charger

b. Number of plus taps:

c. Number of minus taps:

Volts per step.

25. Bushings

	Primary HV end	Primary earthed	Secondary side
a. Name of manufacturer			
b. Country of origin			
c. Standard specification on which the performance data are based			
d. Type of bushing			
e. Impulse withstand kV (peak)			
f. 1 mm dry withstand Km			
g. Wet withstand kV			
h. Puncture kV			

26. Net weight core kgs

27. Net weight of copper kgs

a. HV kgs

b. LV kgs

28. Net undertaking weight of core, frame and coils kgs.

29. Net weight of insulating oil kgs

30. Volume of insulating oil Litres

31. Total weight of transformer less oil Tonnes

32. Dimensioned of the assembled transformer

a. Under base to the top-most point mm

b. Overall breadth mm

c. Overall length mm

d. Minimum thickness of plate:

Tank –sides mm

Tank-bottom mm

Tank-cover mm