भारत सरकार - रेल मंत्रालय
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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

3439404/2024/O/o PED/TI/RDSO

Addendum & Corrigendum Slip No. 01 to the RDSO's Technical Specification No. ETI/PSI/15 (08/2003) for 5kVA, 10kVA, 25kVA &50kVA Auxiliary Transformer.

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1. Standard of Insulating Oil mentioned as "IS 335" at Para No. 2.1-3 and "IS: 12463" at Para no. 7.1 are replaced with "IEC: 60296 (Type A)".

2. In Para no. 7.1 mentioned "The insulating oil shall be procured from the manufacturers approved by RDSO" is replaced with "For the sources of Insulating Oil, refer CLW Vendor Directory (item ID: 2100653) available on IREPS website."

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30/12/2024
(Pramod Sahu)
SSE/TI

30/12/24
(Ramesh Kumar Pal)
ADE/TI-3

Jumar 30/12/24
(Jitendra Kumar)
DTI-3

SPECIFICATION No. ETI/PSI/15 (08/03)

SPECIFICATION

FOR

25 kV/ 240V, 5 kVA , 10 kVA, 25kVA & 50 kVA

50Hz, SINGLE PHASE, OIL FILLED

AUXILIARY TRANSFORMERS

FOR

RAILWAY A.C. TRACTION SYSTEM

ISSUED BY

TRACTION INSTALLATION DIRECTORATE

RESEARCH, DESIGNS & STANDARDS ORGANISATION

MANAK NAGAR, LUCKNOW – 226 011.

SPECIFICATION No. ETI/PSI/15(08/03)

25 kV/ 240 V , 5 kVA ,10 kVA ,25kVA & 50 kVA OIL FILLED AUXILIARY TRANSFORMERS

1.0 SCOPE.

1.1 This specification applies to 25 kV/240 V, 50 Hz a.c. (i) 5 kVA, (ii) 10 kVA, (iii) 25 kVA and (iv) 50 kVA , oil filled , single phase, auxiliary transformer (AT) for installation at. 220/27 kV, 132/27, 110/27 kV and 66/27 kV Railway's traction substations, switching stations and other outdoor locations. The voltage on the primary side will vary from 19 kV (minimum) to 27.5 kV (maximum) and the AT should deliver the rated power within this specified voltage range at any of the provided taps.

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

1.3 This specification supersedes the earlier specification no. ETI/PSI/15(11/92) with A&C slip no. 1 to 2, which was meant for 5kVA, 10kVA and 50kVA AT.

1.4 The AT shall be erected by the Purchaser/Indian Railways. However, in case, a defect /deficiency is noticed, the manufacturer /successful tenderer will have to depute his engineer for necessary remedial action without any cost to the Railways.

2.0 GOVERNING SPECIFICATION.

2.1 The AT shall, unless otherwise specified, conform to the following standards and codes of practices (latest version) which shall be applied in the manner altered, amended or supplemented by this specification and Indian Electricity Rules, wherever applicable.

1.	IS	5	:	Colours for ready mixed paints and enamels.
2.	IS	226	:	Specification for structural steel (standard quality).
3.	IS	335	:	Specification for New Insulating oils.
4.	IS	1271	:	Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.

5.	IS : 1367	:	Technical supply conditions for threaded steel fasteners.
6.	IS : 1554 (Part I)	:	Specification for PVC insulated (Heavy duty), electrical cables for working voltage upto and including 1100 volts.
7.	IS : 1570 (Part v)	:	Schedule for wrought steel for general engineering purposes.
8.	IS : 1576	:	Specification for solid press board for electrical purposes.
9.	IS : 1866	:	Code of practice for maintenance and supervision of insulating oil in service.
10.	IS : 2071	:	Methods of high voltage testing.
11.	IS : 2074	:	Ready mixed paint, air drying red oxide zinc chrome, priming.
12	ISO/EN : 12944	:	Protective Paint systems
13.	IS : 2026 (Part I to IV)	:	Specification for power Transformers.
14.	IS : 2099	:	Specification for bushing's for alternative voltages above 1000 V.
15.	IS : 2927	:	Brazing alloys.
16.	IS : 3024	:	Specification for electrical steel sheets (oriented).
17.	IS : 3347	:	Dimensions for porcelain transformer bushings.
18.	IS : 3639	:	Specification for fittings and accessories for power transformer.
19.	IS : 4253 (Part II)	:	Specification for cork and Rubber.
20.	IS : 5561	:	Specification for Electric Power connectors.
21.	IS : 5621	:	Specification for Hollow insulators for use in electrical equipments.
22.	IS : 6600	:	Guide for loading of oil immersed transformers.

23.	IS : 8570	:	Press paper for electrical purposes.
24.	IS : 8572	:	Paper covered flexible/stranded copper conductor for transformer leads.
25.	IS : 9224	:	Specification for low voltage fuses.
26.	IS : 10028 (Part I to III)	:	Code of practice for selection installation and maintenance of transformers.
27.	IEC : 76	:	Power transformers.
28.	IEC : 137	:	Bushing for alternating voltage above 1000 V.
29.	IEC : 815	:	Guide for the selection of insulator in respect of polluted conditions.

2.2 In case of any conflict between the contents of the above specifications and the contents of this specification, the latter shall prevail.

2.3 Any deviation from this specification, proposed by the tenderer, intended to improve the performance, utility and efficiency of the equipment, will be given due consideration provided full particulars of the deviation with justification therefor are furnished. In such a case, the tenderer shall quote according to this specification and the deviation, if any, proposed by him shall be quoted as an alternative (s).

3.0 ENVIRONMENTAL CONDITIONS

3.1 The AT shall be suitable for outdoor use in moist tropical climate and in areas subject to heavy rainfall, pollution due to industry and marine atmosphere and severe lightning. The limiting weather conditions which the AT has to with stand in service are indicated below:

i)	Maximum ambient air temperature	50^0 C.
ii)	Average ambient air temperature over a period of 24 hrs.	35^0 C
iii)	Maximum relative humidity	100%
iv)	Annual rainfall	Raining from 1750 mm to 6250mm.

v)	Maximum number of thunder storm days per annum.	85
vi)	Maximum number of dust storm days per annum.	35
vii)	Number of rainy days per annum.	120
viii)	Basic wind pressure 1.	200 kgf/mm^2
ix)	Altitude	Not exceeding 1000 m.

3.2 The AT shall be subjected to vibrations on account of trains running on nearby railway tracks. The amplitude of these vibrations which occur with rapidly varying time periods in the range of 15 to 70 ms lies in the range of 30 to 150 microns at present, with the instantaneous peak going upto 350 microns. These vibrations may become more severe as the speeds and loads of trains increase in future.

4.0 **SERVICE CONDITIONS**

4.1 The AT shall be suitable for pole mounting along the railway track for supplying power to electric signaling and/or substation/switching station loads.

5.0 **RATING AND GENERAL DATA**

5.1 The rating and other particulars of the auxiliary transformer shall be as follows:

(i)	Type	Double wound, single phase, ONAN (oil natural air natural) cooled, step-down transformer for outdoor installation.
(ii)	Rated voltage of primary winding	
	a) Nominal Voltage	25 kV
	b) Minimum Voltage	19 kV
	c) Maximum Voltage	27.5 kV
(iii)	Rated voltage of secondary winding	240 V

(iv) Rated current – at rated nominal voltage

a) For Primary winding.

(i) 0.2 A	for 5 kVA.
(ii) 0.4 A	for 10 kVA.
(iii) 1.0 A	for 25kVA.
(iv) 2.0 A	for 50kVA.

b) For Secondary winding.

(i) 21 A	for 5 kVA.
(ii) 42 A	for 10 kVA.
(iii) 105A	for 25kVA.
(iv) 210A	for 50kVA.

The maximum current at the lowest primary voltage at extreme tap position must be worked out and the conductor sizes must be decided accordingly.

(vi) Rated frequency. 50 H_Z +/- 3%

(vii) Rated power at rated nominal voltage (at all tap positions.)

(i) 5 kVA
(ii) 10 kVA
(iii) 25 kVA
(iv) 50 kVA

(viii) Insulation level of winding.

		Primary	secondary
a)	Rated lightning impulse. withstand voltage peak.	190 kVpeak	-
b)	Rated short duration power. frequency withstand voltage.	70 kV rms	3 kV rms
c)	Rated Induced over voltage	80 kV rms	-

(ix) Tapping. Off- circuit tap changer to give the rated secondary winding voltage for a primary winding voltage variation of + 5% to –10% from nominal voltage of 25 kV in steps of 5%. Tapping may be provided either on primary or secondary windings. All tappings shall be capable of

		carrying maximum full load current continuously at lowest primary voltage.
(x)	Polarity	subtractive.
(xi)	Temperature rise limits.	The temperature rise over an ambient temperature of 50^0 C at maximum full load current at lowest primary voltage shall not exceed the value indicated below:- a) Winding: 50^0C (measured by resistance method.) b) Insulating oil: 40^0 C (measured by thermometer). c) Current carrying parts in air: 40^0 C. d) Hot spot temperature: not to exceed 115^0 C.
(xii)	Impedance voltage at rated current at 75^0 C.	5%
(xiii)	Type of cooling.	" ONAN"
(xiv)	Temperature class of insulation.	Class A for all the windings.
(xv)	Current density for primary & secondary windings (max).	2.5 A/mm^2
(xvi)	Maximum permissible losses a) No load loss (at max. primary voltage of 27.5 kV)	i) 50 W for 5 kVA ii) 60 W for 10 kVA iii) 80 W for 25 kVA iv) 150 W for 50 kVA.
	b) Load loss at 75^0 C (at max. current at lowest primary voltage of 19 kV)	i) 200 W for 5 kVA ii) 300 W for 10 kVA iii) 500 W for 25 kVA iv) 950 W for 50 kVA.
xvii)	Minimum creepage distance	i) 900 mm for 36 kV class,

	of the porcelain housing.	ii) 90 mm for 3.6 kV class,
xviii)	Acoustic sound level when energized at rated voltage and at no load.	Not more than 75 db at a distance of 0.3 m from the transformer.
xiv)	Maximum permissible efficiency	At 50% of rated load.

6.0 SALIENT DESIGN FEATURE

6.1 General Construction

6.1.1 The dimensions of the5KVA, 10KVA, 25KVA and 50KVA auxiliary transformers shall not exceed those shown in drawing at Annexure 2. The AT shall be provided with two hot dip galvanised channels at the bottom of the steel enclosure in order to make it suitable for mounting on the mast and the disposition of primary bushing and secondary bushings shall be as shown in the above drawing. The fixing hole distances and slot dimensions on the transformer base channels shall be strictly adhered to.

6.1.2 The overall dimensions of the AT shall be kept, as low as possible and in any case shall not exceed the values given below:

(i) Length x Width: 650 x 500 mm for 5 and 10 kVA (Also shall not exceed the values as per drawing at Annexure-3).
(ii) Length x Width: 825 x 700 mm for 25kVA (Also shall not exceed the values as per drawing at Annexure-3).
(iii) Length x Width: 1000 x 900 mm for 50kVA (Also shall not exceed the values as per drawing at Annexure-3).
(iv) Height of the top most point of the primary bushing (mm) - 1700.
(v) Height of the topmost point of any part including conservator tank should not exceed 1950 mm.

6.2 Transformer tank.

6.2.1 The tank for the auxiliary transformer shall be constructed from good commercial grade low carbon steel suitable for welding with a single tier construction so shaped as to reduce welding to the minimum while fabricating. The tank shall be adequately strengthened to permit hoisting of the transformer filled with oil by a crane or other means.

6.2.2 Welded joints shall be made using the latest welding techniques.

6.2.3 The tank shall be provided with lifting lugs suitable for lifting the transformer filled with oil. The lifting lugs shall be provided on the side- walls of the tank. Separate lifting arrangement for the tank cover and the core shall be provided.

6.2.4 The rubberised cork / nitrile gaskets or any other gaskets shall conform to IS: 4253 (Part II).

6.2.5 Silicagel breather shall be suitably clamped to the tank. Silicagl breather shall have flange type of connecting arrangement. The silicagel container shall be made of a seamless tough acrylic tube and so designed as to facilitate easy replacement and filling and removal of silicagel. The colour of silicagel shall visible to a person standing on the ground.

6.2.6 Auxiliary transformer shall be provided with the channel at the bottom of the tank in order to make it suitable for pole mounting as shown in the drawing at Annexure 3. The centre to centre fixing hole distance and slot dimensions on the base channel shall be rigidly complied with. Unidirectional rollers shall also be provided on the transformers base channel.

6.3 Core

6.3.1 The core shall be made of high permeability cold-rolled grain oriented/ non-ageing electrical silicon steel laminations conforming to IS : 3024. The flux density in any part of the core and yoke with the primary winding excited at the rated voltage and rated frequency shall not exceed 1.55 tesla.

6.3.2 The laminations used for stacking the core, shall be free from defects due to storage/ atmospheric effects. Both sides of the laminations shall be coated with suitable insulation capable of withstanding stress relief annealing. In assembling the core, air gaps shall be avoided.

6.3.3 The core shall be electrically connected to the tank to drain off any electro static potential that may have built up.

6.3.4 Yoke/core clamping bolts shall have adequate threaded length beyond the face of the nuts for tightening at a later stage, if need arises. Each of the core clamping bolts and the core clamping frame work shall be insulated from the core laminations and tested after completion of the core assembly to ensure that they withstand a voltage of 2 kV r.m.s. , with respect to core for a duration of 60 s.

6.4 Windings

6.4.1 Primary and secondary windings shall be of spiral/helical type and shall have class 'A' insulation. These shall be made of continuous electrolytic copper conductor.

6.4.2 Normally, no joint shall be used in the winding conductor. If a joint becomes inescapable, it shall be brazed with high silver alloy grade Ba, Cu, Ag6 conforming to IS: 2927 or electrically butt-welded.

6.4.3 The auxiliary transformer winding shall have the following insulation levels: -

S. No.		Primary	Secondary
a.	Rated voltage between winding and earth.	25 kV	240 V
b.	Rated short duration power frequency withstand voltage.	70 kV rms	3 kV rms
c.	Rated lightning impulse withstand voltage.	190 kV peak	-
d.	Induced over-voltage withstand	80 kV rms	-

6.4.6 As the AT is subjected to frequent short circuit currents while in normal operation, the winding shall be specially designed and suitably braced to withstand electro magnetic forces without any injury. Windings shall be so assembled as to be magnetically balanced with respect to each other to minimise mechanical stresses.

6.4.7 The winding assembly shall be thoroughly dried in vacuum, shrunk to final dimensions and impregnated under vacuum with insulating oil conforming to IS: 335.

6.4.8 All leads and connections shall be mechanically strong, adequately insulated, protected against mechanical injury and rigidly clamped to withstand dynamic stresses due to short circuits.

6.5 BUSHINGS AND TERMINAL ARRANGEMENT

6.5.1 The bushings shall comply with IS: 2099 and IS: 3347. The line terminal of the primary winding shall be brought out through a 36 kV class bushing for connection to the overhead equipment and the neutral terminal brought out through a 3.6 kV class bushing and connected to the tank externally by means of a suitable tin coated copper link. The steel enclosure of the AT shall be connected to earth during service.

6.5.2 The 3.6 kV bushing and connection of the link to the tank shall be covered by a sheet steel of not less than 2 mm thickness welded on to the tank and should have a captive bolted cover.

6.5.3 The porcelain housings of both bushing shall comply with the requirements laid down in IS : 5621 and shall be of a single piece construction i.e. there shall be no joint in the porcelain housing. The shed profile shall have a lip at the extremities, but free from ribs on the underside so as to avoid accumulation of dust and pollutants and to permit easy cleaning.

6.5.4 The design of the bushing shall be such that stresses due to expansion and contraction in any part of the bushing shall not lead to its deterioration.

6.5.5 The bushing shall be free from corona.

6.5.6 Primary and Secondary bushing shall be provided with identical tinned copper stems of 20 mm diameter for 36 kV class bushing and 12 mm diameter for 3.6 kV class bushing. The stem shall be threaded to metric size at suitable places as per IS: 1367.

6.5.7 The bushings shall withstand the following test voltages.

S. No.		Primary (Line end)	Secondary (Including neutral end of primary winding bushing.
a).	Highest voltage for equipment Um.	36 kV rms.	3.6 kV rms.
b).	Rated short duration wet power frequency withstand voltage.	70 kV r.m.s.	10 kV rms.
c).	Rated lightning impulse withstand voltage.	190 kV peak	40 kV peak
d.	Minimum creepage distance,	900 mm	90 mm

6.5.8 The adjustable arcing horns shall be provided on the primary bushing side. The horn gap setting shall be variable between 125 to 250 mm.

6.5.9 The secondary terminal box shall be suitable for following cable sizes for the different ATs:

S.No.	AT Type	Cable Size
1.	5 KVA	2x25 sq. mm Al. Cable
2.	10 KVA	2x70 sq. mm Al. Cable
3.	25 KVA	2x150 sq. mm Al. Cable
4.	50 KVA	2x300 sq. mm Al. Cable

6.5.10 The primary and secondary bushings and terminal connectors shall be procured form Research Designs and Standards Organisation's (RDSO) approved manufacturers only.

7.0 **INSULATING OIL**

7.1 The auxiliary transformers shall be supplied complete with insulating oil conforming to IS: 12463. The transformer shall be shipped with windings and core completely under oil. The insulating oil shall be procured from the manufacturers approved by RDSO. The successful tenderer/manufacturer shall submit test certificates as per IS: 12463 for oil.

7.2 The characteristics of insulating oil before energisation of the new AT and during its maintenance and supervision in service shall conform to the parameters stipulated in IS: 1866.

7.3 In case oil leakage from auxiliary transformers is found at the consignee after unloading, the AT manufacturer shall depute its representative for its attention and proper filling of insulating oil. The BDV of oil and IR value of the winding have to be checked and rectified by the manufacturer.

8.0 FASTENERS

8.1 All fasteners of 12 mm diameter and less, exposed to atmosphere shall be of stainless steel and those above 12 mm diameter shall preferably be of stainless steel or of mild steel hot dip galvanized. The material of the stainless steel fasteners shall conform to IS: 1570 (Pt. V) Grade 04, Cr 17 Ni 12 Mo 2.

9.0 PAINTING

9.1 All steel surfaces in contact with insulating oil shall be painted with heat resistant, oil insoluble insulating varnish.

9.2 All steel surfaces exposed to weather shall be properly descaled/grit blasted. The epoxy and polyurethane protective paints as per ISO/EN 12944 have to be provided for proper protection against corrosive and coastal environments and give life of approx. 12-15 years. The external surfaces of the AT shall be given first coat of epoxy zinc rich (having minimum 83% metallic zinc) primer (50 micron thickness), intermediate coat of epoxy chemical and corrosion resistant paint (100 micron thickness) and final coat of polyurethane paint (50 micron thickness). The total dry film thickness of the paints shall be minimum 200 micron. The shade of paint shall be gray as shade 631 of IS: 5.

10.0 SOURCES OF SUPPLY FOR WINDING WIRE, GASKETS AND 'O' RINGS.

10.1 The winding wire, gaskets and 'O' rings used in the manufacture of the AT shall be procured only from suppliers having BIS certification for the items.

10.2 The successful tenderer / manufacturer shall be required to furnish the following information in respect of winding wire, gaskets and 'O' rings.

(i) Source of supply.

(ii) Reference to standard specification to which the material conforms.

(iii) Reports of type tests carried out in terms of the relevant Indian Standard Specification.

11.0 RATING PLATE

11.1 The auxiliary transformer shall be provided with a rating plate (both in Hindi and English) of weather proof material, fitted in a visible position, showing the items indicated below: -

(i). Type of transformer.
(ii). Governing specification.
(iii). Manufacturer's name.
(iv). Manufacturer's serial number
(v). Year of manufacture.
(vi). Rated output.
(vii). Rated frequency.
(viii). Highest voltage for equipment.
(ix). Rated Voltage.
  a). Primary
  b). Secondary

x). Rated current.
  a). Primary
  b). Secondary

xi). Maximum temperature rise over an ambient of 50^0 c.
  a). of oil
  b). of winding.

xii). Total weight
xiii). Class of insulation.
xiv). Insulation levels.
xv). Connection diagram indicating the taps.

The letters/ figures on the plate shall be indelibly marked by etching, engraving or stamping.

12.0 FITTINGS AND ACCESSORIES

12.1 The following fittings and accessories shall be supplied with each AT:

i). Conservator with oil filling hole and cap.
ii). Drain hole with plug for conservator.
iii). Oil level indicator.
iv). Silicagel breather with oil seal.
v). Upper filter valve.
vi). Lower filter cum drain valve.
vii). Adjustable arcing horn of range 125-250 mm.
viii). Rating plate with connection diagram indicating the taps.

ix). Lifting lugs (for complete transformer).
x). Air release device.
xi). Thermometer pocket.
xii). Lifting luge (for cover, core & windings.)
xiii). Oil sampling valve (20 mm) with plug.
xiv). Two earthing terminals.
xv). Terminal connectors for both HV & LV terminals.
xvi). Off circuit tap changer with locking arrangement and tap position indicator.

13.0 **DRAWINGS.**

13.1 A format of the title sheet to be adopted by the successful tenderer/manufacturer for preparation of the drawings is attached at Annexure – 4.

13.2 The successful tenderer / manufacturer shall submit for approval the following detailed dimensioned drawings to the purchaser/Director General (Traction Installation), Research Design and Standards Orgenisation (DG (TI), RDSO), Lucknow as per Indian Railways standard in sizes of 210 mm x 297 mm or any integral multiples thereof:-

i) Outline general arrangement of the AT showing plan, front elevation, side elevation with all parts, fittings and accessories, electrical clearances, untanking details as well as salient guaranteed particulars indicated therein.

ii) Internal arrangement of the AT indicating primary and secondary bushing lead connections, core to core and core to tank earthing.

iii) Cross sectional view of the core and windings with material specifications.

iv) Details of ‘O’ rings and gaskets.

v) Details of oil level indicator.

vi) Bushing for primary side including cross sectional view, shed profile, arcing horns and salient electrical and mechanical characteristics.

vii) Bushing for secondary side including cross sectional view, shed profile, and salient electrical and mechanical characteristics.

viii) Terminal connectors for primary and secondary side bushing terminals.

ix) Rating plate both in English and Hindi with connection diagram indicating the taps.

x) Details of off circuit tap changer with locking arrangement.

xi) Details of silicagel breather.

xii) Any other Drawing considered necessary by the successful tenderer/manufacturer and/or purchaser/ (DGTI/RDSO), Lucknow.

13.3 The provisionally approved drawings shall be modified, if need be, as a result of changes necessitated during or as a result of type tests or as desired by the purchaser/FOR DIRECTOR GENERAL/TI-IV (TI), RDSO, Lucknow. The modification shall be first got approved by the purchaser/ FOR DIRECTOR GENERAL/TI-IV (TI), RDSO, Lucknow and then incorporating the drawing and each such modification shall be got signed by the authority concerned on the drawings. If there are no modifications at all the drawings shall be finally approved.

13.4 Six copies of approved drawings alongwith two sets of reproducible shall be sent to each consignee (s), as indicated in the purchase order, Besides two copies of drawings alongwtih one set of reproducible and on floppy along with hard copy(in Autocad 2000) after final approval of the drawings , shall be supplied to DIRECTOR GENERAL/TI (TI), RDSO, Lucknow (INDIA).

13.5 The successful tenderer/manufacturer shall also be required to supply at least six copies of the Instruction and Maintenance Manual for AT to each consignee and two copies to DG (TI), RDSO, Lucknow- 226 011.

14.0 TESTING OF TRANSFORMER

14.1 General

Once a purchase order is placed for supply of a auxiliary transformer the designs and drawings shall be furnished to the purchaser/DG (TI), RDSO, Lucknow as the case may be within the period stipulated in the order. Only after all the designs and drawings have been approved for prototype tests and a written advice given to that effect, shall the successful tenderer/manufacturer take up manufacture of the prototype of the transformer. It is to be clearly understood that any change or modification required by the above authorities to be done in the prototype shall be done expeditiously, not withstanding approval having already been given for the designs and drawings. Such change or modification shall be incorporated in the drawings as indicated in clause 13.0.

14.1.2 Prior to giving a call to the Purchaser/DG (TI), RDSO, Lucknow, for inspection and testing of the prototype, the successful tenderer/manufacturer shall submit a detailed test schedule consisting of schematic circuit diagrams for each of the tests and the number of days required to complete all the tests at one stretch. Once the schedule is approved, the tests shall invariably be done accordingly. However, during the process of type testing or even later, the purchaser reserves the right to conduct any additional test (s), besides those specified herein, on any equipment/item so as to test the equipment/item to his satisfaction or for gaining additional information and knowledge. In case any dispute or disagreement arises between the successful tenderer/ manufacturer and representative of the purchaser/ DG (TI), RDSO, Lucknow, during the process of testing as regards the procedure for type tests and/or the inspection and acceptability of the results of type tests, it shall be brought to the notice of the purchaser/DG (TI), RDSO, Lucknow, as the case may be, whose decision shall be final and binding. Only after the prototype transformer is completed and ready in each and every respect, shall the successful tenderer / manufacturer give the actual call for the inspection and testing with atleast 15 days notice for the purpose.

14.1.3 In the event of the tests not being carried through to completion at one stretch and if due to any reason attributable to the successful tenderer/ manufacturer and it is required for the representative of the Purchaser/DG (TI)/RDSO to go again or more number of times to the works of the successful tenderer/manufacturer or other place (s) for continuing and / or completing the tests on the prototype (s) of the equipment, the successful tenderer/ manufacturer shall reimburse to the purchaser/DG (TI) RDSO, Lucknow, the costs for the representative having to visit the works or other place (s) for the tests more than once. The costs as claimed by the purchaser/DG (TI), RDSO Lucknow, shall be paid through a demand draft to the concerned account officer of the purchaser/DG (TI), RDSO, Lucknow, as shall be advised to the successful tenderer/manufacturer.

14.1.4 The type tests shall be carried out in accordance with " Quality plan for Auxiliary Transformer prototype Testing" and with the relevant standards as modified by the specification where ever applicable, at the works of the successful tenderer /manufacturer or at a reputed testing laboratory in the presence of the authorised representative of the purchaser FOR DIRECTOR GENERAL/ TI, RDSO,Lucknow.

14.2 Tests during manufacture.

Following type tests shall be carried out on the prototype unit during manufacture:

a) Vacuum test
b) Pressure test.

14.2.1 **Vacuum Test**

The AT tank only shall be tested at a vacuum of 3.33 kN/m^2 (0.033 kg/cm^2) for 60 min. The permanent deflection of flat plates after release of vacuum shall not exceed the value indicated below.

Horizontal length of flat plate.	Permanent deflection mm.
Upto and including 750 mm	5.0
751 mm to 1250 mm	6.5
1251 mm to 1750 mm	8.0
1751 mm to 2000 mm	9.5

14.2.2 **Pressure test**

Every AT tank and conservator tank shall be subjected to an air pressure corresponding to twice the normal static level of oil or to the normal static level of oil pressure plus 35 kN/m^2 (0.35 kg/cm^2) whichever is lower, as measured at the base of the tank. The pressure shall remain constant for 1 h to indicate that there is no leakage from any point.

14.3 **Type Tests**

The following type tests shall be carried out on the prototype at the works of the successful tenderer/ manufacturer or at any reputed laboratory in the presence of the representative of the purchaser/DG (TI) RDSO, Lucknow, and in accordance, with the relevant specifications altered, amended or supplemented by this specification.

i). Temperature rise test.
ii). Lightning impulse withstand voltage test.
iii). Short circuit test.
iv). Type tests on accessories.

14.3.1 **Temperatures rise test.**

The temperature rise test shall be done in accordance with clause 4 of IS: 2026 (Part II).

The test shall be done continuously without any interruption due to power supply failure. In case interruptions of power supply do take place for some reason, then the entire test shall be repeated after steady state conditions are attained.

14.3.1.1 During the temperature rise test, the following shall be ensured:-

i) The ambient temperature shall be measured as per clause 4.1 of IS: 2026 (Part II). Only alcohol in glass thermometers shall be used for the measurement.

ii) The winding temperature shall be determined by the resistance method only.

iii) The temperature of the top oil shall be measured by an alcohol in glass thermometer placed in an oil filled thermometer pocket.

iv) The temperature of the hot-spot in the winding shall be the sum of the temperature of the top oil and 1.1 times the temperature rise of the winding above the average oil temperature.

14.3.1.2 The test shall be carried out as described below**:**

i) A quantum of power equal to the sum of the measured losses viz. no load and load losses at maximum current, achieved at lowest primary voltage of 19kV and at appropriate tap, corrected to 75^0 C plus 10% of such sum shall be fed to the primary winding of the transformer with the secondary winding short circuited.

ii) The losses so fed to the transformer shall be continuously maintained till such time as the steady state temperature is reached i.e. the top oil temperature rise does not vary by more than 1^0 C during four consecutive hourly readings.

iii) On attaining the steady state temperature, the current in the primary winding of the transformer shall be brought to the rated maximum current, achieved at lowest primary voltage of 19kV which shall be maintained for 1 hr. At the end of the period the power supply to the transformer shall be switched off and the time of switching off recorded.

iv) The measurement of hot resistance shall commence as soon, as is possible after switching off. The first reading of the resistance shall be taken before the expiry of 90s form the instant of switching off and the first 10 readings shall be taken at intervals of 15 s apart. Thereafter, another 10 readings shall be taken at intervals of 30 s apart.

v) The time at which each of the resistance values is read shall also be recorded.

vi) The temperature of the ambient, top oil, and radiator inlet/outlet

shall also be recorded at half hourly intervals throughout the test starting from the instant power supply is switched on to commence the test till it is switched off.

14.3.2 **Lightning impulse test.**

This test shall be done as per clause 12 of IS: 2026 (Part III). The test impulse shall be a full standard lightning impulse i.e. 1.2 ± 30% / 50 ± 20% μs. The voltage shall be applied to the line terminal of the primary winding with the neutral terminal of the winding earthed through a current measuring shunt. The tank and the terminals of the secondary winding shall be earthed. The oscillographs for voltage as well as neutral current shall be recorded. The AT shall withstand a lighting impulse of 190 kV peak.

14.3.3 **Short circuit test.**

The short circuit test shall be done in accordance with clause 16.11 of IS: 2026 (Part I).

14.3.4 **Type Tests on Accessories.**

The type tests on bushings, terminal connectors and other accessories shall be done as per the relevant specifications.

14.4 In addition to the above, all routine tests detailed in clause 14.7 below shall also be carried out on the prototype.

14.5 If the prototype of an AT conforming to this specification has already been approved in connection with previous supplies to Indian Railways, fresh testing of prototype of the auxiliary transformer may be waived at the discretion of the purchaser, provided that no changes whatsoever in the design or materials used have been made. However, the purchaser reserves the right to test an AT against any purchase order if he deems it necessary to do so in the light of experience gained from previous supplies.

14.6 Only after approval of original tracings of drawings incorporating changes, if any, as a result of the type tests and clear written approval of the results of the tests on the prototype is communicated by the Purchaser/Director General (TI), Research Designs and Standards Organisation to the successful tenderer/manufacturer, shall be take up bulk manufacture of the auxiliary transformer which shall be strictly with the same materials and process as adopted for the prototype. In no circumstances shall materials other than those approved in the design/drawings and /or during the prototype be used for bulk manufacture on the plea that they had been obtained prior to the approval of the prototype.

14.6.1 The prototype approval shall be accorded after conducting all the type tests (clause 14.3) and routine tests (clause 14.7) stipulated under this specification and in TIQ 0006 Rev. 1 (Quality Plan For Auxiliary Transformer Prototype Testing) .The validity of the prototype approval shall normally be for a period of two years.

14.7 **Routine Tests.**

Every AT shall be subjected to the routine tests in accordance with relevant parts of IS:2026 in the presence of the purchaser's representative.

i). Visual examination.
ii). Verification of terminal marking and polarity.
iii). Measurement of voltage ratio on all tap positions.
iv). Measurement of winding resistance.
v). Measurement of insulation resistance.
vi). Measurement of impedance voltage on principal tap, short circuit impedance and load loss.
vii). Measurement of no load loss and current.
viii). Induced over voltage withstand test for primary winding.
ix). Separated source power frequency withstands voltage test.

14.7.1 **Visual Examination**

A general examination shall be made to check that the AT conforms to the approved drawings, various item are accessible for maintenance, the quality of workmanship and finish are of acceptable standards and all parts, fittings and accessories are provided.

14.7.2 **Measurement of winding resistance**

The resistance of the winding shall be measured and computed at 75^0 C.

14.7.3 **Measurement of voltage ratio**

Voltage ratio of primary and secondary winding shall be measured on all tap positions.

14.7.4 **Verification of terminal markings and polarity**

The making of the Terminal and the polarity shall be verified.

14.7.5 **Insulation resistance**

The insulation resistance of each of the windings with respect to earth and with respect to each other shall be measured by using 2.5 kV megger.

14.7.6 **Measurements of impedance voltage, short circuit impedance and load losses**

Load losses shall be measured with rated maximum current, achieved at lowest primary voltage of 19kV at ambient temperature and computed at 75^0 C. The percentage impedance voltage at principal tap shall be measured with rated

maximum current, achieved at lowest primary voltage of 19kV at ambient temperature and computed at 75^0 C.

14.7.7 **Measurement of No-load loss and current.**

No load loss and current, referred to the primary winding shall be measured at maximum rated voltage of 27.5 KV.

14.7.8 **Induced over voltage withstand test.**

The secondary winding shall be fed at a convenient voltage and frequency, so as to obtain 80 kV between the primary terminals which shall be kept open circuited with one terminal earthed. Duration of the test at full test voltage shall be 60 s for any test frequency upto and including twice the rated frequency. When the test frequency exceeds twice the rated frequency, the duration of the test in second shall be:

$$\frac{120 \times \text{Rated Frequency}}{\text{Test Frequency}}$$

But not less than 15 s.

14.7.9 **Separate source power frequency withstand voltage test.**

This test shall be done as per clause 10 of IS:2026 (Part III). A voltage of 3000 V shall be applied between line terminal of the secondary winding, the other terminal of the primary winding, the core, the frame and the steel enclosure of the transformer, connected together and then to earth.

15.0 **INFORMATION TO BE GIVEN WITH THE TENDER.**

15.1 The tenderer shall furnish alongwith his offer, in the proforma at Annexure –1, the Schedule of Guaranteed performance and other particulars (SOGP, Part - I) for the AT. The particulars shall be correct and complete in all respects. The values/ information given in this SOGP, Part-I, will be used for technical evaluation of the tender.

15.2 Only the successful tenderer shall furnish the consolidated information as given in the proforma at Annexure-2, the schedule of Guaranteed Performance, Technical and Other Particulars (SOGP, Part - II) for the AT. This SOGP, Part-II will have to be approved by the indenting Railway / RDSO.

15.3 The tenderer shall specifically indicate in a “Statement of Compliance” attached with the offer his compliance with each and every clause of this specification. In case the tenderer wishes to deviate from any clause of this specification he may do so giving reference to the clause (s) with the reasons/justification for the deviation. This shall be in the form of a separate

statement called the "Statement of Deviation" if there in no deviation at all, a specific "NIL" "Statement of Deviation" shall be attached with the offer. If the " Statement of Compliance" and "Statement of Deviation" are not attached with the offer, it is not likely to be considered for the reason that it is an incomplete offer which can not be properly evaluated and compared with other offers, if any

15.4 The tenderer shall furnish the following drawings alongwith the offer:

i) Outline general arrangement drawings giving the overall dimensions of the AT.

ii) Rating and diagram plate.

iii) Internal arrangement of the transformer including cross sectional views.

15.5 The tenderer shall furnish the following documents as a part of the tender documents:

(i) Quality Assurance Plan for the tendered AT.
(ii) ISO certification regarding quality system and R&D facilities.
(iii) List of essential plants, machinery and testing facilities and should conform to the P&M as stipulated in RDSO's STR No. 019.
(iv) Up-dated calibration certificate for the testing equipment.
(v) Type test reports for the relevant rating for the tendered AT.

16.0 SPARES.

16.1 Wherever required the tenderer shall quote apart from main equipment, separately for recommended spares required for five years operation.

16.2 The tenderer shall also quote separately for the following essential spares.

i) 36 kV bushing.
ii) Primary terminal connector.

17.0 AFTER SALES SERVICE.

17.1 The successful tenderer shall make necessary arrangements for closely monitoring the performance of the auxiliary transformers through periodical (preferably once in two months during the warranty period) visits to the locations where they have been erected for observations and interaction with the operating and maintenance personnel of the Indian Railways. Arrangements shale also be made by the successful tenderer for emergency/standby spare parts being kept readily available to meet exigencies warranting replacement so as to keep the AT in service with least down time.

The successful tenderer/manufacturer shall respond promptly and in a workman like manner to any call given by Indian Railways for any assistance by way of attending to failures investigation into the cause of failures including tests, if any to be done and such other items with a view to seeing that the auxiliary transformer serves the purpose for which it is intended. Besides technical guidance to ensure proper operation and maintenance of the AT shall be constantly rendered.

18.0 WARRANTY

18.1 The successful tenderer/manufacturer shall warrant that all equipment shall be free from defects and faults in design, material, workmanship and manufacture and of the highest grade consistent with the established and generally accepted standards for the equipment of the type ordered and in full conformity with the specifications and shall operate properly.

18.2 This warranty shall survive inspection of, payment for and acceptance of the equipment but shall expire 24 (Twenty Four) months after the delivery at ultimate destination in India, or 18 (Eighteen) months from the date of commissioning and proving test of the equipment at ultimate destination in India, whichever period expires earlier, except in respect of complaints, defects and/or claims notified to the successful tenderer/manufacturer within 3 (Three) months of the expiry of such date. Any approval or acceptance by the purchaser of the equipment shall not in any way limit the successful tenderer/manufacturer's liability.

18.3 The successful tenderer /manufacturer's liability in respect of any complaint, defects and /or claims shall be limited to the furnishing and installation of replacement parts free of any charges or the repairs of defective parts only to the extent that such replacement or repairs are attributable to or arise from faulty workmanship or material or design in the manufactures of the goods, provided that the defects are brought to the notice of the successful tenderer /manufacturer within 3 (Three) months of their being first discovered during the warranty period of 3 (Three) months from the date of expiry of warranty period, or at the option of the purchaser, to the payment of the value, expenditure and damage as hereafter mentioned.

18.4 The successful tenderer/manufacturer shall, if required , replace or repair the equipment or such portion thereof as is rejected by the purchaser free of cost at the ultimate destination or at the option of the purchaser, successful tenderer/manufacturer shall pay to the purchaser value thereof at the contract price or in the absence of such price at a price decided by the purchaser and such other expenditure and damages as may arise by reason of the breach of the conditions herein specified.

18.5 All replacement and repairs that the purchaser shall call upon the successful tenderer/manufacturer to deliver or perform under this warranty shall be delivered and performed by the successful tenderer/manufacturer, promptly

and satisfactorily and in any case within 2 (Two) months of the date of advice to this effect.

18.6 If the successful tenderer/manufacturer so desires, the parts that are removed may be taken over by him or his representative in India for disposal as he deems fit at the time or replacement with good parts. No claim whatsoever shall lie on the purchaser thereafter for the parts so removed.

18.7 The warranty herein contained shall not apply to any material which shall have been repaired or altered by the purchaser or on his behalf in any way without the consent of the successful tenderer/manufacturer, so as to affect the strength, performance or reliability or to any defects to any part due to misuse, negligence or accident.

18.8 The decision of the purchaser in regard to successful tenderer/manufacturer's liability and the amount, if any, payable under this warranty shall be final and conclusive.

19.0 TRANSPORTATION OF THE AT

19.1 The transformer may be trans+

19.2 ported according to the transport facilities available for the route, viz. by rail , road or sea. All parts, fittings and accessories, which are liable to damage during transit shall be removed and packed/crated separately. Detached parts may be packed/ crated and sent with AT alongwith the check list, so that all the parts are available at the destination with the unit. The packing has to be done properly so that no damage occurs during transit.

19.2 The various components of each AT shall be securely packed in wooden crates and boxes. General packing list, together with weight and overall dimensions of packing cases shall be furnished for each AT indicating the following**:**

Crate No.	Description of item/component in the Crate.	Approx. gross weight in kg.	Approx. outside dimensional.

19.3 As far as possible, the gross weight of the crate/box shall be so kept that it can be conveniently handled by two persons.

19.4 In case of overseas supplies, packing shall be seaworthy.

19.5 Necessary instructions for handling and storage of all items shall be included alongwith the packing lists.

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ANNEXURE-1

FOR 25kV /240V, 5 kVA , 10 kVA, 25kVA & 50 kVA AUXILIARY TRANSFORMER.

SCHEDULE OF GUARANTEED PERFORMANCE, TECHNICAL AND OTHER PARTICULARS, SOGP- Part-I *(GURANTEED PARTICULARS ARE TO BE ESTABILISHED BY INSPECTION, ACTUAL TESTS/TEST REPORTS)* – Values / Information are to be furnished by each of the tenderers and this will be used for technical evaluation of the tenders.

S. No.	Description	Specified Value / Information				Value / Information to be furnished by the bidder.			
1.	Name of the manufacturer								
2.	Standard specification on which the performance data are based								
3.	Type designation	Single phase oil filled ONAN							
4.	Continuous rating for specified cooling, temperature rise and ambient temperature	i. 5 kVA ii. 10 kVA iii. 25 kVA iv. 50 kVA							
5.	Rated temperature rise under normal operating conditions over a maximum ambient of 50^{o}C.								
	(i) Of oil by thermometer (ii) Of winding by resistance	40 ^{o}C 50 ^{o}C							
6.	Rated primary voltage	25 kV (may vary from 19 kV to 27.5 kV)							
7.	Rated secondary voltage at all the tap positions on the primary / secondary windings.	240 V							
8.	Losses:	5 kVA	10 kVA	25 kVA	50 kVA				
	No Load Loss, watts	50	60	80	150				
	Load Loss at 75^{0}C, watts	200	300	500	950				
	Total Loss, watts	250	360	1300	1100				
9.	Impedance voltage at rated current for the principal tapping referred to the primary at 75 ^{o}C	5 %							
10.	Max. permissible efficieny is to be at	50% of the rated load							

ANNEXURE-1

S. No.	Description	Specified Value / Information				Value / Information to be furnished by the bidder.			
11.	Core								
	Type	CRGO							
	Max. Flux density in any part of the core and yoke at principal tap and winding excited with rated voltage/ frequency	1.55 Tesla							
12.	Max. Current density in any of the winding	2.5 A/mm^2							
13.	Class of the insulation	Class A							
14.	Insulation withstand strength of primary winding with 1.2/50 micro-second wave: i) Impulse full wave. ii) Impulse chopped wave	 190 kV (p) 190 kV (p)							
15.	Short duration power frequency withstand voltage	70 kV							
16.	Tap Changer:								
	Type	Off Circuit							
	No. of plus taps	One (+5%)							
	No. of minus taps	Two (-5%, -10%)							
17.	Bushings	Primary HV end	Primary earthed	Secondary side					
	Standard specification on which the performance data are based	BIS 2099 - 1973							
	Impulse withstand Voltage (Full wave), kV peak	190	40	40					
	one minute dry/wet power frequency withstand voltage, kV rms	70	10	10					
	Minimum creepage distance, mm	900	90	90					
18.	Dimensions of assembled transformer								
	Type of AT	5 kVA	10 kVA	25 kVA	50 kVA				
	Base to topmost point, mm	1950	1950	1950	1950				
	Overall breadth, mm	500	500	700	900				
	Overall length, mm	650	650	850	1000				

Values / Information are to be furnished by each of the tenderers and this will be used for technical evaluation of the tenders.

Annexure-2

SCHEDULE OF GUARANTEED PERFORMANCE,TECHNICAL AND OTHER PARTICULARS, SOGP- PART - II *(GURANTEED PARTICULARS ARE TO BE ESTABILISHED BY INSPECTION, ACTUAL TESTS/TEST REPORTS)* FOR 25kV /240V, 5 kVA , 10 kVA, 25kVA & 50 kVA AUXILIARY TRANSFORMER.

S.No.	DESCRIPTION	UNIT OF MEASUREMENT	5 kVA	10 kVA	25kVA	50kVA
1.	Name of the manufacturer					
2.	Country of origin					
3.	Reference to specification based on which performance data is prescribed.					
4.	Normal rated power	KVA				
5.	Rated primary winding voltage	kV				
6.	Primary Voltage Variation Range	kV				
7.	Rated secondary winding Voltage at all the tap positions.	V				
8.	Rated frequency.	Hz				
9.	Temperature rise over a maximum ambient temperature of 50^0 C.					
	i) Of oil (by thermometer)	^{0}C.				
	ii) Of winding (by resistance)	^{0}C.				
10.	**Losses.**					
	a) No load loss at max. rated Primary Voltage on principal tapping and at rated frequency.	W				
	b) Load loss at max. rated current achieved at min. primary voltage of 19 kV and at principal tapping at 75^0C.	W				
	c) Total loss at rated voltage at principal tapping and at rated frequency.	W				
11.	Impedance voltage at rated current for the principal tapping referred to primary at 75^0C.	%				
12.	Reactance voltage at rated current and rated frequency referred to primary at 75^0 C.	%				

Values / Information are to be furnished by only the successful tenderer for the approval of the designs.

S.No.	DESCRIPTION	UNIT OF MEASURE MENT	5 kVA	10 kVA	25kVA	50kVA
13.	No load current at rated voltage and rated frequency referred to primary.	A				
14.	a) Full wave lightning impulse withstand voltage for winding.	kV peak.				
	b) Separate source short duration power frequency voltage withstand: i) Neutral terminal of primary winding. ii) Secondary winding.	 kV rms. kV rms				
	c). Induced over voltage withstand of primary winding.	kV rms.				
15.	Efficiency at unity and 0.8 power factor (At 75^0 C.) a). 100% load b). 75% load c). 50% load	 % % %				
16.	Regulation at full load at 75^0 C. a) At unity power factor b). At 0.8 power factor lagging.	 % %				
17.	**Core particulars** a) Type of core. b) Flux density at rated voltage and 50 Hz. (max.) c). Thickness of steel laminations. d). Insulation between corelamination (material) e).Type of joint between core limbs and yokes. f). Whether CRGO steel stamping used.	 T mm				

Values / Information are to be furnished by only the successful tenderer for the approval of the designs.

S.No.	DESCRIPTION	UNIT OF MEASURE MENT	5 kVA	10 kVA	25kVA	50kVA
	g). Conforming to IS specification No. h) Core bolt insulation flash over voltage (1 minute).					
18.	**Winding particulars:** a).Type of winding. i) Primary. ii) Secondary b).Current density in winding: i). Primary winding. ii). Secondary c). Size and No. of turns of: i).Primary winding wire. ii).Secondary winding wire d). Resistance of: i). Primary winding at 75^0 C. ii). Secondary winding at 75^0 C. e). Conforming to IS Specification No. f). Insulation on winding conductor. g).Type of joints in the winding, if any. h).Minimum flash over distance to earth between. i). Secondary winding and core ii). Primary winding and yoke.	 A/mm^2 A/mm^2 Ohm. Ohm. mm. mm.				
19.	**Tap changer:**					
	a). Type of tap changer.					
	b). No. of plus taps.					
	c). No. of minus taps.					

Values / Information are to be furnished by only the successful tenderer for the approval of the designs.

S.No.	DESCRIPTION	UNIT OF MEASURE MENT	5 kVA	10 kVA	25kVA	50kVA
20.	**Primary and Secondary bushings:**		**Primary**		**Secondary**	
	a).Name of the Manufacturers.					
	b). Manufacturer's type designation.					
	c). Standard specification on which the performance data are based:					
	d).Whether primary bushings metallised.					
	e). Rated voltage	kV				
	f). Rated current.	A				
	g). Power frequency withstand voltage: i). Wet ii). Dry	 kV rms kV rms				
	h) Dry lightning impulse Withstand voltage (1.2/50 us).	kVpeak.				
	i) Total creepage distance in air.	mm				
	j). Recommended horn gap setting	mm				
	k). Weight of assembled bushing.	kg.				
	l) Dia of the stem.	mm.				

Values / Information are to be furnished by only the successful tenderer for the approval of the designs.

S.No.	DESCRIPTION	UNIT OF MEASURE MENT	5 kVA	10 kVA	25kVA	50kVA
21.	Weight and dimensions. a). Net weight of core. b). Net weight of copper in i).Primary winding ii).Secondary winding. c) Net untanking weight of Core frame and coils. d) Total weight of complete Transformer. e). Insulating oil:- i). Net weight ii). Total volume	 kg. kg kg kg. kg. kg. l.				
22.	Overall dimensions of the assembled transformer: i). Height ii). Length iii). Breadth	 mm. mm. mm.				
23.	Untanking height.	mm.				
24.	Base mounting details.					
25.	Minimum thickness of Plate of sheet steel enclosure. i). Side ii). Top cover iii). Bottom	 mm mm mm				

Values / Information are to be furnished by only the successful tenderer for the approval of the designs.

S.No.	DESCRIPTION	UNIT OF MEASUREMENT	5 kVA	10 kVA	25kVA	50kVA
26.	Name of suppliers and conforming IS specification No. i). Terminal connector. ii). Insulating oil. iii). 'O' ring and gaskets. iv). Paints/varnish. v).Fasteners. a). Stainless steel b). M. S. hot dip galvanised. vi). Press boards. vii).Precompressed press. board. viii) Winding wire. ix). Core material.					
27.	**Other particulars.** i). Is the transformer fitted with lifting lugs ? ii). Is the core electrically connected with the tank ? iii). What is the number of joints numbers provided in the a).Primary winding b).Secondary winding. iv)Are windings preshrunk ?	Yes/No Yes/No Yes/No				

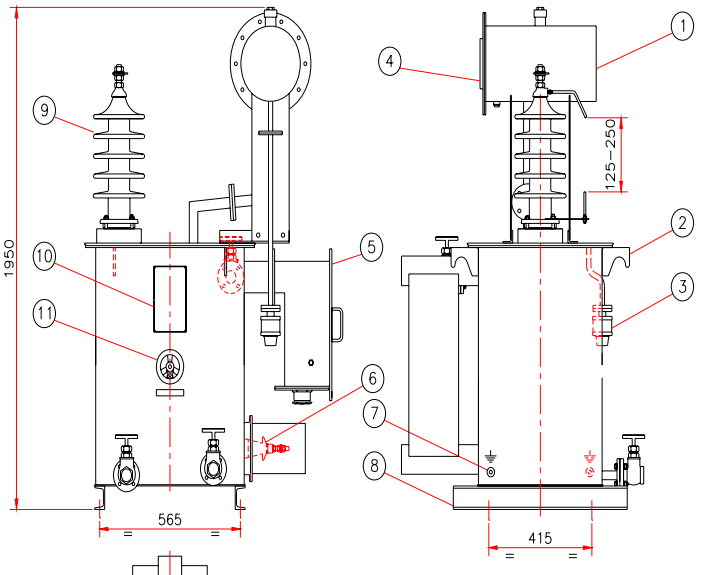
Values / Information are to be furnished by only the successful tenderer for the approval of the designs.

S.No.	DESCRIPTION	UNIT OF MEASURE MENT	5 kVA	10 kVA	25kVA	50kVA
	v). Are arcing horns provided for primary bushing?	Yes/No				
	vi). Are the porcelain housing of bushings of single piece construction ?	Yes/No				
	vii).Is the shed profile of porcelain housing of the bushing free from under ribs, but has a lip ?	Yes/No				
	viii).Is clause by clause statement of compliance attached?	Yes/No				
	ix). Are fasteners of 12 mm dia-meter and less exposed to atmosphere of stainless steel to grade 0 4 Cr. 17 Ni 12 MO 2 to IS: 1570 (Part II)?	Yes/No				
	x). Are the fasteners of more than 12 mm diameter exposed to atmosphere stainless steel or MS hot dip galvanised ?	Stainless steel / Hot dip galvanized.				
	xi). Are all the drawings required as per clause 15.4 attached ?	Yes/No				
	xii). Is warranty as per clause 18.0 ?	Yes/No				
	xiii). Is the list of spares furnished or not?	Yes/No				

Values / Information are to be furnished by only the successful tenderer for the approval of the designs.

Annexure-3

INDIAN RAILWAYS	RESEARCH DESIGNS AND STANDARDS ORGANISATION



RATING	X	Y
5 KVA	650	500
10 KVA	650	500
25 KVA	825	700
50 KVA	1000	900

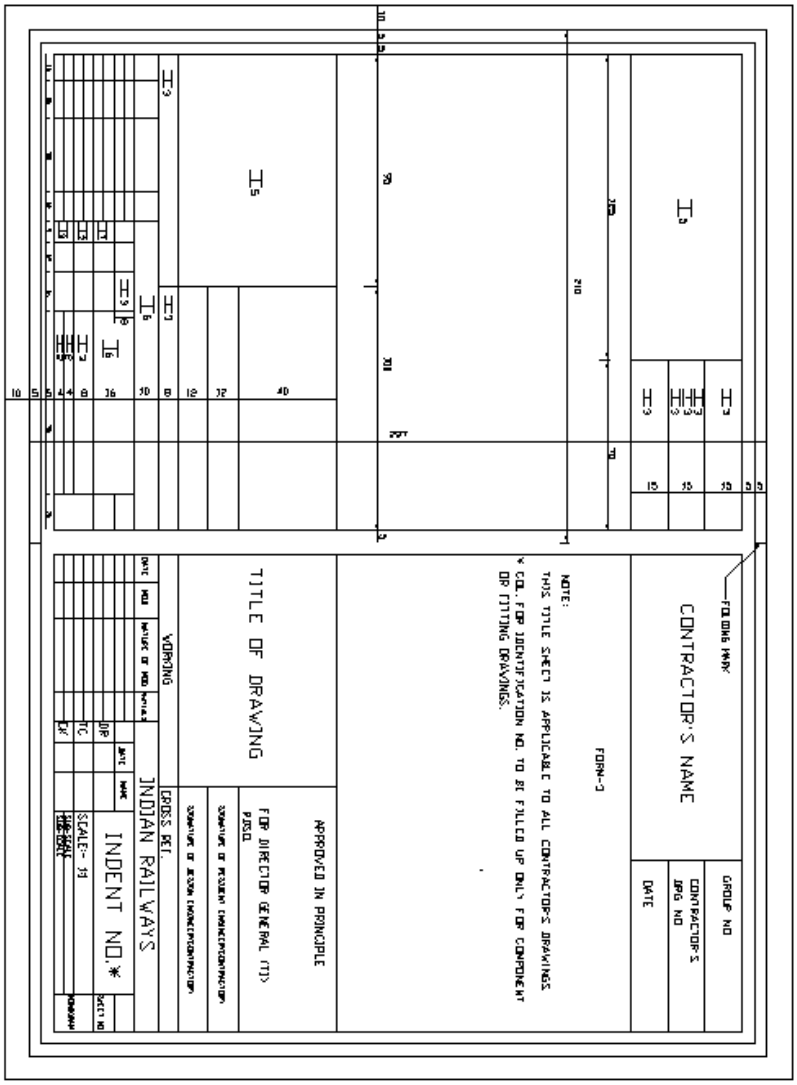
LIST OF FITTING

IT.NO.	DESCRIPTION	QTY.
1	OIL CONSERVATOR	1 NO.
2	LIFTING LUG	2 NOS.
3	SILICAGEL BREATHER	1 NO.
4	OIL LEVEL INDICATOR	1 NO.
5	SECONDDARY BUSHING, 3.6 KV CABLE BOX	1 NO.
6	3.6 KV BUSHING FOR EARTH END CONNECTION	1 NO.
7	EARTHING PAD	2 NOS.
8	UNDER BASE CHANNEL	2 NOS.
9	PRIMARY BUSHING, 36 KV	1 NO.
10	RATING & DIAGRAM PLATE	2 NOS.
11	OFF CIRCUIT TAP CHANGER	1 NO.

OUTLINE DIMENSIONAL DRAWING FOR

5 KVA, 10 KVA, 25 KVA & 50 KVA AUXILIARY TRANSFORMER

ANNEXURE-4


CONTRACTOR'S NAME
FORM-D
TITLE OF DRAWING
INDIAN RAILWAYS
INDENT NO.*