

TENDER SPECIFICATION

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|--------|--|--|--|--|--|--|
| ALT | | | | | | |
| SHEETS | | | | | | |

ENCLOSERS:

1. DRG. NOS.:- CLW/ES/3/SK-1 to SK-5 /0456

TOTAL NO. OF SHEETS:- 17

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| ALT | | | | | | |
| SHEETS | | | | | | |

**SPECIFICATION
for
MAIN TRANSFORMER with Steel Tank for WAG-9H
Locomotive**

ISSUED BY:

DY.CHIEF ELECTRICAL ENGINEER D-I
CHITTARANJAN LOCOMOTIVE WORKS
P.O. CHITTARANJAN, 713331
DIST. BURDWAN, WEST BENGAL, (INDIA)

| | | | | | | | |
|---|-------------|-----------|---|--|--|--|--|
| SPECIFICATION FOR MAIN TRANSFORMER WITH STEEL TANK FOR WAG-9H LOCOMOTIVE | DRN | CHKD/REV. | CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA | | | | |
| | APPROVED BY | | Date: SPEC.NO.- CLW/ES/3/xxxx | | | | |
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ALTERATION RECORD SHEET

| AMENDMENT NO. | DATE OF AMENDMENT | PAGE NO | ALTERATION NO. | REASON | AUTHORITY |
|---------------|-------------------|---------|----------------|--------|-----------|
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DRAFT

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1. **SCOPE :**

This specification applies to MAIN TRANSFORMER for 3-phase, 6000 HP WAG-9H class locomotive for 25 KV AC 50Hz system.

2. **Climatic and Environment Conditions:**

| | | |
|----|----------------------------------|---|
| 1. | Maximum atmospheric Temp | |
| | Under sun | 70°C |
| | In shade | 50°C |
| 2. | Humidity | 100% saturation during rainy season |
| 3. | Reference site conditions | |
| | (i) Ambient temperature | max 55°C min 0°C |
| | (ii) Humidity | 60% |
| | (iii) Altitude | 160m above main sea level |
| | (iv) Rain fall | Very heavy in certain areas. (The locomotive will be designed to permit its running at 10 kmph in flood water level of 102 mm above rail level.) |
| 4. | Atmosphere during hot weather | Extremely dusty and desert terrain in certain areas |
| 5. | Coastal area | locomotive and equipment will be designed to work in coastal areas in humid and salt laden atmosphere. |
| 6. | Vibration & Shock | The equipment, sub-system and their mounting arrangements will be designed to withstand vibrations and shocks encountered in services as specified in corresponding IEC publications unless otherwise prescribed. |

3. **DESCRIPTION**

3.1 **SUBJECT**

SHORT DESCRIPTION

Transformer for supply of the bogie related traction converters and the auxiliary converters from the centenary (25kV/50Hz). In order to connect a passive filter, the transformer includes an additional filter winding.

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NUMBER OF ITEMS (within transformer)

Each loco requires one transformer, which consists of following components:

- 1 Transformer
- 4 Traction winding
- 1 Primary winding
- 1 BUR winding
- 1 Filter winding
- Series resonance choke unit(2 chokes)
- BUR choke unit (3 double chokes)
- Transformer oil

3.2 FUNCTION/PRINCIPLE

The transformer tank contains main transformer, the series resonant & auxiliary converter chokes. External cooling of oil is designed with two independent oil circuits. Note, that there is no separation wall in the tank. The cooling units are located within the Machine Room.

4. TECHNICAL DATA

4.1: GENERAL DESIGN

ASSEMBLY

The transformer tank should be suspended horizontally at the middle of the under frame (under floor transformer). The HV – supply connected through a HV- cable with an Elastimold Plug.

COOLING

| | |
|---------------------------------------|---|
| Type | Forced Oil Cooling with Two Circuit |
| Oil Flow Rate (Nominal) | 2x1000 Lt./Min |
| Pressure Drop, Transformer Tank (Max) | 1000 mbar at 1000 Lt./Min |
| Pump Type | Plumettaz TA08-2174/15 or equivalent |
| Oil Temperature, Tank Drainage (Max) | 80 °C at P _{vert max} = 240 kW |
| Oil Temperature, Tank Drainage (Max) | 84 °C |
| Oil Temperature Rise (Max) | 4 K at 1000 Lt./Min |

Maximum temperature of the winding and oil according to standard IEC 310 minus 20°C

| | | | | | | | | | | |
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COOLANT

| | |
|------------|-------------------|
| Coolant | Mineral Oil |
| Make | RDSO/CLW approved |
| Standard | IEC 60296 |
| Oil Weight | 1850 kg. |

FIXED ELECTRICAL CONNECTIONS

- Preferably pressed –on
- Not soldered (brazed)

SHOCK AND VIBRATIONAL STRESS

Suitable for railway stock, according to latest version of IEC 61373

INFLAMMABILITY AND TOXICITY OF THE MATERIALS

- NO PCB
 - Non Toxic
- Avoid any flammable prone materials.

4.2 TRANSFORMER UNIT

Assembly : Dimension according to HSTN003359P0001
 Estimated total weight oil : 9500kg ± 3%
 Included

Transformer tank

| | |
|---------------------------|------------------------------------|
| Material Transformer Tank | Steel (Grade S355) as per EN 10025 |
| Cover Transformer Tank | Bolt-on, oil proof |
| Shock Resistance | As per IEC 61373 |
| Color | RAL-7009 |
| Finish | Silky |

Electrical Connections: Connection for winding and chokes according to outline drawing HSTN003359P0001

ADDITIONAL APPARATUS OF THE TRANSFORMER

| | | | | | | | |
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- Overflow valve (in case of over pressure the tank must not be damaged and overflowing oil shall be drained off the transformer cover)
- Oil drain tap, oil level screw
- Slide for oil drainage and intake
- Transformer tank fastening
- **2 Expansion tanks, RAL 7030**
- Earthing

Additional Apparatus of the Expansion tank

- Air dehumidifier including valve
- Oil level gauge
- Connection to the transformer including rapid action coupling
- Oil filler tap
- Oil drainage screw

4.3 : MAIN TRANSFORMER

Scheme position : 7
 Type : LOT 6500
 Required number : 1
 Indent. No. : HSTN205436
 Outline drawing : HSTN003359 P0001

APPLICATION:

| SUPPLY FROM | Number of windings |
|-----------------------------|--------------------|
| 2 traction converters (NSC) | 4 |
| 3 Auxiliary converter | 1 |
| 1 filter winding | 1 |

The traction converters (2 per loco) use GTO/IGBT- technology with a 2 point circuit and a link circuit. In order to reduce harmonic, the traction converters are phase shifted (nsc clock frequency : 250Hz, k=5). On the other hand, the auxiliary converters are controlled according to requirements and they are independent of each other.

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4.3.1 Catenary

| Catenary Supply | |
|-----------------|----------------------------------|
| Frequency | 50 ^{+3%} _{-3%} |
| Voltage | |
| Maximum | 30 kV |
| Minimum | 17.5 kV |

4.3.2 Power Data

Ratios:

U = U_{nom} : U_x Tolerance +0.5% (accordance to IEC 310)

| Secondary no load voltage calculated with U ₁ = 25 kV | | | | |
|--|----------------|----------------|---------|-------|
| Winding | No. of Winding | Des. | Voltage | Ratio |
| Traction Winding | 4 | U _T | 1269V | 19.7 |
| Auxiliary Winding | 1 | U _B | 1000V | 25 |
| Filter Winding | 1 | U _F | 1154V | 21.7 |

Thermal Design:

| Calculated at U _{lmin} = 22.5 kV | | | | |
|---|-------------|------------|-----------------------------------|-------------------------------------|
| Winding | Power (kVA) | Voltage(V) | Rated Current (A _{eff}) | Maximum Current (A _{eff}) |
| Primary | 5878 | 22500 | 261 | 261 |
| Traction per winding | 1304 | 1142 | 1142 | 1142 |
| Auxiliary winding | 301 | 900 | 333 | 333 |
| Filter winding | 361 | 1039 | 347 | 347 |

Inrush current

Maximum inrush peak load: I_{peak} (25KV) = 1400 A (line impedance not taken into account)

Peak load 35 periods after : I_{peak} (25 KV) = 400 A

Rated Power

At U_{nom} (25 KV) and I_{nom} (261A) : 6531 kVA

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Power Loss

At U_{1def} (22.5kV): 195 KW + 15%

Magnetizing current:

| | |
|----------------------|-------|
| At | |
| U_{1nom} (25 KV) | 0.7 A |
| U_{1min} (22.5 KV) | 0.5 A |
| U_{1max} (27.5 KV) | 1.3 A |
| U_{1max} (17.5 KV) | 0.3 A |
| U_{1max} (30 KV) | 3.5 A |

Winding data:

- Values, secondary side related
- Values, measured on the terminal
- Values, at an operational temperature $T_{cu} = 75C$

| Winding | Resistance | | Inductance | |
|------------------------|------------|---------------|------------|---------------|
| | Value (MΩ) | Tolerance (%) | Value (mH) | Tolerance (%) |
| Primary Winding | | | | |
| Traction Winding | 37 | | 2.1 | +15% |
| Auxiliary Winding (HB) | 60 | | 0.43 | |
| Filter winding | 19 | | 0.29 | |

With the exception of the traction inductance, the above given values are for information only
All winding should be inductance decoupled as far as possible.

Measures against eventual over voltage transformer (e.g. system resonance)

- Appropriate arrangement of the winding
- No capacitive screening

Preventive measures against blow-outs (e.g. Contamination of the coil circuit with metallic particles).

- Insulated bus bar within the transformer.

Short circuit Resistance : According to IEC 310, edition 1991

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4.4 ARRANGEMENT OF THE WINDING, TERMINAL DESIGN



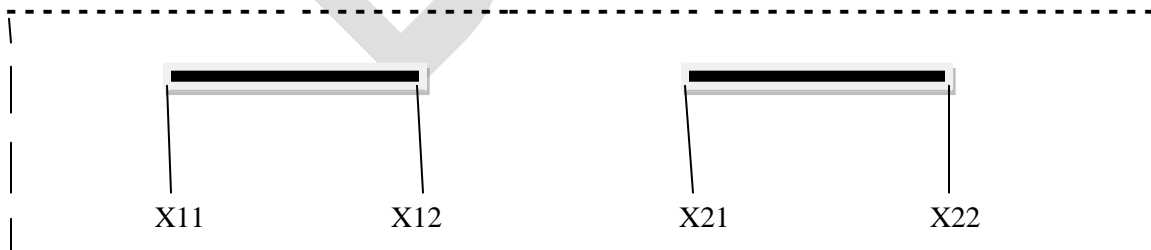
4.5.1 Series Resonant Inductor Unit :

- Scheme position : 15.3
- Type : 2 SOD 240
- Required Number : 1

Electrical Data

Inductance : 2x0.551 mH ($\pm 15\%$) (until $I_{peak} = 1391\text{Amp}$)
 Thermal Current : 2x 984 A_{eff}
 Resonance frequency : 100HZ
 Voltage Stress
 Between terminals Max : 482 V AC (maximum)
 Against Earth Max : 3471 V
 Power Loss : 12.5 KW + 15%

4.5.2 TERMINAL ARRANGEMENT and DESIGNATION



| | | | | | | | |
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4.6.1 AUXILIARY CONVERTER CHOKE UNIT : (3 Double Choke)

- Scheme position : 51.3
- Type : 6 GOD 120

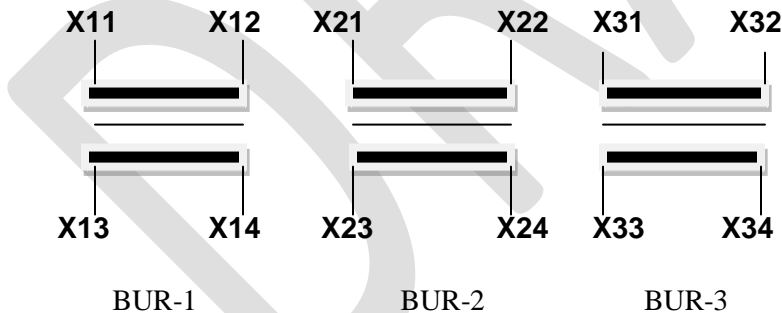
Inductance per BUR – Choke

- 0 A : 30mH
- 120 A : 30mH
- 155 A : 26mH
- 190 A : 20 mH
- Tolerance : - 0% + free
- Frequency : 100HZ
- Current Rated : 155 A
- Maximum : 190 A
- Ripple Nom : 38.6%
- Max : 50.2%

- Voltage Stress
- Rated : 1153 V AC (maximum)
- Against Earth Max : 200 V

Dissipation Power at I_{nom} : 12 KW + 15%

4.6.2 TERMINAL ARRANGEMENT and DESIGNATION



Each scope consists of a magnetic frame, which contains a part choke. Due to asymmetrical voltages all chokes shall be completely decoupled from each other.

5. STANDARDS/ QUALITY

5.1 Standards

| | | | | | | | |
|---|--------------------|------------------|---|--|--|--|--|
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| | | | Alt. | | | | |

| | |
|-------------|--|
| IEC 38 | : Standard voltage |
| IEC 77 | : Electrical traction devices |
| IEC 310 | : Rules for traction transformers and reactors |
| BS 148-1984 | : Transformer Oil |
| IEC 1133 | : Complete loco |
| IEC 61373 | : Shock and Vibration |

5.2 Quality

QS-qualification (according to quality management manual 3EHQ600002 Rev. C)

| | |
|-----------------------|--------------|
| Transformer complete | : Q-Klasse 3 |
| Main transformer | : Q-Klasse 3 |
| Series resonant choke | : Q-Klasse 3 |
| BUR-Choke | : Q-Klasse 4 |
| Transformer tank | : Q-Klasse 4 |

Execution : An ISO: 9001 similar QS system must be used at least.

6. List of checks and tests to be made on traction transformers

| SL.No. | Type test | Routine test |
|--------|--|--|
| 1 | Dimensions & preliminary check | Dimensions & preliminary check |
| 2 | IR values and oil test | IR values and oil test |
| 3 | Measurement of wiring resistance | Measurement of wiring resistance |
| 4 | Measurement of voltage ratio | Measurement of voltage ratio |
| 5 | Measurement of no-load current and no-load losses. | Measurement of no-load current and no-load losses. |
| 6 | Measurement of impedance voltage and load losses | Measurement of impedance voltage and load losses |
| 7 | Measurement of short circuit resistance | Measurement of short circuit resistance |
| 8 | Induced voltage withstand test | Induced voltage withstand test |
| 9 | Separate source voltage withstand test | Separate source voltage withstand test |
| 10 | Impulse test. | ----- |
| 11 | Temperature rise test. | ----- |
| 12 | Weighment test | ----- |
| 13 | Oil leakage test. | Oil leakage test. |

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Reactors : 2 SOD 240

| | | |
|---|--|--|
| 1 | Preliminary checks | Preliminary checks |
| 2 | Measurement of IR valves | Measurement of IR valves |
| 3 | Measurement of winding resistance | Measurement of winding resistance |
| 4 | Measurement of winding inductance and losses | Measurement of winding inductance and losses |
| 5 | Separate source voltage withstand test | Separate source voltage withstand test |
| 6 | Temperature rise test | ----- |

Reactors : 6 GOD 120

| | | |
|---|--|--|
| 1 | Preliminary checks | Preliminary checks |
| 2 | Measurement of IR valves | Measurement of IR valves |
| 3 | Measurement of winding resistance | Measurement of winding resistance |
| 4 | Measurement of winding inductance and losses | Measurement of winding inductance and losses |
| 5 | Separate source voltage withstand test | Separate source voltage withstand test |
| 6 | Temperature rise test | ----- |

7.2 (a) – Prototype and routine inspection will be carried out by the authorized representative of Indian Railways

7.2 (b) – All types test and routine test will be carried out as per the tender specifications.

8. DOCUMENTATION

8.1 – General

Project designation : Indian railways, WAG-9 locomotive

8.2 – QAP

8.3 - Test protocol

8.4 - Bill of material (sorted by indent no-)

8.5 - OGA Drawing (sorted by indent no-)

8.6 - Sub component Drawing (sorted by indent no-)

8.7 Drawings, traction and description

| | | | | | | | |
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All drawings and description which are necessary design, assembly and commissioning of the transformer. A part list/ composition list of each drawing has to be given. Within the individual lists- all parts of the corresponding drawing have to be mentioned, including consumable items.

8.8 Manual

The manual includes all necessary information for correct operation, maintenance, fault-finding and repair of the transformer, including spare part catalogue and instructions for assembly, dismantling and replacement of the individual components. An overview of function and work order has to be given. The chapters of the manual must belong to the individual sub-assembly components. All drawing and documents, which are used as reference documents, have to be given as annexure to the manual.

8.9 Language

All documents, including reference documents have to be given in English. For translation the document 3EHP620108 “index of English and German abbreviations and designations” has to be used. Other ideas and short forms may be used with approval by the responsible documentation department within the project of organization

8.10 STANDARDS/UNITS

Only IEC – standards will be accepted. Internally used BBC / ABB / Drantz – standards may only be mentioned together with correspondence IEC – standard. Only SI – units will be accepted.

8.11 NO. Of DOCUMENTS

8.11.1 Drawings, tracing and descriptions

- 6 sets of copies (According to 8.7)
- 1 set of reproducible (only drawings, sorted by indent No.)
- 1 set micro film (only drawings, sorted by indent No.)

8.11.2 Manuals

- 04 sets of copies (According to 8.8)

8.11.3 Type / Routine Test Documentation

| Documents | |
|--|--|
| Records, type and serial tests, Test programs, type and serial tests Documents according to chapter 1 | |

| | | | | | | | |
|---|--------------------|-----------|---|--|--|--|--|
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8.11.4 Quality Proof

| | |
|-----------|--|
| Documents | |
| HSGQ20061 | |

8.11.5 DELIVERY REQUIREMENT

- Acceptance : as per bid document
- Delivery : as per bid document
- Packing : as per bid document
- Delivery address : as per bid document
- Type test : as per tender specification
- Routine test : as per tender specification
- Purchasing specification : as per tender specification

8.11.6 REFERENCE DOCUMENTS

- Main power circuit CoCo : 3 EHP 281141
- Auxiliary scheme CoCo : 3 EHP 281142
- Cooling system CoCo : 3 EHP 510077

9. SCOPE OF SUPPLY

- Transformer : 1 No
- Series Resonant Choke : 2 Nos
- D.C. Link Circuit Choke Aux. Converter : 6 Nos
- High voltage Bushing mounted on a transformer : 1 set
- RTD – PT 100 mounted on transformer : 1 Nos
- Conservator tank with breather : 2 Nos
- Hose with nipple (3EHP431215R0001) : 2 Nos
- Connecting hose complete with nipple (3EHP431217R0001) : 1 No.s
- Connecting hose complete with nipple (3EHP431253R0001) : 2 No.s
- Quick coupling as per drawing no. – CLW/ES/3/SK-5/0456 : 6 sets (one set consists of one male and one female)
- Union as per drawing no.- CLW/ES/3/SK-5/0456 : 2 No.s
- Transformer Oil : **Shel diala DX or equivalent APAR oil confirming to IEC 296 class II**

The transformer and conserveter tank should be completely filled with oil. One barrel (209 liters) separately provided for filling in oil pipes and other accessories.

Supply should also conform to Drg. No. CLW/ES/3/SK-1/0456 to CLW/ES/3/SK-5/0456 .
Set of transformer fixing bolts and plates as per specn No: CLW/ES/3/0069 Alt C : 01 set.

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10. DOCUMENTS TO BE SUPPLIED BY THE TENDERER:

The tenderer shall furnish the following documents in 3 copies along with the quotation.

- I. Clause wise comments on the specification and test program.
- II. Detailed Dimensional Drawings
- III. Past experience with supporting papers (if any).
- IV. Quality Assurance program.
- V. Machinery and plant for such job.

11. TECHNICAL DOCUMENTS TO BE SUPPLIED BY THE SUPPLIER:

The following document should be supplied by the supplier as a part of the contract.

- i) Type test reports – 5 copies.
- ii) Routine test reports along with each set – 5 copies.
- iii) Maintenance manual – 1 copy per unit.
- iv) Detailed dimensional drawings – 6 copies.
- v) Supplier should submit drawings and technical source of sub supplier for approval before manufacturing of prototype sample.
- vi) Design Data Calculation and Drawing of Transformer submitted by the supplier during design approval

Design data:

- i) Make and type
- ii) Type of construction
- iii) Particular of winding with their continues rating
- iv) Permissible duty cycle
- v) Percentage impedance voltage of each winding with other winding opened no load magnetization current.
- vi) Transformer losses and efficiency
- vii) Permissible temperature rise
- viii) Details of insulation of winding
- ix) Dielectric levels
- x) Overall dimensions and weight of the transformer without cooling equipment, details of devices associated with the transformer.
- xi) Reliability predictions for transformer
- xii) Dimensional Drawings
- xiii) List of materials (General Bill of Materials) used in construction of the transformer general arrangement of transformer, windings

12. QUALITY ASSURANCE:

Quality assurance should be as per ISO 9000.

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13. REFERENCE

ABB identification No. – HSTE101119R0001
 Supplier / OEM – ABB secheron SA
 Geneva / Switzerland

Note:

1. The firm should emboss the following data in their products.
 - I. Make
 - II. Year and month of manufacturing
 - III. SI No.
 - IV. Trade mark, if any
 - V. Drg. No.
 - VI. Order No.
2. Standard fasteners of M/S TVS, M/S LPS, M/S Un-Brako and spring washers of M/S Forbes make only to be used.
3. Firm should provide min/max oil level scale in conservator tanks.

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|---|--------------------|------------------|---|--|--|--|--|
| SPECIFICATION FOR MAIN TRANSFORMER WITH STEEL TANK FOR WAG-9H LOCOMOTIVE | DRN | CHKD/REV. | CHITTARANJAN LOCOMOTIVE WORKS WEST BENGAL, INDIA | | | | |
| | APPROVED BY | | Date: | | | | |
| | Dy.CEE/D-1 | | SPEC.NO.- CLW/ES/3/xxxx | | | | |
| | | | Alt. | | | | |