

INSTRUCTION & MAINTENANCE MANUAL

PRODUCT : 72.5, 145 , 170 kV
LIVE TANK CURRENT TRANSFORMER



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PRODUCT : CURRENT TRANSFORMER

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1.0 CONSTRUCTION

1.1 Cross Sectional Drawing of A Typical Live Tank CT

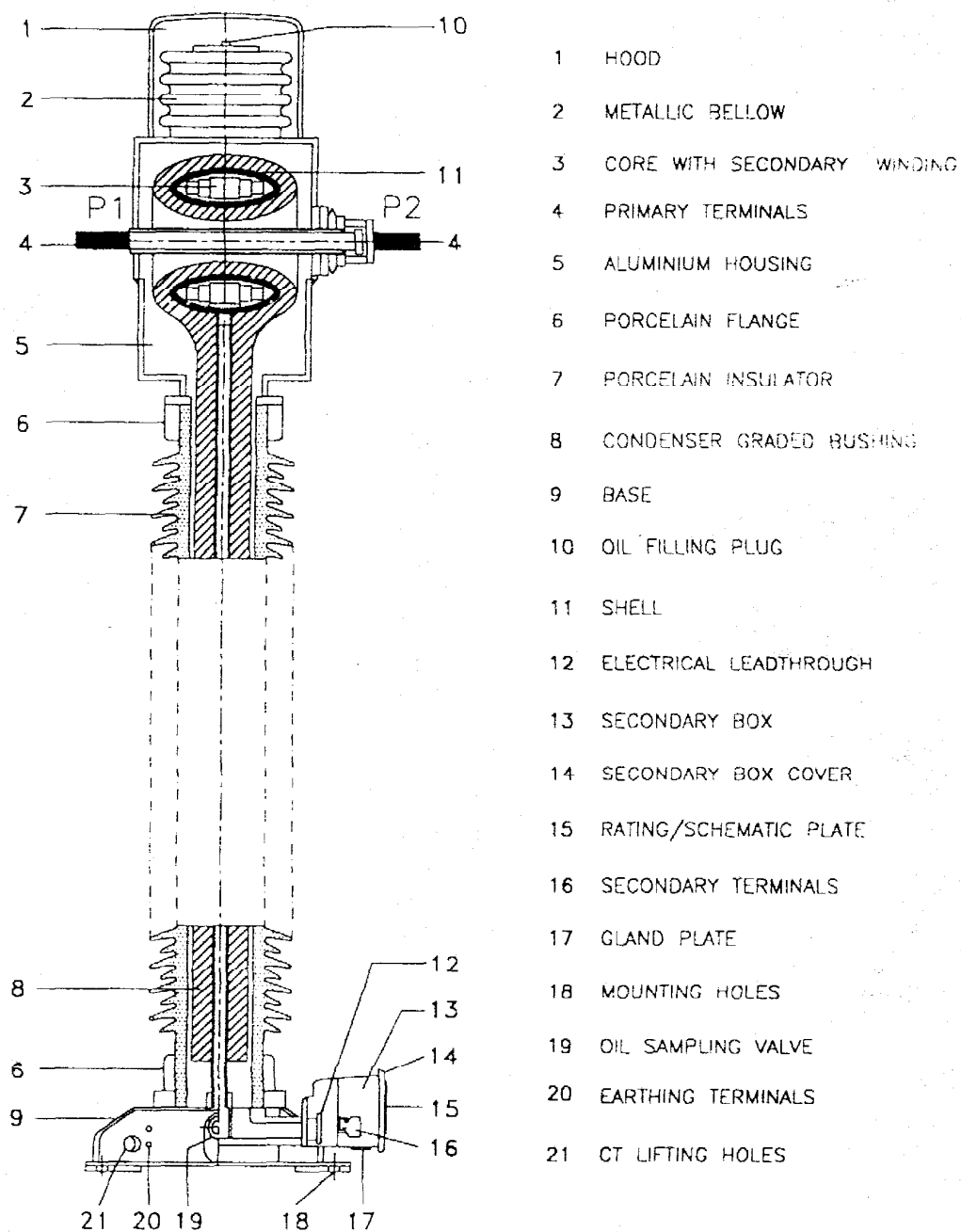


FIG.1

1.2 General Construction :

The cross sectional drawing given on Sheet no. 1 is a typical live tank CT.

- Primary Winding :

The primary winding is of rigid aluminium sections (i. e. Rod, Tube or flat) to withstand the mechanical stress due to electrical short circuit.

- Secondary Winding :

This is torroidal winding. The core (either of High quality Silicon steel or of Mu-Metal) is wound in a ring form. The secondary winding of enamelled copper wire is uniformly distributed over the circumference of the core. The uniform distribution minimises the reactance of the secondary winding and in turn helps the accurate transformation of primary current to secondary side. The relevant leads of the secondary winding are brought to terminal block through the Aluminium tube.

- Insulation :

Major insulation between primary and secondary winding and that between winding to earth is of high quality Insulation kraft paper. The complete assembled CT is dried and filled with specific quantity of oil under vacuum. The drying and oil filling is carried out in specially designed autoclaves. The insulation on the tube thru' which secondary leads are passed, is with condenser grading. This helps in achieving optimum and consistent impulse withstand capability.

- Porcelain Insulator :

Hollow porcelain insulator serves two purposes i. e. it insulates H. V. side from base and also it houses the insulated tube carrying secondary leads. Cast aluminium alloy flanges are cemented at both the ends of insulator; providing adequate mechanical strength.

- Hermetic Sealing :

The oil filled metallic Bellows compensates for the oil volume variation due to ambient changes. The CT is hermetically sealed by using these bellows. Due to this, the insulating characteristics of the dielectric will be maintained during the operation.

1.3 Terminal Details :

- **Primary Terminals :**

Normally the terminals are of types shown in fig. 2, 3, 4 & 5.

- **Secondary Terminals :**

These are available on the Terminal Block.

- **Earthing Terminals :**

These are available on CT Base.

Primary Terminals Type 1 (P1 - P2 Fixed)

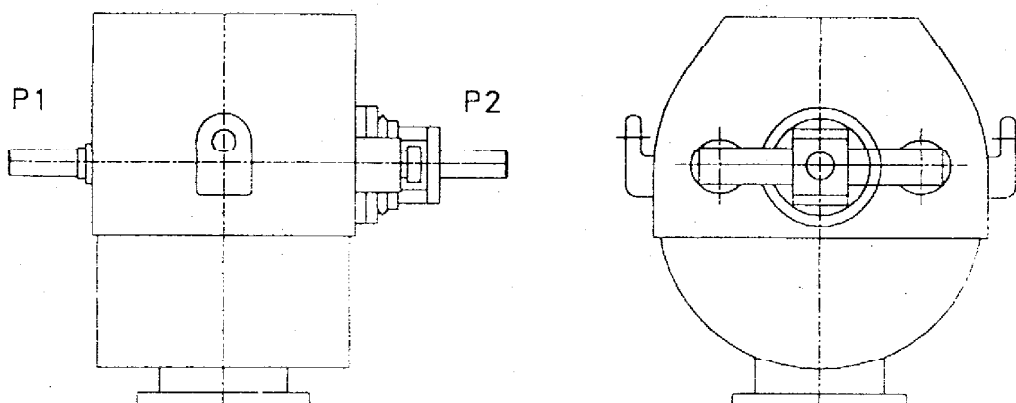


FIG.2

Primary Terminals Type-2.(P1 Fixed,P2 changeover 1:2T)

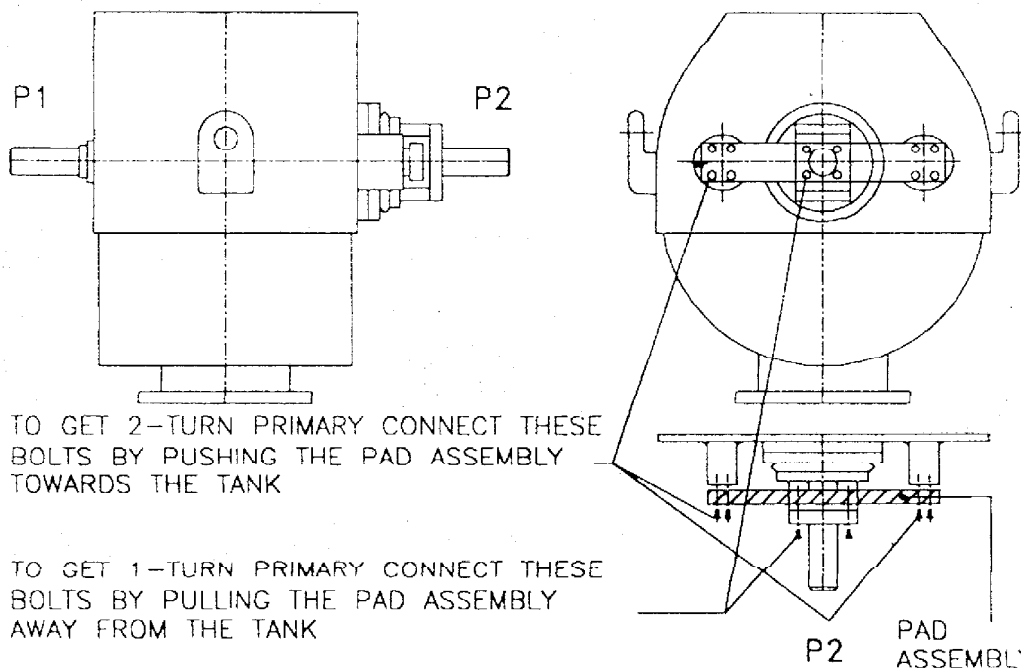


FIG.3

Primary Terminals Type 3 (P1 - P2 Changeover 1: 2 :4T)

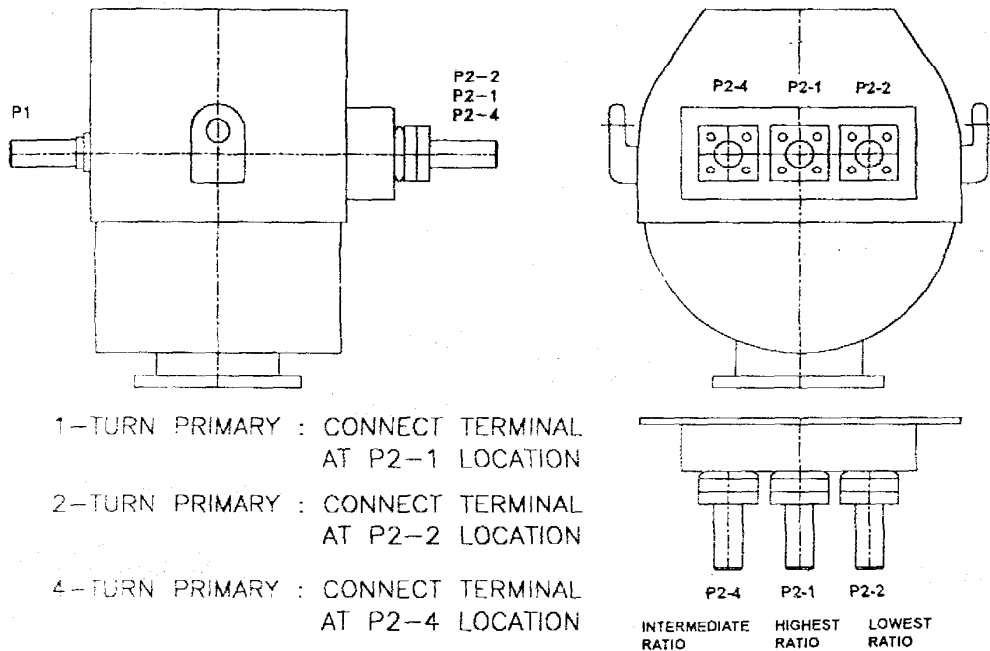


FIG.4

Primary Terminals Type-4.(P1 Fixed,P2 changeover 2:4T)

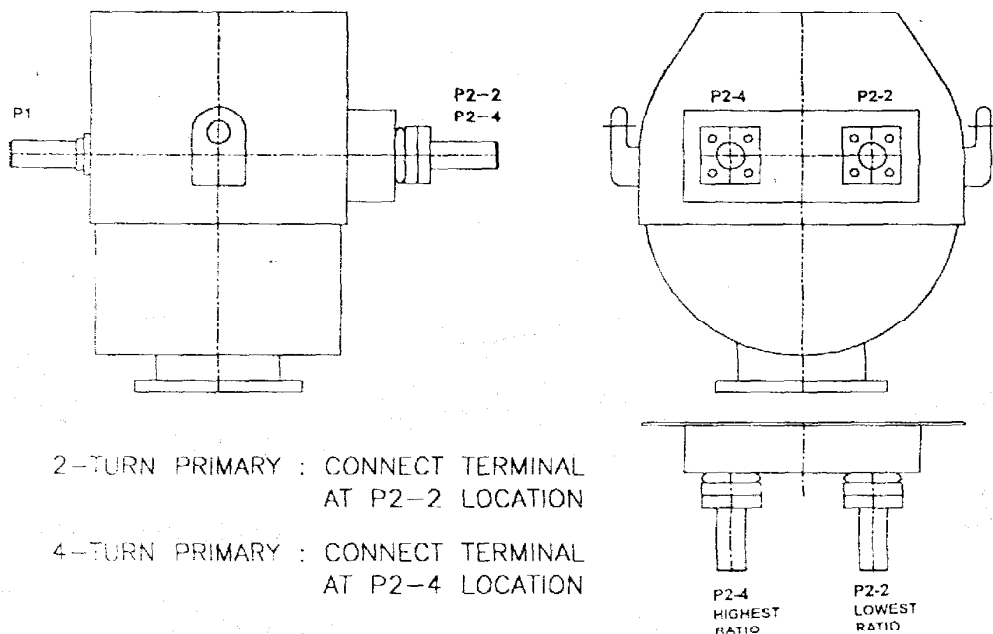


FIG.5

2.0 RECEIVE YOUR PRODUCT



2.1 Packing :

Unless otherwise agreed upon, the CTs are packed in wooden crates, with M. S. angle iron frame to hold the basic unit. Fig. No. 6 shows a typical packed CT. The packed CTs are transported in horizontal position.

2.2 Receiving the Goods & Visual Inspection :

- Please scrutinize the shipping documents with your Purchase Order and the markings on the packing case.
- Please carry visual check for any external damage.
- In case goods are insured by you, and any damage is noticed, please inform your insurance company and proceed further as per Standard practice.
- In case any damage is noticed and the insurance is by us please do
 - ◆ Inform CG on Fax/Telephone/E-mail as per the addresses given on the cover of this manual.
 - ◆ Take photographs of the damaged packing case and send the same to CG alongwith your F. I. R.
 - ◆ CG would take the necessary actions and would keep you informed.

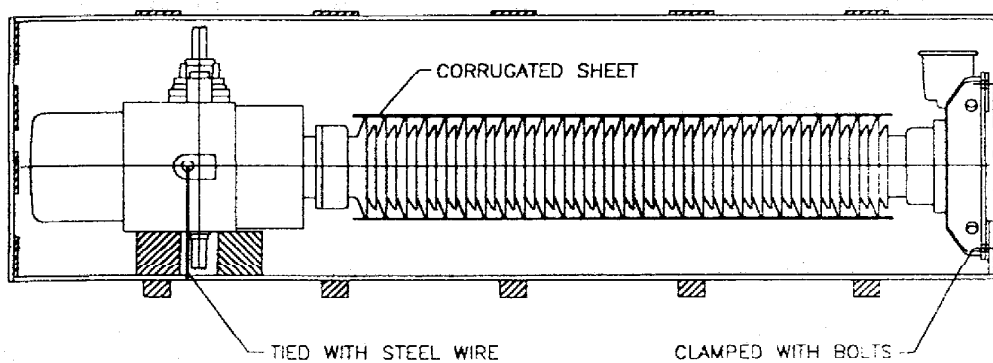


FIG. 6

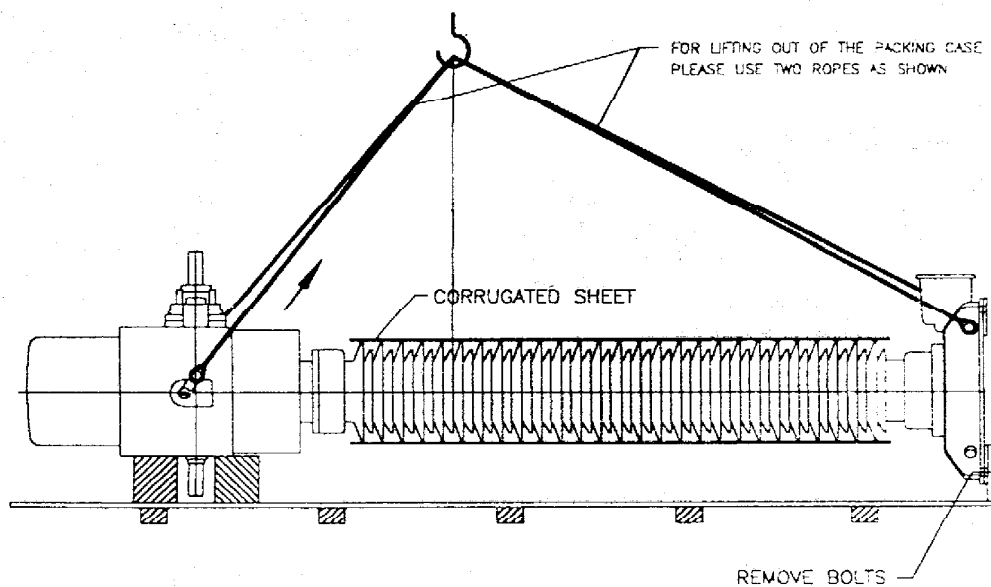


FIG. 7

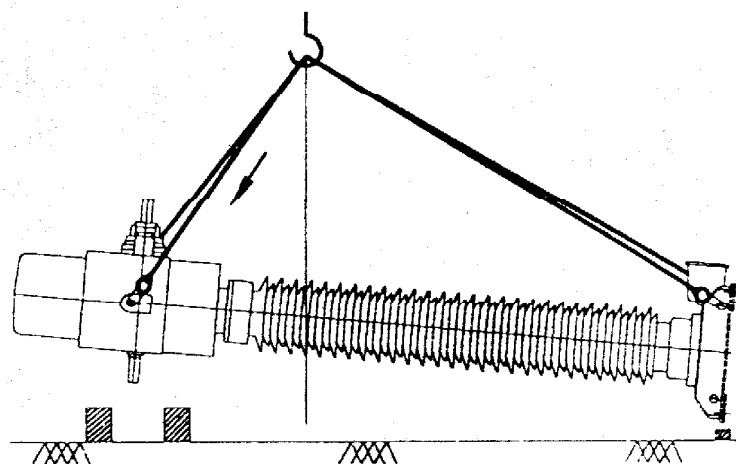


FIG. 8

3.0 ERECTION

3.1 Lifting & Keeping The CT in Position :

- Please refer to fig. 6 and follow the instructions given therein correctly.
- Open the packing case and unscrew all nuts and bolts used for clamping the CT in packing case.
- For lifting the CT from packing case and keeping it on platform use two ropes as shown in the fig. 7 & 8
- For erection i. e. keeping the CT in the final position use single rope as shown in the fig. 9, 10 & 11

3.2 Mounting of CT :

- Four mounting holes are provided to hold the CT firmly on the support structure at your site.

3.3 Electrical Connections :

- Earthing Connection
 - ◆ Use earthing terminals for earthing the mounting base.
 - ◆ Earthing systems should be capable to carry full short circuit current of the system.
 - ◆ Remove protective coating around the earthing holes to ensure firm contact.

- Secondary Connections

Use Secondary Terminal Blocks for connecting instruments relays etc.
Connections to be done as per rating & Schematic Plate.
Ensure that VA values given on the rating plate are adhered to.

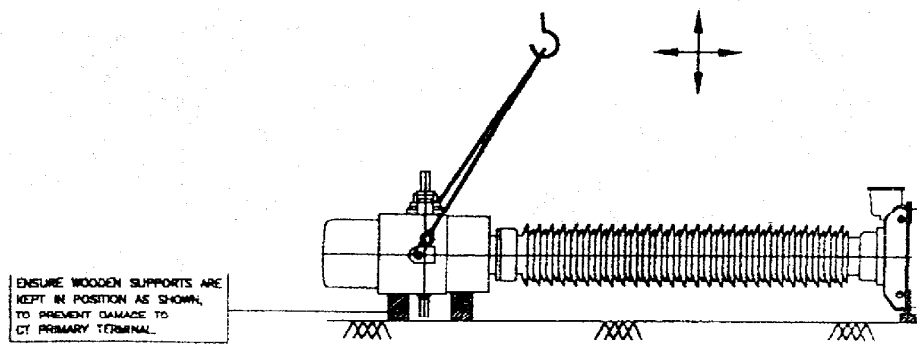


FIG.9

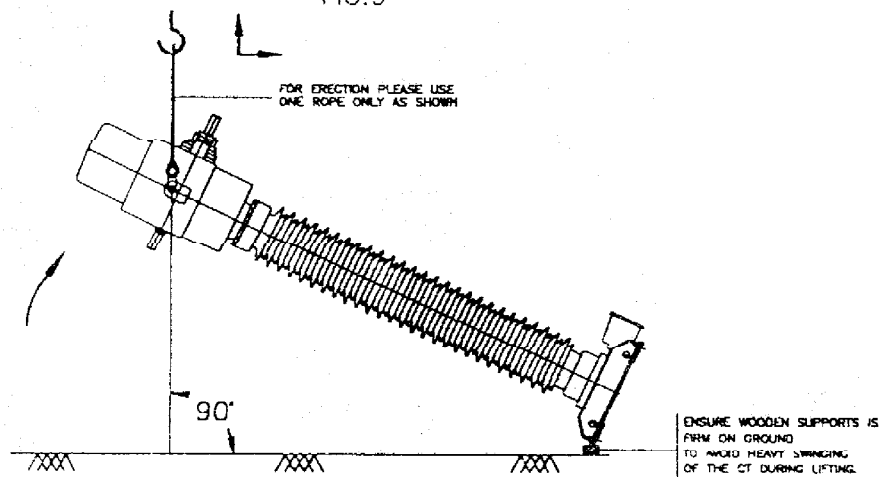


FIG.10

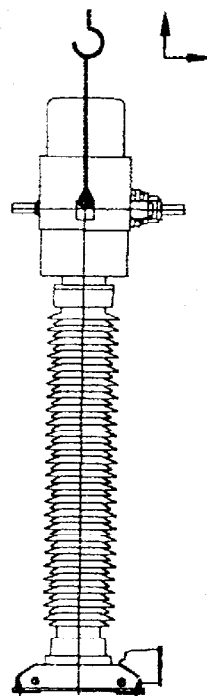


FIG.11

Caution :

"The CT secondary winding, if left open circuited, will lead to CT explosion; hence secondary windings not in use should be short circuited."

● Primary Connections :

Before starting with primary connections, please ensure that -

- The base is correctly mounted on the structure.
- Earthing is correctly done as stated above and
- Secondary connections are in position as explained earlier.

Now connect main H. V. line to primary terminals P1-P2 (Item 4 fig. 1) while doing H. V. connections please ensure -

- i) Pull on primary terminals does not exceed limits specified in relevant IEC standards.
- ii) In order to avoid contact corrosion do not connect aluminium terminals with Copper cables/tubes directly. Use weather resistant protective coating in transition region. (we recommend GTZ 8785 of Dowells.)
- iii) As screw/bolts shall be used with correct washers in order to ensure the clamping pressure.
- iv) The connections must be mechanically firm.
- v) The connections shall be checked and if required tightened during first few weeks of operations. Also the connections to be checked after exposure of the transformer to mechanical force resulting from a rope strike, storm or earthquake. Periodic plan for this shall be prepared.

4.0 COMMISSIONING

4.1 Pre - Commissioning checks :

Check the following points before charging the CT and tick-mark in column B after having completed the check.

Table No. 1 :

<u>Sr. No.</u>	<u>A</u>	<u>B</u>
1	Tightness of all Secondary connections.	<input type="checkbox"/>
2	Porcelain insulator is clean.	<input type="checkbox"/>
3	Base structure is firmly earthed.	<input type="checkbox"/>
4	Protective cover around the bellow is removed and the bellow is visible through the window on hood.	<input type="checkbox"/>
5	No secondary winding is open and "CX" lead is connected to earth inside terminal box. *	<input type="checkbox"/>
<p>* <u>Caution :</u></p> <p>In Case of tapped secondary winding [1S1, 1S2, 1S3, 1S4] if the instrumentation is connected to any of sections [say 1S1 & 1S2] the other sections [1S3, 1S4] of the same winding shall not be shorted.</p>		
6	Secondary winding which is not used, is shorted firmly by short links supplied alongwith CT.	<input type="checkbox"/>
7	The burden values of the connected instrumentation does not exceed the values specified on rating plate for particular core.	<input type="checkbox"/>

<u>Sr. No.</u>	<u>A</u>	<u>B</u>
8	Polarities of primary & secondary connections are as per schematic diagram on rating plate.	<input type="checkbox"/>
9	Desired ratio is correctly selected as per the schematic diagram on rating plate.	<input type="checkbox"/>
10	Bellow position of the CT is at the middle of minimum and maximum positions mark on the hood.	<input type="checkbox"/>
11	Secondary box cover is closed tightly.	<input type="checkbox"/>

4.2 Commissioning:

After completion of these pre-commissioning checks, CT can be charged at its operating voltage.

5.0 MAINTENANCE

5.1 Periodic Maintenance :

For periodic maintenance of CTs already installed & commissioned,
please carry out following checks at recommended time intervals.

TABLE NO. 1 :

When To Be Checked	G	After exposure of the CT to mechanical force resulting from rope strike, storm or earthquake.										
	F	After change of burdens & connections before reconnections.										
	E	After switching operations, over voltages, earth faults or after short circuits.										
	D	Every five years.										
	C	Annually.										
	B	Weekly routine checks.										
	A	Before commissioning the CT after transport.										
What To Be Checked	1	Earthing Base structure	•		•							
	2	Secondary Circuits Check if properly connected (no CT winding open)	•			•	•	•	•			
	3	Primary Terminals Check whether the connections are firm.	•		•			•	•	•		
	4	Transformation Ratio Check for rated value.	•									
	5	Secondary Current Check for rated value.	•		•			•				
	6	Metal Bellows Check for correct min; max positions. (refer Section 5.2 - table 2).	•	•				•			•	
	7	Oil Leakage Check for oil traces.	•		•			•			•	
	8	Terminal Box Check whether the secondary connections are firm.	•		•							
	9	Porcelain Insulator Check for cleanliness.	•		•							
	10	Metal Parts Check for corrosion	•		•							
	11	"Tan Delta" of CT Refer Section 5.3						•				
	12	Typical characteristics of Oil Sample Refer Section 5.4						•				
			A	B	C	D	E	F	G			

Tests 11 & 12 are recommended after 10 years of service & thereafter every five years.

5.2 Checking of "Oil Level" in Bellows :

"The level of oil in Bellow" as seen from outside happens to be very reliable indication of the health of CT.
Hence observe this level at the intervals stated in Table No. 1 and interpret the health as per Table No. 2

TABLE NO. 2

Sr. No	Bellow Position	Results & Measures to be taken
1	All CTs in the same substation have approximately same bellow position	CTs are OK
2	At approximately 20°C the bellow position is approximately halfway between min. & max. position.	CTs are OK.
3	Extremely different bellow position in one of the identical CTs in the same substation.	<ul style="list-style-type: none"> • Inform CGL immediately. • Observe CT continuously. It might become necessary to switch off the CT
4	Bellow at minimum position.	<ul style="list-style-type: none"> • Check the CT for leakage. • Inform CGL.
5	Bellow position is independent of the temperature.	<ul style="list-style-type: none"> • The CT is no longer hermetically sealed. • Bellow is jammed • Inform CGL.
6	Bellow exceeds the maximum permitted limit "MAX"	<ul style="list-style-type: none"> • Pressure in the CT due to gas generated by partial discharges or excessive temperature rise. • Disconnect CT immediately. • Inform CGL.

5.3 "Tan Delta" of CT :

This measurement is to be done on CT in position but disconnected electrically from the transmission line. The procedure for such measurement is as below.

5.3.1 Procedure

- ◆ Disconnect CT primary terminals from transmission line. Disconnect Cx terminal in secondary box from earth.
- ◆ Tan Delta measurement is to be conducted between primary terminal P1 and Cx terminal provided in secondary box.
- ◆ Use a separate power source which can develop between 2 kV to 20kV voltage.
- ◆ Use portable capacitance & tan delta test set.
- ◆ Do connections as recommended by the manufacturer of capacitance & tan delta test set.
- ◆ Measure capacitance & tan delta by applying a voltage more than 2 kV & less than 10 kV. (Tan delta measurements at a voltage below 2 kV are not accurate.)
- ◆ Disconnect CT from tan delta test set & source & reconnect primary in the transmission line & Cx must be earthed.
(Caution - During normal operations always ensure that Cx is firmly connected to earth.)

Notes :

- 1) Capacitance & tan delta measurements at site are most sensitive & can also be affected by the atmospheric conditions & electrical environment are carried out under dry atmospheric conditions.
- 2) We recommend the CT to be tested for tan delta before commissioning and the value obtained shall be considered as a reference value for further monitoring during service. Tan delta should be 0.005 before commissioning.

- 3) CT is to be tested for tan delta after 10 years. Limiting value of Tan delta is 0.010. In case tan delta exceeds this value, contact CGL factory.
- 4) CT is tested at factory for capacitance & tan delta under controlled conditions & to the test voltages specified in standards.

5.4 Dissolved Gas Analysis of Oil :

The oil sample from CT is to be collected at the frequency mentioned in Table No. 1.

The complete procedure for testing of samples is as below.

5.4.1 Taking out oil sample from CT :

- ◆ Oil sampling valve is provided on base structure.
- ◆ Break the sealing wire and remove the steel plug from oil sampling valve.
- ◆ Use oil sampling device to take out sample from CT.
(Approximately 250 cc of oil is required for this test in complete.)
- ◆ Ulmost cleanliness is essential when taking out oil sample as the test result can also be affected by atmospheric conditions & electrical environment at site.
- ◆ Replace the sampled oil quantity with a freshly filtered new oil of BDV higher than 60 kV. (The oil used in the CT is Napthene based uninhibited mineral oil, hence it is recommended to use oil of same quality.)

5.4.2 Dissolved Gas Analysis of Oil Sample :

We recommend DGA of oil sample done after every five years of service period. The limits to be used for analysis shall be as specified in "Reliability, Surveillance & Maintenance of High Voltage Insulations in Power Systems" State of Technique Report of Study Committee 15, published by CIGRE Study Committee 15 in 1991.



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