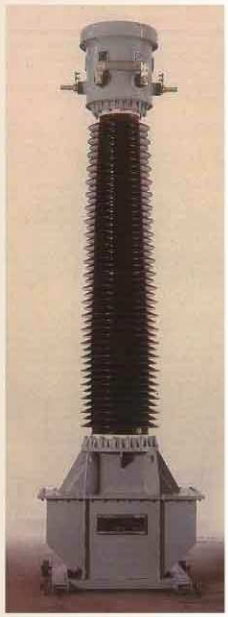
Current Transformer

Instrument Transformer
Division

132KV DEAD TANK CT

33KV CT



220KV CT

GENERAL

AUTOMATIC ELECTRIC LTD. introduced their indigenously developed Instrument transformers in the year 1968. Since then 'AE' are one of the leading Manufacturers in the Country for quality Instrument Transformers.

'AE' manufactures OUTDOOR OILCOOLED CURRENT TRANSFORMERS ranging from 11kv to 220 kv. The Modern Plant situated at Ambernath is equipped with full range of testing equipments and plant & machinery to manufacture INSTRUMENT TRANSFORMERS. 'AE' have supplied thousands of these transformers in almost all the STATE ELECTRICITY BOARDS and Utilities in the country. These instrument Transformers are working satisfactorily under different service conditions at the sites. 'AE' are also EXPORTING these transformers. The Instrument transformers are fully type tested in accordance with latest I.S. / I.E.C. specifications.

APPLICATION

Direct measurement of current in High Voltage System is not possible because of insulation problem of measuring instruments. It is also not possible to use current flowing through the system directly for protection purpose due to its high value and high insulation problem.

BASIC FUNCTIONS OF CURRENT TRANSFORMERS ARE:

1. To reduce the line current to a value which is suitable for standard measuring Instruments, relays etc.
2. To isolate the measuring instruments. Meters, relays etc. from high voltage side of an installation.
3. To protect measuring instruments against short circuit currents.
4. To sense abnormalities in current and give current signals to protective relays to isolate the defective system.

THEORY

A current transformer operates on the principle of balance of Ampere turns in primary and secondary winding. Theory of current transformers can easily be understood with the help of vector diagram give in FIG. No. 1

Voltage Es developed across secondary of the current transformer can be represented as Es = Zs x Is where Zs is impedance of burden, connecting leads and CT secondary. The flux Φ required to develop voltage Es needs excitation current Io. This excitation ampere turns are supplied through total primary ampere turns causing error in the transformation ratio of the CT. Due to non-linear characteristics of magnetic material, errors in the current transformers are also non- linear over the current range of 120% to 5%. Refer Error Curve given in FIG. NO.2.

There are four main factors which determine the capability of current transformer i.e.

- Insulation Level (Service Voltage)
- Rated primary current
- Short time withstand current
- Burden and Accuracy

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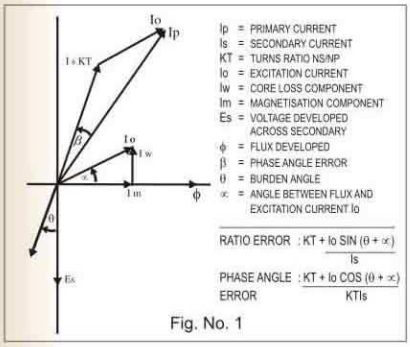


Fig. No. 1

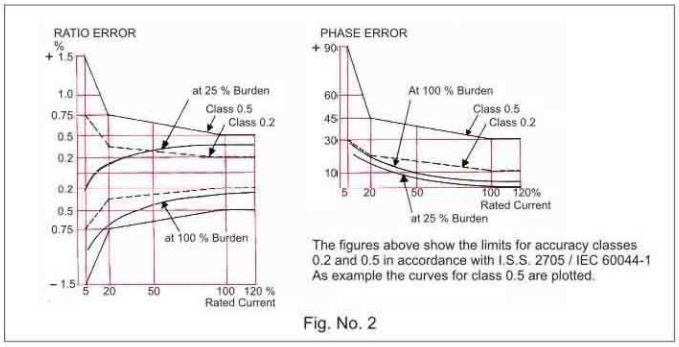


Fig. No. 2

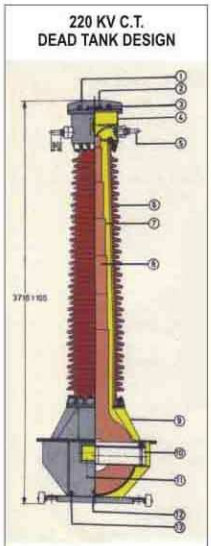


Fig. No. 3

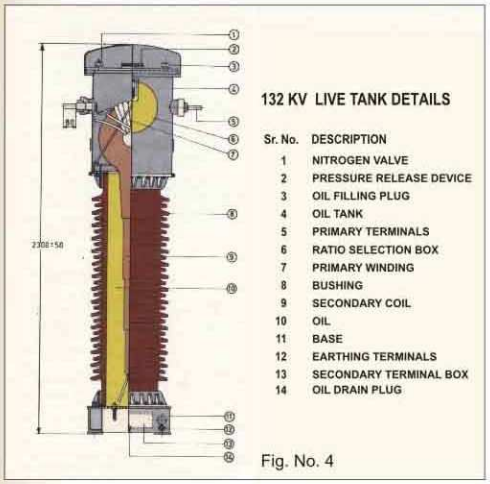


Fig. No. 4

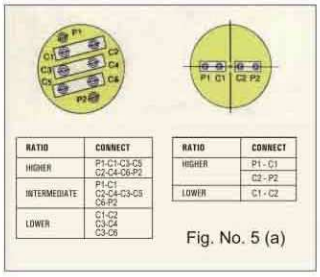


Fig. No. 5 (a)

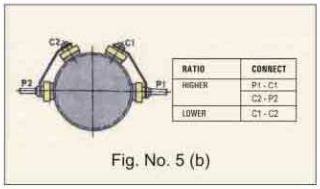


Fig. No. 5 (b)

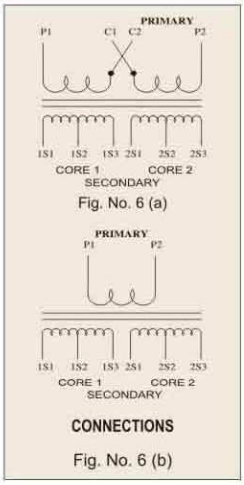


Fig. No. 6 (a)

Fig. No. 6 (b)

THE CURRENT TRANSFORMER MUST

1. Withstand operational voltage and over voltage in the network
2. Withstand rated primary current in continuous operation without exceeding maximum allowed temperature rise.
3. Be capable to sustain thermal and mechanical stresses developed due to system fault current
4. Feed current to external circuit with specified accuracy at specified primary currents.

DESIGN

'AE' manufacture current transformers in both type i.e. Live Tank Design and Dead Tank Design FIG. 3 shows basic construction of Dead Tank design whereas FIG. 4 shows construction of Live Tank design.

Current transformer can be designed for single ratio or multi ratio. The ratio selection can be achieved by providing two or four sections of primary for series/parallel reconnection as show in FIG . 5 (a) and FIG. 5(b). However the current ratios shall be in proportion of 1:2:4 The advantage of this type of ratio selection is that output from each secondary remains constant for any selected ratio.

Ratio selection is also possible by giving taps on the secondary winding as shows in FIG. 6(b). Advantage of this type is that ratio can be achieved in any multiple fo the lowest ratio. It is also possible to change the ratio on CT without taking shutdown on the main system. However, it is obvious that output rating shall change as per the ratio.

For multi ratio CT. 2 or 3 ratios can be provided by primary Series / Parallel reconnection and additional ratios by secondary tape shown in FIG 6(a).

High output (Burden/knee point voltage/Accuracy Limiting Voltage) with minimum excitation current and better accuracy class can be provided on the CT if primary current is higher. Higher output can also be obtained with multi-turn primary design. Limitations on No. of primary turns are however, imposed by short time current rating and peak dynamic current. It is advisable to provide minimum primary turns to limit the dynamic forces and mechanical stress experienced by the CT under fault condition. the limitations on output of each core of CT also depends on a number of cores provided in a single CT.

CONSTRUCTION

Core & Secondary winding:

High permeability. CRGO silicon steel is used as core material. Toroidal cores from continuos strips are made at our works and annealed in controlled atmosphere to achieve best quality secondary cores. Secondary winding is done on automatic winding machine and is distributed equally on the periphery of the core to minimise leakage reactance. Best quality enamelled wire with adequate inter-layer insulation is provided to avoid secondary winding short circuiting in most adverse conditions.

PRIMARY WINDING

Primary winding is of braided electrolytic copper conductor with double cotton covering. Varnished fibreglass sleeve is provided as an additional insulation on this conductor. In case of live tank construction, the primary is wound on insulated secondary. The primary is positioned properly to sustain dynamic forces developed during short circuit condition. In case of Dead Tank construction, the primary is encapsulated in circular rigid fibre glass ring and aluminum pipe to form EYE BOLT construction.

INSULATION

High quality crepe insulating paper is used to build up main insulation of the CT. In live tank design, insulation is built up on secondary core and secondary leads are brought out through a metallic galvanised pipe. In Dead Tank CT primary Winding is encapsulated in fibre glass ring and Aluminum pipe. Main insulation is built up on primary winding (Paper condenser is formed on the pipe) with fine grading of insulation. Semiconducting shield is used togive linear distribution of Electric stress along the length of the bushing the paper insulation is dried in oven under very high vacuum and strictly controlled conditions. Filtered and de-aerated EHV Grade oil is filled in CT while CT is under vacuum. To seal it, the space left for expansion on the top is filled with dry and pure nitrogen through non-returanable valve at pre-determined pressure.

PORCELAIN INSULATOR

Brown Glazed porcelain bushings with different shed profiles to suit different pollution conditions are used. These Bushings are hollow cylindrical type conforming to IS 5621/IEC 60044-1

Bushings with Collar at both the ends are clamped using. Aluminum Flange. Nitrile and Neoprene Gaskets are used at both sides of collar to form flexible joint. This joint can sustain vibrations without damaging bushing. Bushings with cemented flanges are also used.

TANK & BASES

Top tank (which also acts as oil Expansion Chamber) of the CT having current less than 1200 Amps. are made of MS sheet. Stainless Steel Tanks are used for CTs with primary current of 1200 Amps and above. Bases are fabricated from MS Plates and Channels. All MS Tanks and Bases are painted with oven baked paint, after cleaning by seven tank process. All surfaces which come in contact with oil are painted with oil Insoluble Paint. All MS parts can be supplied Hot Dip Galvanised on request.

TESTING

Our Testing Lab is equipped with modern test facilities to carry out all routine tests including temperature rise test. Partial Discharges test plays vital role in quality control of insulation. All our CTs are tested for Partial Discharge on most modern bridge type Partial Discharge Test Set.All the CTs pass through a standardized quality assurance plan to ensure requisite top quality at every stage and in the final product..

PACKING & TRANSPORTATION

All CTs are packed with strong jungle wood to take care of most adverse conditions of transportation all over the country. Special Sea-worthy packing is done for the CTs for EXPORT. All CTs upto 145kV Class are packed to transport vertically. 245 kV Class Cts are transported horizontally.

MAINTENANCE

The CTs do not require maintenance apart from occasional cleaning of Bushings and checking of Nitrogen pressure. For more details refer Instruction Manual supplied with the CT.

HOW TO SELECT THE C.T.

It is important to specify correct parameters of CT while ordering for optimum design. Following are main factors for selecting current transformer.

1. Service Voltage :

System Voltage is which CT is to be installed e.g. 11 kV, 22 kV, 33 kV. etc.

2. Installation :

Whether OUTDOOR or INDOOR

3.Atmospheric Conditions :

Such as condition of Pollution, Altitude Ambient Temperature etc.

4. Insulation Level :

If insulation level other than associated with service voltage is required, it should be specifically mentioned

5. Rated primary current :

Specify rated primary current / currents (if required more than one value) Also indicate if different primary current is required for different cores.

6. Continuous Primary current :

Max. primary current that can be withstood continuously by current transformer e.g. 120% of primary current.

7. Rated secondary current :

Whether 1 Amp or 5 Amps

8. Short Time Current & its Duration :

Specify fault current of the system in which CT is to be installed along with its duration. It is most important to specify realistic value of S.T.C. as at lower primary current, higher S.T.C. value necessitates bulky & costlier design. Also specify dynamic current if other than 2.5 times S.T.C. is required.

9. No. of cores Their Burdens Accuracy :

Basis of application, No. of cores, their burdens and accuracy class should be specified. It is advisable to specify minimum required Burden for metering core as unnecessary high burden will necessitate for bulky and costlier design. Specified accuracy is guaranteed for 100% to 25% of rated burden only. Current transformer offers minimum error if 75% to 60% burden is connected to secondary. Therefore, ideally rated burden higher than 1.5 time actual burden should be specified.

Also, it is important to specify correct burden in context of Instrument Security Factor (I.S.F.) The I.S.F. indicates the over current as multiple of rated current at which the metering core will saturate, thus limiting the secondary current flowing through meter and protect it from damage. If actual burden connected is half of the rated burden, the actual I.S.F. will increase two-fold of its rated value.

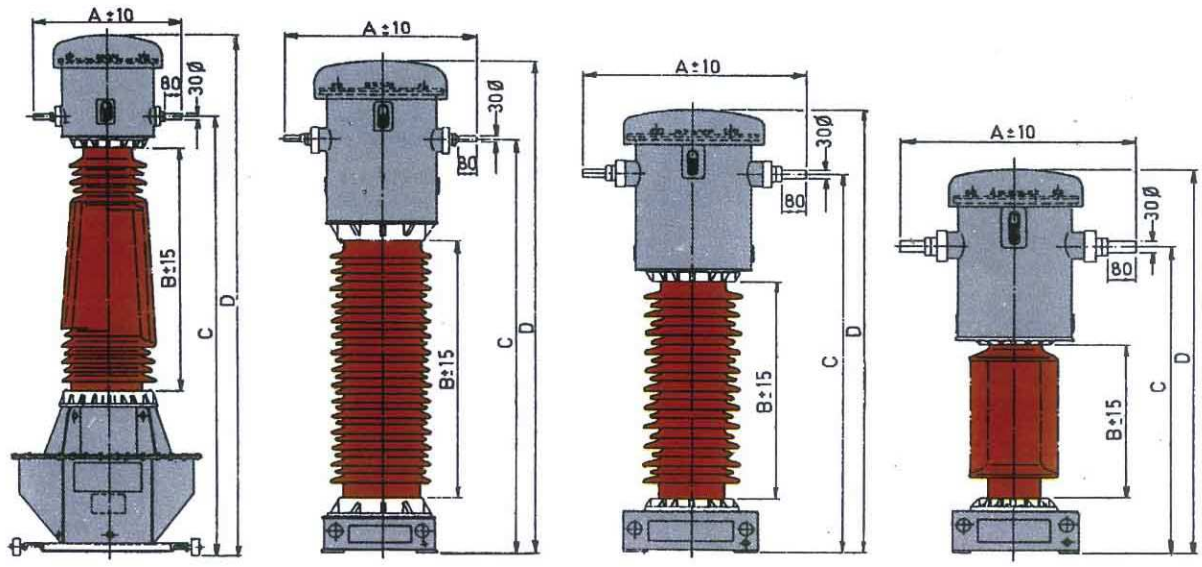
10. Knee point voltage, Secondary resistance and excitation current :

For differential protection. R.E.F. Protection, Bus Bar Protection. C.T. with accuracy class PS is required. The Knee Point Voltage. Secondary resistance and excitation current should be specified for this core. It is always better to specify Formula for Knee Point Voltage related to relay used for the protection. This will help designer to optimise the design.

CT Testing Bench

Vacuum Drying Oven

High Voltage Testing



TYPE	VOLTAGE CLASS	DIMENSIONS				MOUNTING	TOTAL CREEPAGE IN mm	TOTAL WEIGHT IN kg (Approx)
		A	B	C	D			
OC AS 220	220kV	770	2130	3240 ± 75	3710 ± 100	750 X 750	6125	1050
OC AS 132	132 / 110 / 100kV	825	1215	1935 ± 35	2300 ± 50	400 X 400	3625	465
OC HP 66	66kV	750	805	1390 ± 35	1625 ± 50	375 X 375	2310	250
OC NP 33	33 / 22 /kV		450	980 ± 20	1160 ± 35	300 X 300	900	140
OC NP 33		710	310	840 ± 20	1020 ± 35		620	135
OC NP 33			450	980 ± 20	1160 ± 35		1320	140

PRINCIPLE DIMENSIONS OF OIL COOLED CURRENT TRANSFORMERS