OUTDOOR C&V TRANSFORMERS

A division of ACTOM (Pty) Ltd

ACTOM

Formerly ALSTOM South Africa

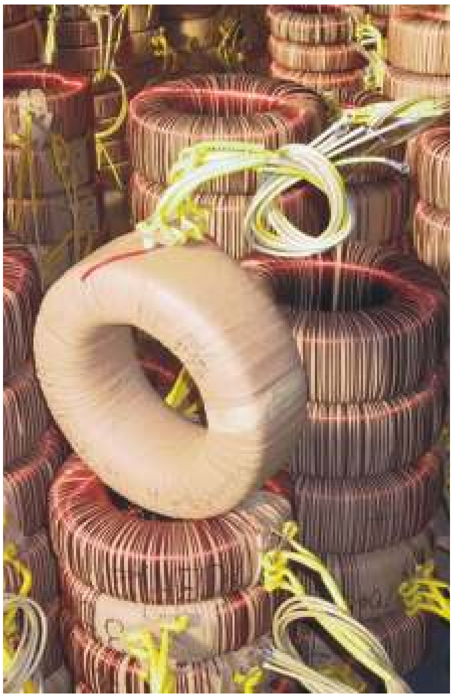
ACTOM OUTDOOR C&V TRANSFORMERS

Current transformers

- Reliable track record, due to con-servative design parameters
- Three year comprehensive guarantee
- All gaskets under oil, enabling early detection of a compromise in the hermetical seal
- ISO 9002 accredited by BVQI
- Primary earth lead termination to allow for condition monitoring
- Conservator expansion filled with dry air.

Construction of a current transformer

ACTOM's current transformers (CTs) are of a post type hairpin and oil filled design, which is well proven with over 10 000 units in service ranging from 11 kV to 132 kV. The CTs are manufactured according to the IEC or AS specifications. The main components are the secondary cores, primary, insulator and the steel tank. The CTs are hermetically sealed and do not require any maintenance. ACTOM's CTs are flexible in design and can be manufactured to accommodate ratios as low as 5 A to a maximum current rating of 2500 A.
ACTOM has also developed its CTs to accommodate a high seismic withstand of 0,7 g.



Secondary cores.

Outline of 132 kV CT.

Secondary cores

The cores are made from grain oriented silicon steel (grade M0H) wound in a toroid. The build up of the core is dependent on the ratio, burden and class of accuracy. The core is annealed at 800 °C. After the core has been processed and allowed to cool down, it is covered with insulation material and the desired number of turns are wound around the core. The core will then be tested for accuracy and magnetising current.

To correctly specify a secondary core the following information is required:
ratio, burden or kneepoint voltage, class of accuracy, resistance and maximum magnetising current.

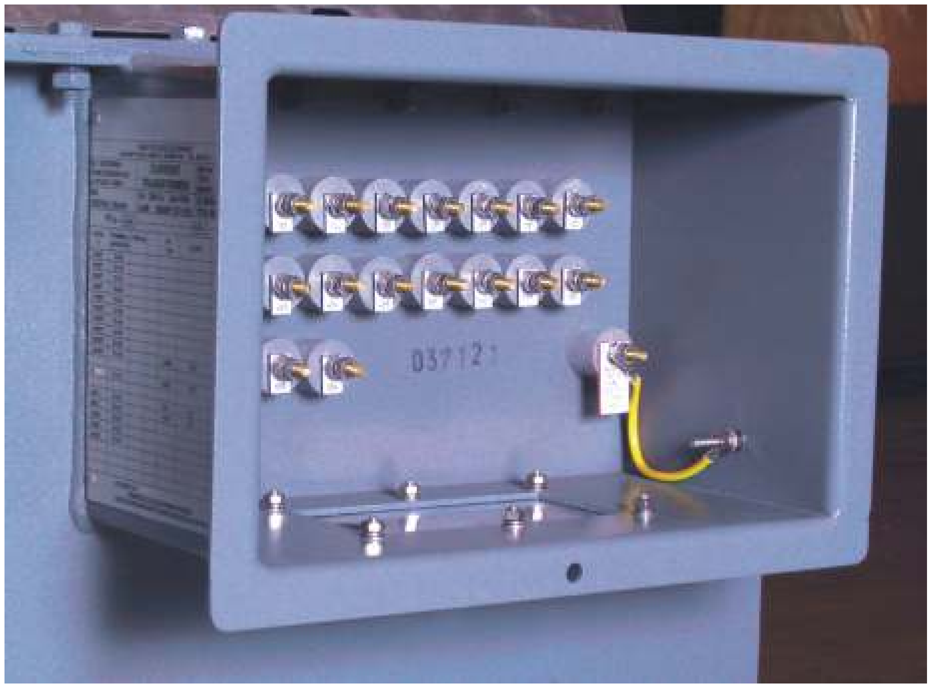
Primary winding

The primary winding consists of annealed copper bent in a "U" shape. The primary is insulated with a special purified crepe paper, having a high mechanical and dielectric strength, and low losses. Aluminium stress grading foils are layered between the paper. These are strategically placed to reduce and control high voltage stresses. The last "screen" is then brought out via a terminal in the terminal box and connected to earth via a removable link. This will allow the end user to perform and check the paper insulation by means of tan delta tests and continuous condition monitoring of the CT. The primaries are dried out in a heat-cycled oven, to remove all moisture.

132 kV primary taping.

Steelwork

The lower portion of the transformer consists of a mild steel tank which houses the primary and secondary windings. The top portion of the transformer consists of a conservator, which incorporates the oil level indicator and oil filler plug. The steelwork can be either hot dip galvanised or zinc sprayed and painted to customer requirements.



CT secondary terminal enclosure detail.

Above and below: CT high voltage connection detail

Terminals

The high voltage (HV) terminals of a CT are electro-tinned copper, which is fixed through the porcelain insulator and is connected to the primary winding. The terminal dimensions are 38 mm diameter for currents between 800 A and 2500 A, and 26 mm diameter for currents of 800 A and below. Flat terminals can also be used according to customer requirements. Typical static loading on the stems is 2000 N and dynamic load is 2800 N.

The secondary terminals are located in the terminal enclosure on the tank. Secondary terminals are resin encapsulated and of fully threaded 6mm diameter brass rod. The terminal stud is of sufficient length to accept two 2,5 mm^2 cables, three locknuts and washers.

Non-metallic labels identify the secondary terminals.

Terminal enclosure

The terminal enclosure is of a weatherproof type fitted with a sliding cover. The enclosure houses the secondary winding terminations that are brought out through low voltage (LV) terminals.

The last screen of the primary winding is also brought out through a terminal, and is earthed via a link to earth inside the terminal box. This link must NEVER be disconnected when the unit is in service, only when tan delta tests and partial discharge tests are done.

A breather is provided in the terminal enclosure that prevents condensation. An aluminium glandplate is bolted to the bottom of the terminal enclosure.

Voltage transformers

- Reliable track record, due to conservative design parameters
- Three year comprehensive guarantee
- All gaskets under oil, enabling early detection of a compromise in the hermetical seal
- ISO 9002 accredited by BVQI
- High voltage factor of 2.1 continuous
- Conservator expansion filled with dry air.

Construction of voltage transformer

The voltage transformers (VTs) are of the inductive single-phase oil filled types. They are installed and connected between phase and earth. The VTs are manufactured to the IEC or AS specifications. Main components are the core and winding assembly, steelwork and insulator. The VTs are designed with a low flux density accommodating a very high voltage factor of 2,1 continuous. This reduces the possibilities of ferroresonance due to the large core area. The VT normally has two secondary windings, but in some cases a power winding of up to 2 kVA can be added.

ACTOM has also the following variations available:

- A power VT with a winding of 16 kVA rating
- The 11, 22, and 33 kV VTs in three phase or five limb design
- Dual voltage VTs – 44/66 kV and 88/132 kV.

The VTs are hermetically sealed and do not require maintenance.

Core and winding

The primary and secondary windings are wound around a former that in turn fits around one leg of the core. The core is made up of stacked core steel. The secondary windings are closest to the core with the primary windings being wound on top of the secondary windings.

The primary is a multi-layered coil of enamelled copper wire with insulation paper between the layers.

VT winding machine.

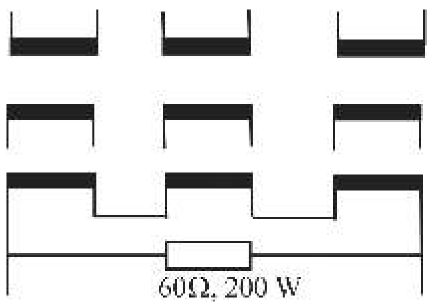
Outline of 132 kV VT.

132 kV VT conservator detail.

Ferroresonance

VTs connected between line and ground in networks with ungrounded neutral can, under certain line or fault conditions, give rise to ferroresonance (series resonance). This is where the capacitance of the line and the inductance of the VT start to oscillate, causing a rise in neutral voltage. This may cause overheating of the VT.

Loading a tertiary winding with a resistor (60 ohm, 200 W) as shown in the diagram can eliminate ferroresonance



The HV winding neutral terminal is earthed via a link inside the terminal box. A breather is provided in the terminal enclosure that prevents condensation. An aluminium glandplate is bolted to the bottom of the terminal box.

Terminals

The HV terminal of the VT is made of a 26 mm diameter stainless steel rod that is welded to the top of the conservator. The neutral end of the HV winding is brought out through a terminal inside the terminal enclosure. The high voltage side of the primary winding is channeled through the porcelain insulator and condenser bushing to the top of the VT conservator on to the high voltage terminal.

The secondary terminals are located in the terminal enclosure on the tank. Secondary terminals are resin encapsulated and of fully threaded 6 mm diameter brass rod. The terminal stud is of sufficient length to accept two 2,5 mm² cables, three locknuts and washers.

Non-metallic labels identify the secondary terminals.

Steelwork

As with the CTs the lower portion of the transformer consists of a mild steel tank which houses the primary and secondary windings. The top portion of the transformer consists of a conservator and the HV connection.

The steelwork can be either hot dip galvanised or zinc sprayed and painted to customer requirements.

Terminal enclosure

The terminal enclosure is of a weatherproof type fitted with a sliding cover. The enclosure houses the secondary winding terminals. The secondary windings are fused with 32 A fuses where the neutral side of the secondaries is brought out via links.

VT terminal enclosure detail.

Insulators

The central portion of the transformer consists of a high grade brown or munsel grey glazed hollow porcelain. Total creepage is a minimum of 25 mm/kV but larger creepage distances can be accommodated.

Conservator arrangement

The head of ACTOM's instrument transformers consists of a gascushioned conservator, which is of sufficient volume to allow for expansion/ contraction of the oil due to the temperature and atmosphere variances. Also located in the conservator is an oil gauge and filler plug, which will always be under oil. Swage-lock valves can be fitted at customer's request for easy clip-on/off, which allows simple and safe oil sampling.

132 kV CTs during oil filling.

Assembling and oil filling

Before assembly commences, all components are quality checked and tested to verify compliance with the specification. The units are then filled under vacuum with hot degassed oil.

Only virgin oil is used with no PCBs present. The units are then checked for oil leaks by means of pressure test at 75 kPa.

The CTs and VTs will then undergo routine testing according to the applicable standards. Units will be quality inspected before release.

Testing

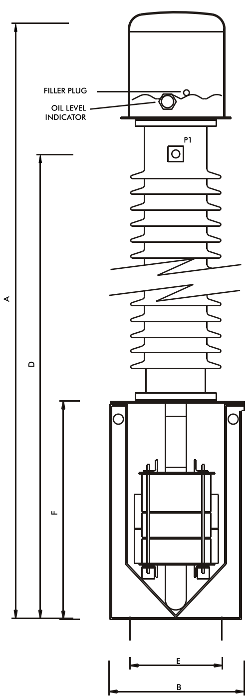
The manufacturing of instrument transformers requires accurate and careful testing at any step of construction. ACTOM has a thorough quality system that is managed by a QA manager.

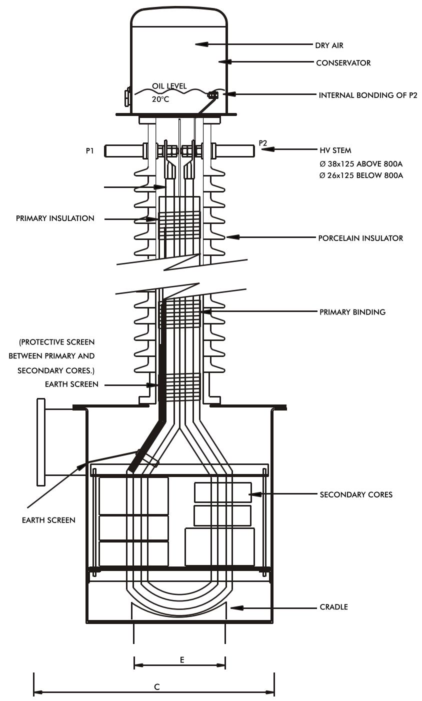
Prototypes are built and type tests carried out before mass production commences. During the manufacturing process stage inspection is carried out at various steps to ensure unvarying characteristics of each type of transformer.

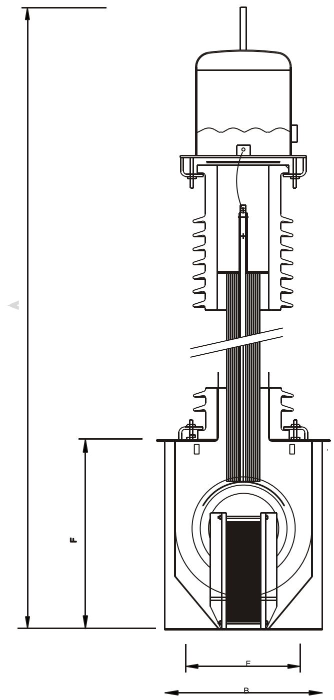
High voltage testing, normally tan delta, partial discharge and power frequency testing are carried out in a special Faraday cage. All HV tests are in compliance with standards and customer requirements

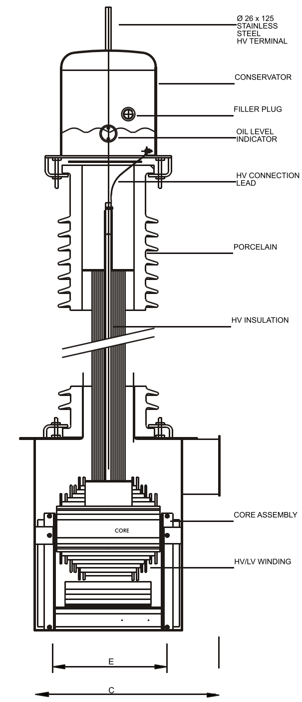
132 kV CT conservator detail.

132 kV CT in high voltage test bay.









STANDARD DIMENSIONS (mm) for single phase post type current transformers: 22kV - 132kV

		A	B	C	D	E	F				
Nominal System Voltage	Impulse Withstand Voltage	Height	Width	Length	Height Stem to Base	Fixing Centres	Tank Height	Live To Earth	Porcelain Creepage	Total Mass (kg)	Crated Volume (m^3)
22kV	160kV	1320	550	490	940	300x300	560	230	600	180	0.52
33kV	2000kV	1470	550	490	1070	300x300	560	400	900	220	0.56
44kV	250kV	1610	550	490	1210	300x300	560	550	1360	250	0.70
66kV	350kV	1960	420	780	1520	300x300	710	720	1820	380	1.00
88kV	380kV	2735	540	820	2190	500x500	755	1030	2500	650	1.74
132kV	650kV	2850	540	820	2300	500x500	755	1500	4495	750	1.80

STANDARD DIMENSIONS (mm) for single phase post type current transformers: 33kV - 132kV

		A	B	C	D	E	F				
Nominal System Voltage	Impulse Withstand Voltage	Height	Width	Length	Height Stem to Base	Fixing Centres	Tank Height	Live To Earth	Porcelain Creepage	Total Mass (kg)	Crated Volume (m^3)
33kV	200kV	1380	400	625	980	350x350	400	430	1120	200	0.58
44kV	2500kV	1725	390	695	1225	350x350	500	570	1430	245	0.77
66kV	350kV	1945	540	750	1385	450x450	560	750	1825	365	1.1
88kV	380kV	2425	540	850	1760	500x500	665	750	2500	450	1.6
132kV	650kV	2875	710	830	1995	500x500	880	1500	4100	785	2.1

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