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CURRENT TRANSFORMERS UP
TO 132KV**

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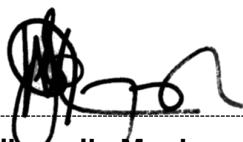
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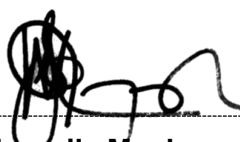
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1. Introduction

This standard stipulates Eskom's requirements for designing, manufacturing and testing of current transformers up to 132kV. The requirements stipulated in this document are based on international practices combined with Eskom's experiences. The requirements are specified in order to ensure the integrity of the product thereby minimising the risk of failure of equipment.

2. Supporting clauses

2.1 Scope

This standard details the requirements applicable to current transformers used in Eskom for nominal voltages up to 132kV.

2.1.1 Purpose

The document is written to capture and standardise Eskom current transformer requirements.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] IEC 60060-1: High voltage test techniques – Part 1: General definitions and test requirements
- [2] IEC 60071-1: Insulation co-ordination – Part 1: Definitions, principles and rules
- [3] IEC 60085: Electrical insulation – Thermal classification
- [4] IEC 60270: High voltage test techniques – Partial discharge measurements
- [5] IEC 60296: Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear
- [6] IEC 60455 (all parts): Resin based reactive compounds used for electrical insulation
- [7] IEC 60529: Degrees of protection provided by enclosures (IP code)
- [8] IEC 60694: Common specifications for high-voltage switchgear and controlgear standards
- [9] IEC 60815: Guide for the selection of insulators in respect of polluted conditions
- [10] IEC 62271-2: High-voltage switchgear and controlgear – Part 2: Seismic qualification for rated voltages of 72.5 kV and above.
- [11] CISPR 18-2: Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits
- [12] IEC 61869-1: Instrument Transformers – Part 1: General
- [13] IEC 61869-2: Instrument Transformers – Part 2: Additional requirements for current transformers
- [14] Note: Some IEC documents mentioned above are available from SABS with the same number preceded by SANS.

2.2.2 Informative

None

2.3 Definitions**2.3.1 General**

Definition	Description
Accuracy class	a designation assigned to an instrument transformer, the ratio error and phase displacement of which remain within specified limits under prescribed conditions of use
Accuracy limit factor (ALF)	ratio of the rated accuracy limit primary current to the rated primary current
Burden	admittance (or impedance) of the secondary circuit expressed in siemens (or ohms) and power factor
Class P protective current transformer	protective current transformer without remanent flux limit, for which the saturation behaviour in the case of a symmetrical short-circuit is specified
Class PX protective current transformer	protective current transformer of low-leakage reactance without remanent flux limit for which knowledge of the excitation characteristic and of the secondary winding resistance, secondary burden resistance and turns ratio, is sufficient to assess its performance in relation to the protective relay system with which it is to be used
Class TPY protective current transformer	protective current transformer with remanent flux limit, for which the saturation behaviour in case of a transient short-circuit current is specified by the peak value of the instantaneous error
Composite error (ϵ_c)	under steady-state conditions, the r.m.s. value of the difference between the instantaneous values of the primary current, and the instantaneous values of the actual secondary current multiplied by the rated transformation ratio with the positive signs of the primary and secondary currents corresponding to the convention for terminal markings
Creepage Distance	shortest distance, or the sum of the shortest distances, along the insulating parts of the insulator between those parts which normally have the operating voltage between them
Current transformer	instrument transformer in which the secondary current, under normal conditions of use, is substantially proportional to the primary current and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections
Duration of first fault (t')	duration of the fault in a C-O duty cycle, or of the first fault in a C-O-C-O duty cycle
Duration of second fault (t'')	duration of the second fault in a C-O-C-O duty cycle
Enclosure	housing affording the type and degree of protection suitable for the intended application
Exciting current (I_e)	r.m.s. value of the current taken by the secondary winding of a current transformer, when a sinusoidal voltage of rated frequency is applied to the secondary terminals, the primary and any other windings being open-circuited

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Definition	Description
Fault repetition time (tfr)	time interval between interruption and re-application of the primary short-circuit current during a circuit breaker auto-reclosing duty cycle in case of a non-successful fault clearance
Highest voltage for equipment (Um)	the highest r.m.s. value of phase-to-phase voltage for which the equipment is designed in respect of its insulation as well as other characteristics which relate to this voltage in the relevant equipment standards
Instrument security factor (FS)	ratio of rated instrument limit primary current to the rated primary current
Knee point e.m.f.	e.m.f. of a current transformer at rated frequency, which, when increased by 10%, causes the r.m.s. value of the exciting current to increase by 50%
Measuring current transformer	current transformer intended to transmit an information signal to measuring instruments and meters
Mechanical load (F)	forces on different parts of the instrument transformer as a function of four main forces: <ul style="list-style-type: none"> • forces on the terminals due to the line connections • forces due to the wind • seismic forces • electro dynamic forces due to short circuit current
Nominal voltage of a system (Un)	highest value of the phase-to-phase operating voltage (r.m.s. value) which occurs under normal operating conditions at any time and at any point in the system
Peak value of exciting secondary current at Eal (I_{al})	peak value of the exciting current when a voltage corresponding to E_{al} is applied to the secondary terminals while the primary winding is open
Phase displacement ($\Delta\phi$)	difference in phase between the primary voltage or current and the secondary voltage or current phasors, the direction of the phasors being so chosen that the angle is zero for an ideal transformer
Primary terminals	terminals to which the voltage or current to be transformed is applied
Protective current transformer	a current transformer intended to transmit an information signal to protective and control devices
Rated burden	value of the burden on which the accuracy requirements of this specification are based
Rated dynamic current (Idyn)	maximum peak value of the primary current which a transformer will withstand, without being damaged electrically or mechanically by the resulting electromagnetic forces, the secondary winding being short-circuited
Rated equivalent limiting secondary e.m.f. (E_{al})	that r.m.s. value of the equivalent secondary circuit e.m.f. at rated frequency necessary to meet the requirements of the specified duty cycle.
Rated frequency (f_R)	value of the frequency on which the requirements of this standard are based
Rated insulation level	combination of voltage values which characterizes the insulation of a current transformer with regard to its capability to withstand dielectric stresses
Rated knee-point e.m.f (E_k)	lower limit of the knee point e.m.f.

Definition	Description
Rated primary current (I_{pr})	value of the primary current on which the performance of the transformer is based
Rated primary short-circuit current (I_{psc})	r.m.s. value of the a.c. component of a transient primary short-circuit current on which the accuracy performance of a current transformer is based
Rated resistive burden (R_b)	rated value of the secondary connected resistive burden in ohms
Rated secondary current (I_{sr})	value of the secondary current on which the performance of the transformer is based
Rated short-time thermal current (I_{th})	maximum value of the primary current which a transformer will withstand for a specified short time without suffering harmful effects, the secondary winding being short-circuited
Rated symmetrical short-circuit current factor (K_{ssc})	ratio of the rated primary short circuit current to the rated primary current
Rated turns ratio	specified ratio of the number of primary turns to the number of secondary turns
Ratio error (ϵ)	the error which an instrument transformer introduces into the measurement and which arises from the fact that the actual transformation ratio is not equal to the rated transformation ratio
Secondary terminals	terminals which transmit an information signal to measuring instruments, meters and protective or control devices or similar apparatus
Secondary winding resistance (R_{ct})	actual secondary winding d.c. resistance in ohms corrected to 75°C or such other temperature as may be specified
Section	electrically conductive part of an instrument transformer insulated from other similar parts and equipped with terminals
Specified duty cycle (C-O and / or C-O-C-O)	duty cycle in which, during each specified energization, the primary short circuit current is assumed to have the worst-case inception angle
Specified primary time constant (T_p)	that specified value of the time constant of the d.c. component of the primary short-circuit current on which the transient performance of the current transformer is based
Specified time to accuracy limit in the first fault t'_{al}	time in a C-O duty cycle, or in the first energization of a C-O-C-O duty cycle, during which the specified accuracy has to be maintained
Specified time to accuracy limit in the second fault t''_{al}	time in the second energization of a C-O-C-O duty cycle during which the specified accuracy has to be maintained
Transient dimensioning factor (K_{td})	dimensioning factor to consider the increase of the secondary linked flux due to a d.c. component of the primary short circuit current
Unified specific creepage distance	creepage distance of an insulator divided by the r.m.s. value of the highest operating voltage across the insulator and is expressed in mm/kV

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

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2.4 Abbreviations

Abbreviation	Description
ALF	Accuracy Limit Factor
CT	current Transformer
E_{al}	rated equivalent limiting secondary e.m.f.
E_k	rated knee-point e.m.f.
F	mechanical load
f_R	rated frequency
I_{al}	peak value of the exciting secondary current at E_{al}
I_{dyn}	rated dynamic current
I_e	exciting current
I_{pr}	rated primary current
I_{psc}	rated primary short-circuit current
I_{sr}	rated secondary current
I_{th}	rated short-time thermal current
K_{ssc}	rated symmetrical short-circuit current factor
K_{td}	transient dimensioning factor
R_b	resistive burden
R_{ct}	secondary winding resistance
T	turns
t'	duration of first fault
t''	duration of second fault
t''_{al}	specified time to accuracy limit in the second fault
t'_{al}	specified time to accuracy limit in the first fault
t_{fr}	fault repetition time
T_p	specified primary time constant
Un	system nominal voltage
$\Delta\phi$	phase displacement
ε	ratio error
ε_c	composite error

2.5 Roles and responsibilities

All the Eskom employees and/or appointed bodies involved in the procurement of current transformers of nominal voltages up to 132kV shall ensure that the product meets the requirements of this standard. Any deviation from these requirements shall constitute a non-conformance, unless if approved in advance by a delegated Eskom current transformer specialist in writing and is based on sound engineering judgement.

All the Contractors supplying current transformers to Eskom must be conversant with the requirements of this specification, and shall comply with the requirements. All the deviations shall be clearly listed in the deviation schedule as part of the tender deliverables. No deviations will be accepted unless approved by Eskom in writing.

The Eskom Instrument Transformer Care Group shall be responsible for ensuring the validity of this document.

2.6 Process for monitoring

This document and its relevance will be evaluated by the relevant instrument transformers Care Group.

2.7 Related/supporting documents

Not applicable.

3. General requirements

The schedule A of the relevant A/B schedules shall form part of this specification and they shall take precedence over this specification in case the two documents are conflicting.

3.1 Life expectancy

The life expectancy of current transformers under normal service conditions shall be 25 years.

3.2 Standard service conditions

Unless otherwise specified in schedule A, the following standard conditions shall apply:

- a) Ambient temperatures:
 - 1) Minimum: -5°C
 - 2) Maximum: 40°C
 - 3) Maximum diurnal variation: 35°C
 - 4) Yearly daily average: 25°C
- b) Altitude: Up to 1800m
- c) Solar radiation: 2500 kWh/m²
- d) Relative humidity: Not exceeding 95% (measured for a period of 24 hours)
- e) Wind Pressure: 700 Pa (corresponding to a 34m/s wind speed)
- f) Seismic shock: 0.3g

4. Ratings

4.1 General

The common ratings of instrument transformers, including their auxiliary equipment if applicable, should be selected from the following:

- a) Highest voltage for equipment (U_m);
- b) Rated insulation level;
- c) Rated frequency (f_R) and
- d) Rated accuracy class

The rating applies at the standardized reference atmosphere (temperature (20°C), pressure (101,3 kPa) and humidity (11 g/m³)) specified in IEC 60071-1.

4.2 Insulation requirements

These requirements shall apply to all types of current transformer insulation. The rated insulation levels for current transformers shall comply with the requirements in Table 1.

Table 1: Rationalized Voltage Ratings

Eskom Nominal System Voltage (kV)	Equipment Nominal Voltage Rating (U _n) (kV)	Highest Voltage for Equipment (U _m) (kV)	Rated Lightning Impulse Withstand Voltage (kV peak at 1 000 m AMSL)	Rated Power Frequency Withstand Voltage (kV rms at 1 000 m AMSL)
-	-	0.72	-	3
6.6, 11, 22	22	24	150	50
33	33	36	200	70
44, 66	66	72,5	350	140
88, 132	132	145	650	275

Note: The rated insulation withstand levels for lightning impulse and short time power frequency withstand are specified in Table 1. The service conditions for South Africa are rationalized for altitudes up to 1 800m. Although the insulation levels in Table 1 are specified at an altitude of 0 m to 1 000 m, the values have been selected for appropriate insulation coordination for altitudes up to 1 800 m and need not be corrected for altitude. The CTs should be supplied with standard values as per Table 1. Test values must, however, be corrected for deviations from the standard reference atmospheric conditions.

- a) For a current transformers without primary windings and without primary insulation of their own, the value U_m = 0.72 kV is assumed.

4.3 Rated primary terminal insulation level

- a) Primary terminals shall be of the type and orientation specified in technical schedule A.
- b) Primary terminals shall either be made of electro-tinned copper without subsequent heat treatment or machining or either Aluminium. The dimensions thereof shall be according to Table 2 & 3.

Table 2: Copper terminal stem dimensions for current transformers

Current (A)	Diameter (mm)	Length (mm)
Up to and including 800	26	100
Above 800 up to and including 2 500	38	125
Above 2 500 up to and including 4 000	60	150

Table 3: Aluminium terminal stem dimensions for current transformers

Current (A)	Diameter (mm)	Length (mm)
Up to and including 500	26	100
Above 800 up to and including 1250	38	125
Above 1250 up to and including 3150	60	150

- c) If pad ("palm") terminals are required, the details shall be specified in technical schedule A.

- d) Primary terminals shall be marked P1 and P2 with the following additional requirements:
- 1) P1 is the terminal which is insulated from the CT head and
 - 2) P2 is the terminal connected to the CT head.
 - 3) The connection between the terminal P2 and CT's head shall be of the same (or of compatible) material as that of the terminals and shall not be of braided construction. It shall be able to carry the rated short circuit current specified in technical schedule A.

Notes:

Distribution uses only electro-tinned copper terminals of 26mm and 28mm (see table 2).

The intention of this requirement is to ensure that any flashover from the CT head to earth, or to other phases, will fall within the protected zone of the feeder circuit and will therefore be cleared selectively. To achieve this, the CT is mounted with the P1 terminal (insulated terminal) connected towards (facing) the circuit breaker.

4.4 Other requirements for primary terminals

4.4.1 Partial discharges

- a) Partial discharge requirements are applicable to current transformers having $U_m \geq 7.2\text{kV}$ and the level shall not exceed limits specified in Table 4.

Table 4: – Partial discharge test voltages and permissible levels

Type of earthing of the neutral system	PD test voltage (r.m.s.) kV	Maximum permissible PD level PC	
		Liquid or gas insulation	Solid insulation
Earthed Neutral	U_m	10	50
	$1.2 U_m / \sqrt{3}$	5	20
Non effectively earthed	$1.2 U_m$	10	50
	$1.2 U_m / \sqrt{3}$	5	20

4.4.2 Chopped impulse

- a) Current transformers shall be capable to withstand a chopped lightning impulse voltage applied to primary terminals having a peak value of 115% of rated lightning withstand voltage.

4.4.3 Capacitance and dielectric dissipation factor

- a) A capacitive test tap is required for dielectric dissipation factor (DDF = tangent-delta) testing and should be brought through a separate terminal (for all current transformers having $U_m \geq 24\text{kV}$)
- b) The special test requirements apply only to current transformers having $U_m \geq 72.2\text{kV}$ with liquid immersed primary insulation or gas insulated current transformers with capacitance grading insulation system.

4.4.4 Between-section insulation requirements

- a) For interconnected terminal of each section, the rated power frequency withstand voltage of insulation between sections shall be 3kV.

4.4.5 Insulation requirements for secondary terminals

- a) The rated power-frequency withstand voltage for secondary terminals insulation shall be 3kV.
- b) The rated withstand voltage for inter-turn insulation shall be 4,5 kV peak

4.5 Rated frequency

- a) The standard frequency value is 50Hz.

4.6 Rated output

- a) Standard values for measuring classes and class P current transformers are: 2.5, 5, 10, 15 and 30VA. The required output shall be specified in technical schedule A.
- b) If an extended burden is required, it shall be stated in the technical schedule.

4.7 Description of standard current transformers used in Eskom

Table 5 summarises the standard current transformers used in Eskom

Table 5: Standard CT Options required by Eskom

SAP No	Current Transformer Short Description	Core Layout	Protection Core (P)	Buszone Core (B)	Measurements Core (M)
180087	CT 22kV 1600A 25kA 2P2M 31mm/kV	PPMM	1/1600T MR	—	1/1600T MR
180088	CT 22kV 2500A 25kA 2P2M 31mm/kV	PPMM	1/2400 MR	—	1/2400 MR
180038	CT 33kV 1600A 31.5kA 2P2M 31mm/kV	PPMM	1/1600T MR	—	1/1600T MR
180035	CT 66kV 1600A 31.5kA 2P2M2B500 31mm/kV	PBBPMM	1/1600T MR	1/500T FR	1/1600T MR
180037	CT 66kV 1600A 31.5kA 2P 2M 2B10/12/16 31mm/kV	PBBPMM	1/1600T MR	1/1600T MR	1/1600T MR
675092	CT 66kV 200A 20kA 2M 31mm/kV	MM	—	—	1/200T MR
180031	CT 132kV 2500A 40kA 2P2M2B(500) 31mm/kV	PBBPMM	1/2400T MR	1/500T FR	1/2400T MR
180034	CT 132kV 2500A 40kA 2P 2M 2B10/12/16 31mm/kV	PBBPMM	1/2400T MR	1/1600T MR	1/2400T MR
257374	CT 132kV 2500A 40kA 2P2M2B24 31mm/kV	PBBPMM	1/2400T MR	1/2400T FR	1/2400T MR
216835	CT 132kV 2500A 40KA 3P1M2B2431mm/kV	PPBBPMM	1/2400T MR	1/2400T FR	1/2400T MR
243900	CT 132kV 2500A 40kA 2P2M2B16 31mm/kV	PBBPMM	1/2400T MR	1/1600T FR	1/2400T MR
217028	CT 132kV 2500A 40kA 3P1M2B16 31mm/kV	PPBBPMM	1/2400T MR	1/1600T FR	1/2400T MR
243902	CT 132kV 2500A 40kA 2P2M2B12 31mm/kV	PBBPMM	1/2400T MR	1/1200T FR	1/2400T MR
630597	CT 132kV 2500A 40kA 3P1M2B12 31mm/kV	PPBBPMM	1/2400T MR	1/1200T FR	1/2400T MR
675093	CT 132kV 200A 20kA 2M 31mm/kV	MM	—	—	1/200T MR
675463	CT 132kV 3150A 40kA 2P2M2B24 31mm/kV	PBBPMM	1/3200T	1/2400T	1/3200T

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Notes:

- 1) There are current transformers used in Eskom which are regarded as non-standard due to low utilisation, when they are require, their special requirements shall be stated in technical schedule A.
- 2) Current transformers with 3 * Protection cores, 1 * Metering core and 2 * Bus zone cores are used for capacitor banks application. The core layout thereof shall be PPPBBM.

Table 6 summarises the standard unbalance current transformers used for Eskom Capacitor Bank applications.

Table 6: Unbalance current transformers used for capacitor banks

SAP No:	Current Transformer Short Description	Core layout
242962	CT 22KV 10A 0.6kA 3P 31mm/kV	PPP
242950	CT 132KV 10A 0.6kA 2P 31mm/kV	PP
242951	CT 132KV 20A 0.6kA 2P 31mm/kV	PP
242952	CT 132KV 2A 0.6kA 2P 31mm/kV	PP
242954	CT 132KV 4A 0.6kA 2P 31mm/kV	PP

4.8 Core and winding design details

4.8.1 Cores, ratios and special characteristics

- a) Where multi-ratio CTs are required, the various ratios shall be provided by means of tapping that can be obtained by changing the effective number of turns on the secondary winding.

4.8.1.1 Core Layout

Figures 1 – 3 show the core layouts for Protection (P), Measuring (M) and Bus zone (B). It is important to note the primary terminal polarity markings (i.e. P1, P2) with respect to the core layout.

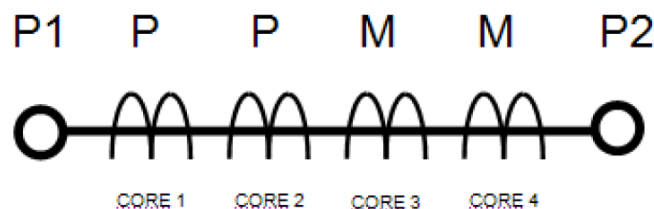


Figure 1: Core Layout – Four Core Current Transformer (2P2M)

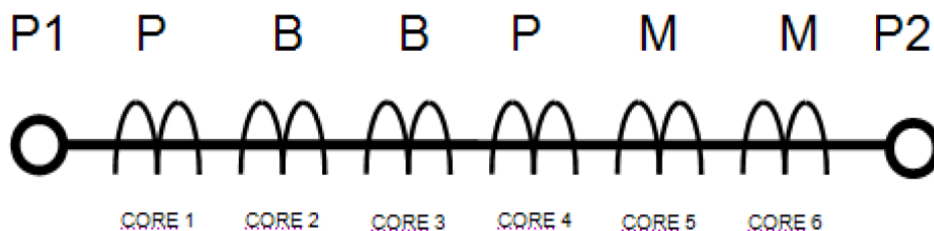


Figure 2: Core Layout – Six Core Current Transformer (2P2M2B)

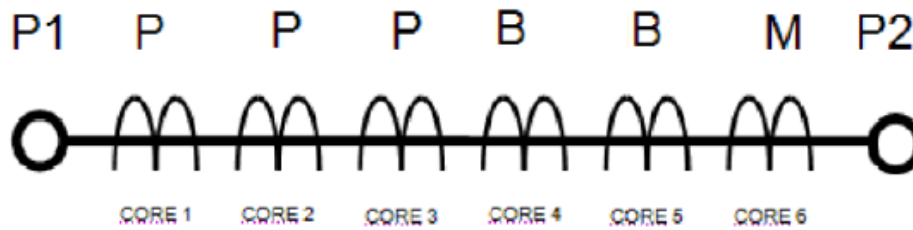


Figure 3: Core Layout – Six Core Current Transformer (3P1M2B)

4.8.1.2 Tapping arrangements

The secondary core tapping arrangements shall be as indicated in Figure 4 to Figure 8:

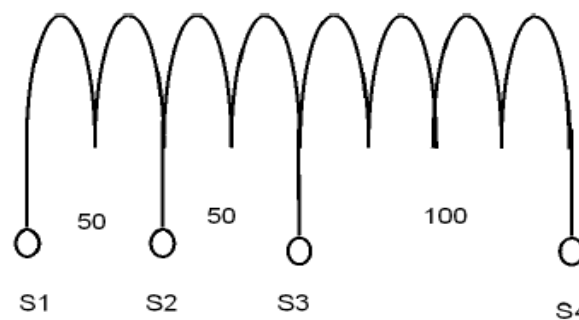


Figure 4: Tapping Arrangement for Multi-ratio 1/200 Measuring Cores

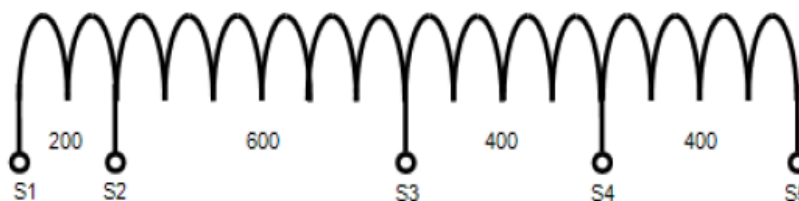
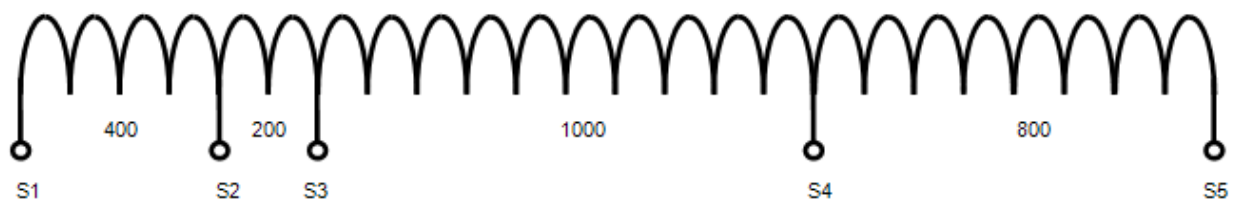


Figure 5: Tapping Arrangement for Multi-ratio 1/1600 Protection/Measuring Cores



Figure 6: Tapping Arrangement for multi-ratio 1/1600T Buszone Cores



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Figure 7: Tapping Arrangement for Multi-ratio 1/2400 Protection/Measuring Cores

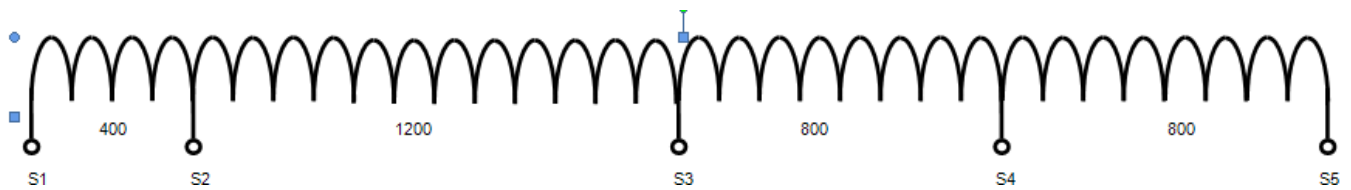


Figure 8: Tapping Arrangement for Multi-ratio 1/3200 Protection/Measuring Cores

4.9 Rated accuracy class

4.9.1 Measuring current transformers

- For measuring current transformers, the accuracy classes used in Eskom are class 0.2 and in special cases class 0.2S.
- However Eskom has special requirements for standard measuring current transformers and these are stated in Table 7.

Table 7: Measuring Core Specifications

Maximum Core Ratio	Tapping	Ratio	Class	Burden	Security Factor
MR 1/200	S1 - S2	50/1	0.2	5VA	FS 20
	S3 - S4	100/1		10VA	—
	S1 - S4	200/1		10VA	—
MR 1/1600	S1 - S2	200/1	0.5	5VA	FS 20
	S3 - S4	400/1		10VA	—
	S2 - S3	600/1		10VA	—
	S1 - S3	800/1		10VA	—
	S2 - S4	1000/1		10VA	—
	S1 - S4	1200/1		10VA	—
	S2 - S5	1400/1		10VA	—
	S1 - S5	1600/1		10VA	—
MR 1/2400	S2 - S3	200/1	0.2	2.5VA	—
	S1 - S2	400/1		5VA	FS 20
	S1 - S3	1/600T		10VA	—
	S4 - S5	800/1		10VA	—
	S3 - S4	1000/1		10VA	—
	S2 - S4	1200/1		10VA	—
	S1 - S4	1600/1		10VA	—
	S3 - S5	1800/1		10VA	—
	S2 - S5	2000/1		10VA	—
	S1 - S5	2400/1		10VA	—
	S1 - S2	400/1		5VA	FS 20
MR 1/3200	S3 - S4	800/1	0.2	10VA	—

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Maximum Core Ratio	Tapping	Ratio	Class	Burden	Security Factor
	S2 - S3	1200/1		10VA	—
	S1 - S3	1600/1		10VA	—
	S2 - S4	2000/1		10VA	—
	S1 - S4	2400/1		10VA	—
	S2 - S5	2800/1		10VA	—
	S1 - S5	3200/1		10VA	—

In cases where Class 0.2S measuring cores are required, the requirements shall be specified in the technical schedule A.

4.9.2 Protective current transformers

- a) The standard protective current transformers used in Eskom are class PX and class P but there are exceptional cases where TPY is utilized.

4.9.2.1 Class PX Protective Current Transformers

- a) The performance of class PX protective current transformers shall be specified in terms of the following:
- b) Rated primary current (I_{pr});
- c) Rated secondary current (I_{sr});
- d) Rated turns ratio;
- e) Rated knee point e.m.f. (E_k);
- f) Upper limit of exciting current (I_e) at the rated knee point e.m.f. and
- g) Upper limit of the secondary winding resistance (R_{ct}).

4.9.2.2 Class PX protection core specifications

- a) Table 8 gives specifications for class PX protection cores.

Table 8: Class PX Protection Core Specifications

Maximum Core Ratio	Tapping	Ratio	Class	E_k min (V)	I_e max (mA)	R_{ct} (Ω) @ 75°C
MR 1/1600	S1 - S2	1/200T	PX	200	300	0.8
	S3 - S4	1/400T		400	150	1.6
	S2 - S3	1/600T		600	100	2.4
	S1 - S3	1/800T		800	75	3.2
	S2 - S4	1/1000T		1000	60	4
	S1 - S4	1/1200T		1200	50	4.8
	S2 - S5	1/1400T		1400	43	5.6
	S1 - S5	1/1600T		1600	38	6.4
MR 1/2400	S2 - S3	1/200	PX	200	300	0.8
	S1 - S2	1/400T		400	150	1.6
	S1 - S3	1/600T		600	100	2.4

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Maximum Core Ratio	Tapping	Ratio	Class	E_k min (V)	I_e max (mA)	R_{ct} (Ω) @ 75°C
	S4 - S5	1/800T		800	75	3.2
	S3 - S4	1/1000T		1000	60	4
	S2 - S4	1/1200T		1200	50	4.8
	S1 - S4	1/1600T		1600	38	6.4
	S3 - S5	1/1800T		1800	33	7.2
	S2 - S5	1/2000T		2000	30	8
	S1 - S5	1/2400T		2400	25	9.6
MR 1/3200	S1 - S2	1/400T	PX	400	150	1.2
	S3 - S4	1/800T		800	75	2.4
	S2 - S3	1/1200T		1200	50	3.6
	S1 - S3	1/1600T		1600	38	4.8
	S2 - S4	1/2000T		2000	30	6
	S1 - S4	1/2400T		2400	25	7.2
	S2 - S5	1/2800T		2800	22	8.4
	S1 - S5	1/3200T		3200	19	9.6

4.9.2.3 Class PX buszone protection core specifications

- a) Table 9 gives specifications for class PX buszone protection cores.

Table 9: Buszone Core Specifications

Maximum Core Ratio	Tapping	Ratio	Class	E_k min (V)	I_e max (mA)	R_{ct} (Ω) @ 75°C
FR 1/500	S1 - S2	1/500T	PX	550	50	2
FR 1/1200	S1 - S2	1/1200T	PX	550	50	2
FR 1/1600	S1 - S2	1/600T	PX	550	50	2
MR 1/1600	S1 - S2	1/1000T	PX	550	50	2
	S1 - S3	1/1200T		660	42	2.4
	S1 - S4	1/1600T		880	31	3.2
FR 1/2400	S1 - S2	1/2400T	PX	550	50	2

Note: The CT's name plate shall reflect the manufacturer's design values for the core excitation current, i.e. rather than the maximum allowable values specified above.

4.9.2.4 Class P protective current transformers

- a) The standard accuracy limit factor (ALF) values are 5, 10, 15, 20 and 30.
- b) The accuracy class is designated using the highest permissible percentage of the composite error, followed by the letter "P" (standing for "protection") and the ALF value.
- c) The standard accuracy classes for protective current transformers are 5P and 10P.
- d) At rated frequency and with rated burden connected, the ratio error, phase displacement and composite error shall not exceed the limits given in Table 10.

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Table 10: Error limits for class P current transformers

Accuracy class	Ratio error at rated primary current $\pm \%$	phase displacement at rated primary current		Composite error at rated accuracy limit primary current $\%$
		\pm Minutes	\pm Centiradians	
5P	1	60	1.8	5
10P	3	—	—	10

Note: Class P protection current transformers are non-standard and will be specified in technical schedule A when required.

4.9.2.5 Class P unbalance current transformers

- a) Table 11 give the specifications for class P protection cores specifications.

Table 11: Unbalance CT Core specifications

Maximum Core Ratio	Tapping	Ratio	Class	ALF	Burden
1/1	S1 - S2	1/1T	5P	10	10VA
1/2	S1 - S2	1/2T	5P	10	10VA
1/5	S1 - S2	1/5T	5P	10	10VA
1/10	S1 - S2	1/10T	5P	10	10VA
1/20	S1 - S2	1/20T	5P	10	10VA

4.9.2.6 Class TPY protective current transformers

- a) The error limits for class TPY current transformer at the rated frequency and burden are given in Table 12.

Table 12: Error limits for TPY current transformers

Class	At rated primary current			Transient error limits under specified duty cycle conditions
	Ratio error ±%	Phase displacement		
		minutes	Centiradians	
TPY	1.0	±60	±1.8	ε = 10%

- b) The performance of class TPY protective current transformers shall be specified in terms of the following:

- 1) Class designation (i.e. TPY),
- 2) Rated symmetrical short circuit current factor (K_{SSC}),
- 3) Duty cycle consisting of C-O-CO cycle: t'_{al} , t' , t_{fr} and t''_{al} ,
- 4) Rated primary time constant (T_p)
- 5) Rated resistive burden (R_b)

Note: For current transformers with tapped secondary windings, the given accuracy requirements can be fulfilled with only one ratio.

4.10 Standard values of rated primary current

- a) The standard values for rated primary current for current transformers used in Eskom are 1A, 2A, 4A, 10A, 20A, 40A, 800A, 1600A, 2500A and 3150A.
- b) Should a non-standard rated primary current for a current transformer be required, it shall be stated in technical schedule A.

4.11 Standard values of rated secondary current

- a) The standard value for rated secondary current for current transformers used in Eskom is 1A.

4.12 Short-time current rating (I_{th})

- a) The standard values for short-time current (I_{th}) for current transformers used in Eskom are 0.6kA, 25kA, 31.5kA, 40kA and 50kA

4.13 Rated dynamic current (I_{dyn})

- a) The standard value of the rated dynamic current (I_{dyn}) is 2.5 times the rated short-time thermal current (I_{th}).

5. Design and construction

5.1 Requirements for liquids used in equipment

5.1.1 General

- a) The manufacturer shall specify the type and the required quantity and quality of the liquid to be used in the equipment in schedule B.
- b) Facilities for oil filling and draining shall be provided. These facilities shall be suitably sealed below the normal operating oil level and shall not leak oil when the transformer is tested.
- c) The method used to allow for the expansion of the insulating oil shall be submitted for approval. If bellows are used, they shall be of stainless steel.
- d) If so specified in schedule A, oil sample valves shall be provided. Details of the oil sample valves shall be submitted for approval before manufacture is undertaken.

5.1.2 Liquid quality

For oil-filled equipment, insulating oil shall comply with IEC 60296.

5.1.3 Liquid level device

The device for checking the liquid level shall indicate whether the liquid level is within the operating range, during operation.

5.1.4 Liquid tightness

- a) No liquid loss is permitted (i.e. current transformers shall be hermetically sealed). Any liquid loss represents a danger of insulation contamination.
- b) Details of the sealing arrangement shall be submitted for approval if requested in schedule A.
- c) Where the manufacturer's design requires specially designed gasketed joints to be above the oil level, machined surfaces and O-rings shall be used. Details of such joints shall be submitted for approval if requested in schedule A.

5.2 Requirements for solid materials used in equipment

- a) Specifications for organic material used for instrument transformers (i.e. epoxy resin, polyurethane resin, epoxy-cycloaliphatic resin, composite material, etc.) either for indoor or outdoor installations are given in the IEC 60455 series.
- b) Dry type CTs shall have resin-encapsulated cores and windings.

5.3 Requirements for temperature rise**5.3.1 General**

- a) The temperature rise in a current transformer when carrying a primary current equal to the rated continuous thermal current, with a unity power-factor burden corresponding to the rated output, shall not exceed the appropriate value given in Table 13, when operating under service conditions specified in paragraph 3.2.

Table 13: limits for temperature rise

Part of current transformer	Temperature rise limit K
1. Oil immersed current transformers	
• Top oil	50
• Top oil hermetically sealed	55
• Winding average	60
• Winding average, hermetically sealed	65
• Other metallic parts in contact with oil	As for winding
2. Solid or gas insulated current transformers	
- Winding (average) in contact with insulating material of the following classes:	
• Y	45
• A	60
• E	75
• B	85
• F	110
• H	135
• Other metallic parts in contact with the above insulating material classes	As for windings
Insulating class definitions according to IEC 60085	

5.3.2 Influence of altitude on temperature

If a current transformer is specified for service at an altitude in excess of 1 000m and tested at an altitude below 1 000m, the limits of temperature rise ΔT given in Table 13 shall be reduced by the following amounts for each 100m that the altitude at the operating site exceeds 1 000 m:

- a) Oil-immersed current transformers: 0.4% and
- b) Dry-type current transformers: 0.5%.

5.4 Requirements for earthing

The frame of current transformers shall be provided with an earthing terminal for connection to an earthing conductor. The connecting point shall be marked with the earth symbol.

5.5 Requirements for external insulation

- For outdoor current transformers with ceramic (porcelain) or composite insulators susceptible to contamination, the creepage distance of 31mm/kV shall be used.
- NB: Ratio of the creepage distance between phase and earth over the r.m.s. phase-to-phase value of the highest voltage for the equipment (see IEC 60071-1). For further information and manufacturing tolerances on the creepage distance, see IEC 60815.

5.6 Mechanical requirements

- The requirements apply to current transformers rated for highest voltage of 72.5kV and above. Current transformers must be able to withstand static loads given in table 14 applied in any direction to the primary terminals.

Table 14: Static withstand test loads

Highest Voltage for Equipment U_m kV	Static withstand test load FR N	
	Load Class 1	Load Class 2
72.5 - 100	1250	2500
123 - 170	2000	3000

5.7 Internal arc fault protection

- The requirements apply to oil immersed free-standing current transformers with $U_m \geq 72.5\text{kV}$ for which arc fault protection is additionally specified.
- If the requirements are specified, the current transformer must be able to withstand internal arc of the specified current and duration specified in table 15.

Table 15: Arc fault duration and protection criteria

Internal arc fault current r.m.s. value kA	Protection stage	Arc fault duration s	Internal arc fault protection class I	Internal arc fault protection class II
<40	1	0.2	Fracture of housing and fire permitted, but all projected part to be within the containment area	No external effect other than the operation of pressure relief device
	2	0.5		No fragmentation (burn-through or fire acceptable)
≥ 40	1	0.1		No external effect other than the operation of pressure relief device
	2	0.3		No fragmentation (burn-through or fire acceptable)

NB: This test is not a guarantee against containment under all short-circuit conditions, but a test to demonstrate conformance to an agreed level of safety.

- If required in schedule A, the CTs' construction shall comply with the fail-safe design, yielding a low explosion risk. The supplier is to provide details of the fail-safe design features in the tender.

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5.8 Degrees of protection by enclosures

- a) The recommended minimum degree of protection for low-voltage control and/or auxiliary enclosures for outdoor current transformers is IP56.

5.9 Electromagnetic compatibility

5.9.1 Requirement for Radio Interference Voltage (RIV)

- a) The requirement applies to current transformers having $U_m \geq 123\text{kV}$ to be installed in air-insulated substations. The radio interference voltage shall not exceed $2\,500\mu\text{V}$ at $1.1\,U_m/\sqrt{3}$.

5.9.2 Requirement for transmitted overvoltages

- a) These requirements apply to instruments transformers having $U_m \geq 72.5\text{ kV}$. The overvoltages transmitted from the primary to the secondary terminals shall not exceed the values given in Table 16.

Table 16: Transmitted overvoltage limits

Type of impulse	Air insulated current transformers
Peak value of applied voltage (U_p)	$1.6 * \frac{\sqrt{2}}{\sqrt{3}} * U_m$
Waveshape characteristics <ul style="list-style-type: none"> conventional front time (T_1) time to half (T_2) 	$0.5\mu\text{s} \pm 20\%$ $\geq 50\mu\text{s}$
Transmitted overvoltage peak limits (U_s)	1.6kV

6. Construction

6.1 Secondary terminals

- a) The bushings used for bringing the secondary connections through the tank into the secondary terminal box shall not be used as the secondary terminals for service connections, unless approved by Eskom.
- b) Studs shall have centre distances of not less than 25mm. A minimum clearance of 12mm shall be maintained between terminals. Stud terminals shall be size M6.
- c) The secondary terminals shall be rail-mounted, and shall be the spring-loaded screw clamp type of 10 mm width in accordance with IEC 60947-7-1. The terminals shall accept two back-to-back hook blade lugs.

6.2 Secondary terminal boxes

- a) Each CT shall be fitted with a secondary terminal box that shall be located in an accessible position and shall be provided with an easily removable (preferably slip-on) weather-proof cover. When in place, the cover shall be secured to the corresponding terminal box by means of a minimum M8 stainless steel set screw or an otherwise approved method.

- b) The type of terminal box shall be stated in schedule B and, subject to approval, shall be either:
 - i). Integrally cast with the CT case; or
 - ii). Steel box welded to the main tank.
- c) The terminal box with the cover fixed in place shall have a degree of protection of at least IP56 in accordance with SANS 60529.
- d) The secondary terminal box shall have an opening, at the bottom of the box, for vertical entry of the secondary control cables. The opening shall be covered externally by an undrilled, removable gland plate of brass (of minimum thickness 2mm), aluminium alloy (of minimum thickness 3mm) or stainless steel (of minimum thickness 2mm) for a steel or aluminium box. Unless otherwise specified in schedule A, this gland plate and the opening shall have an effective area of at least 75mm × 50mm. This area shall be stated in schedule B. Access to the gland-plate opening shall not be obstructed for cables that enter the terminal box vertically from below.
- e) The distance between the bottom terminals and the gland plate shall be at least 75 mm.
- f) The terminal box shall be fitted with a breathing vent of diameter at least 10 mm. This vent shall be situated in the bottom of the box, shall be made of non-corroding material and shall be designed to prevent the entry of insects.
- g) The beginning and the end of each secondary winding with all secondary taps, if any, shall be wired to suitable terminals accommodated in the terminal box.
- h) An earth stud shall be provided for earthing of the secondary windings inside the terminal box. The earth stud shall be of diameter at least 6 mm, and shall have an external connection to the main earthing system.
- i) The capacitive tap connection shall be connected to an insulated terminal inside the terminal box. This terminal shall be clearly labelled and display a warning that it shall be solidly earthed during service.

6.3 Tanks

- a) The tank shall have an unpainted earthing flag of 5 mm × 50 mm × 100 mm (minimum), with two 14 mm holes at 50 mm centres arranged vertically. The flag shall be situated in close proximity to a tank mounting bolt hole on the same side as the terminal box.
- b) Alternative designs shall be submitted for approval, and, in the case of painted tanks, the underside of transformer tank mounting flanges shall be zinc metal sprayed, and shall not be painted.
- c) Corrugated tanks are not acceptable. Tanks and fittings shall be of such shape that water cannot collect at any point on the outside surfaces.

6.4 Hollow core insulators

- a) Insulators shall comply with SANS 60815-2 and SANS 61462.
- b) The name of the manufacturer and the country of origin of the HV insulators shall be stated in schedule B, and detailed drawings of the insulator shall be supplied with the tender. Permission shall be obtained from the purchaser before a change of insulator supplier during the course of a contract.

6.5 Mounting arrangement

- a) The base mounting arrangement for the CTs shall be such that it can be bolted to a support structure, with mounting holes arranged on the corners of a square of dimensions not exceeding those specified in schedule A.

6.6 Corrosion

Unless otherwise approved, all ferrous parts associated with current transformers shall either be:

- a) Hot-dip galvanized in accordance with SANS 121, of minimum coating thickness not less than 90µm; or
- b) Zinc metal sprayed in accordance with SANS 2063, of minimum coating thickness not less than 80µm.

Metallization shall be followed by a base coat and top coat in accordance with SANS 12944-5.

All materials shall be inherently corrosion-resistant or treated against corrosion for the design lifetime of the equipment.

6.7 Markings

6.7.1 Terminal Markings

The terminal markings shall identify:

- a) The primary and secondary windings,
- b) The winding sections, if any,
- c) The relative polarities of windings and winding sections and
- d) The intermediate taps, if any.

NB: Further clarity on terminal markings is provided in Table 208 of IEC61869-2.

6.8 Rating and diagram plates

The plate(s) shall be mechanically affixed e.g. screwed or riveted, to the equipment. Mounting by means of adhesives is not acceptable.

The plate(s) shall be manufactured from anodized aluminium or stainless steel and the material, and the method of mounting the plates, shall be stated in technical schedule B.

The plate(s) shall be externally fixed on a vertical surface of the main body of the CT, in close proximity to the terminal box and not to any removable part. The size of the characters shall be not less than 4mm.

The details as inscribed must be clearly visible from ground level during the day and to last the expected lifetime of the current transformer.

The following information shall be engraved or stamped into the rating plate:

- 1) Manufacturer's name
- 2) Year of manufacture, serial number and type designation
- 3) Rated primary and secondary current
- 4) The rated continuous thermal current if it is different from the rated primary current.
- 5) Rated short-time thermal current (I_{th})
- 6) Rated dynamic current (I_{dyn})
- 7) Rated frequency
- 8) Highest voltage of equipment
- 9) Rated insulation level
- 10) Mass in kg
- 11) Class of mechanical requirements (for $U_m \geq 72kV$)

- 12) On current transformers with two or more secondary windings, the use of each winding and its corresponding terminals

NB: Some items can be combined e.g. 24/50/150kV

6.9 Warranty

Eskom only accepts current transformers with a minimum warranty of 5 years.

7. Tests

7.1 General

7.1.1 Classification of tests

The tests specified in this standard are classified as follows:

- a) Type test: a test made on equipment to demonstrate that all equipment made to the same specification complies with the requirements not covered by routine tests.
- b) Routine test: a test to which each individual piece of equipment is subjected. Routine tests are for the purpose of revealing manufacturing defects. They do not impair the properties and reliability of the test object.
- c) Special test: a test other than a type test or a routine test, agreed on by manufacturer and Eskom.

7.2 Type tests

Unless valid and approved type test certificates specified in IEC 61869-1, IEC 61869-2 and in schedule A are available, type tests must be carried out on one fully assembled current transformer of each type and rating at an IEC approved test facility. The certificates of the tests shall be included in the test reports. Type tests shall be followed by routine tests. Type tests are listed in (a) to (g):

- a) Short-time current test
- b) Temperature rise test
- c) Lightning impulse test on primary terminals
- d) Wet test for outdoor type transformers
- e) Radio interference voltage (for current transformers with $U_m \geq 123\text{kV}$)
- f) Test for accuracy
- g) Verification of the degree of protection by enclosures

7.3 Routine tests

7.3.1 General

Each fully assembled current transformer shall be subjected to the routine tests mentioned below at the manufacturer's works to prove compliance to this specification.

- a) Verification of terminal markings
- b) Power-frequency withstand test on primary winding
- c) Partial discharge measurement
- d) Power-frequency withstand test on secondary terminals
- e) Power-frequency withstand tests between sections
- f) Test for accuracy

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- g) Capacitance and dielectric dissipation factor (tan delta) tests
- h) Determination of the secondary winding resistance
- i) Test for rated knee point e.m.f. and exciting current at rated knee point e.m.f.

7.3.2 Capacitance and dielectric dissipation factor (tan delta) tests

7.3.2.1 General

The main purpose is to check the uniformity of the production. Conduct this test after the power-frequency withstand test; this test is applicable to all oil-immersed paper-insulated current transformers with $U_m \geq 24$ kV. Record the tangent delta and the capacitance (C) readings at 10 kV on the information plate mounted on the tank for the purposes of condition monitoring.

7.3.2.2 Current transformers with $24\text{kV} \leq U_m < 52\text{kV}$

Raise the voltage applied between primary terminals bonded together and the earth screen terminal to 120% of $U_m / \sqrt{3}$. While the voltage is being raised, record the tangent delta measurements at voltages of 10kV, 100%, and 120% of $U_m / \sqrt{3}$. Thereafter, take the measurements in the reverse order back to 10kV, i.e. 100% and 10kV.

The current transformer is deemed to have passed the test when it meets the following two conditions:

- a) The absolute value of tangent delta readings at each step, during both excursions, is not more than 0.5% (i.e. 0.005) and
- b) The difference in percentage value between the reading at the maximum test voltage (120% of $U_m / \sqrt{3}$) and the reading at the minimum test voltage (10 kV) is not more than 0.0015.

7.3.2.3 Current Transformers with $U_m \geq 52\text{kV}$

Raise the voltage applied between primary terminals bonded together and the earth screen terminal to 120% of $U_m / \sqrt{3}$. While the voltage is being raised, record the tangent delta measurements at voltages of 10kV, 66.6%, 100%, and 120% of $U_m / \sqrt{3}$. Thereafter, take the measurements in the reverse order back to 10kV, i.e. 100%, 66.6% and 10kV.

The current transformer is deemed to have passed the test when it meets the following two conditions:

- a) The absolute value of tangent delta readings at each step, during both excursions, is not more than 0.5% (i.e. 0.005) and
- b) The difference in absolute value between the readings at the maximum test voltage (120% of $U_m / \sqrt{3}$) and that at the minimum test voltage (10kV) is not more than 0,001.

7.4 Special tests

When specified in schedule A, special tests shall be performed and may be specified as type tests. The following special tests which are listed and described in detail in IEC 61869-1 and IEC 61869-2 are required by Eskom:

- a) Chopped impulse voltage withstand test on primary windings
- b) Mechanical tests (applicable to current transformers with $U_m \geq 72.5\text{kV}$)
- c) Transmitted overvoltage test (applicable to current transformers with $U_m \geq 72.5\text{kV}$)
- d) Internal arc fault test (applicable to current transformers with $U_m \geq 72.5\text{kV}$)
- e) Corrosion test

7.4.1 Mechanical tests

When the mechanical tests on primary terminals are specified in schedule A, the applied design factor of safety shall be at least 2.

7.5 Test certificates (Routine tests certificates)

- a) Each CT shall be delivered with one copy of all routine test certificates together with a copy of the excitation curve showing clearly where the knee-point occurs for each protective core and, in the case of multi-ratio windings, stating to which ratio the curve applies.
- b) These certificates and curves shall be packed in a waterproof container and housed inside the terminal box of each respective current transformer.
- c) All tests shall be fully documented in English, signed by the relevant (competent) manufacturer's personnel and stamped.
- d) Electronic copies must be stored by the manufacturer for a period not less than 10 years and be made available to Eskom upon request.

7.6 Works inspections and witnessing of tests

- a) Eskom reserves the right to appoint a representative to inspect the current transformers at any stage of manufacture, or to be present at any of the tests specified.

8. Marking, labelling and packaging

- a) The marking, labelling and packaging details are to be submitted to Eskom for approval prior to manufacturing.
- b) Imported CTs shall be packaged in robust wooden crates and suitably supported in order to protect the CT from the stresses of normal handling that can be expected from the point of despatch to the point of construction.
- c) Crates must be designed such that inspection can be effected without opening or damaging the crate. The crate must be able to be lifted by slings with lifting points clearly marked. Any special handling requirements shall be clearly specified to purchaser before delivery and shall be clearly specified on packaging.
- d) Packaging shall not disintegrate due to exposure to rain and direct sunlight during outdoor storage and the construction period of 18 months in total. The manufacturer/supplier shall notify the purchaser of any special methods recommended for storage prior to delivery, and on packaging materials.
- e) If CTs are packed in crates on pallets, the gross weight of the pallets shall not exceed 1 800 kg. Pallets shall be suitable for handling by forklift trucks, capable of entry from both sides. All boxes, pallets or containers shall be clearly marked in accordance with the following example, or similar approved template:
 - 1) Eskom Order No.:
 - 2) Eskom SAP No.:
 - 3) Project Name:
 - 4) Project Number:
 - 5) Delivery Address:
 - 6) Supplier's Name:
 - 7) Supplier's Serial No.
 - 8) Technical Description of current transformers
 - 9) Gross Weight:

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8.1 User manual

- a) The manufacturer must provide Eskom with an electronic user manual in pdf format specifying the following details:
- 1) Packaging,
 - 2) Handling (correct handling and slinging methods),
 - 3) Transportation,
 - 4) Installation,
 - 5) Storage (short and long terms) and
 - 6) Maintenance

9. Documentation

9.1 Tender documentation

- a) The following technical information and drawings shall be submitted as part of the tender:
- 1) Completed technical schedule(s),
 - 2) Technical deviation sheet if there are deviations to Eskom's requirements,
 - 3) Current transformer outline drawing(s),
 - 4) Detailed drawing of the insulator(s),
 - 5) Instruction / user manual(s) and
 - 6) Type test reports

Unless otherwise specified in schedule A, one hard copy and one digital copy of all documentation pertaining to the equipment offered shall be supplied. The digital copy shall be compatible with "Adobe Acrobat pdf" format. All information shall be in English.

9.2 Contract documentation after tender award

- a) The following drawings and technical information shall be submitted for final approval after the contract is awarded but before manufacturing can commence:
- 1) Outline drawing,
 - 2) Section drawing,
 - 3) Terminal box drawing (internal),
 - 4) Detailed drawing of the rating plate,
 - 5) Scheme diagram,
 - 6) Instruction / user manual and
 - 7) Typical routine test sheet.

10. Drawings

10.1 Details of drawings

10.1.1 Outline drawing

A outline drawing that shows the following minimum information shall be provided for each type of CT such that the physical arrangement can be correlated with the electrical schematic arrangement:

- a) Nominal voltage, normal current, short-circuit withstand current and durations in the title block,
- b) The type of insulating material,
- c) Mounting details,
- d) Primary terminal dimensions and markings,
- e) Overall dimensions,
- f) The position of the earthing terminal,
- g) The height of the gland plate in the secondary terminal box above the base, and the distance of the terminal box centre-line from the centre-line of the CT,
- h) The total creepage and the arcing distance of the hollow core insulator; and
- i) The mass of the complete CT and the volume of the oil.
- j) Allowance for the inclusion of:
 - 1) Eskom SAP number and
 - 2) Eskom drawing number

Note: The numbers shall be incorporated in the drawing upon issue.

10.1.2 Section drawing

A sectional arrangement drawing, which depicts the following details, shall be supplied with other drawings after contract award:

- a) The relative position of the core and windings,
- b) The hollow core insulator,
- c) Oil-sealing arrangement,
- d) The method used to accommodate expansion of the oil and
- e) Pressure-relief device, where applicable

10.1.3 Insulator drawing

A detailed drawing of the insulator showing all important dimensions shall be provided.

10.1.4 Terminal box

A detailed drawing of the terminal box showing the following:

- a) Method of affixing the cover,
- b) Position and dimensions of the gland plate,
- c) Arrangement and clearances of the secondary terminals, creepage extension barriers, if applicable, and markings; and
- d) Breathing arrangement

11. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Sibongile Maphosa	Engineer (TX AME – Substation Equipment & Diagnostics)
Bheki Ntshangase	Senior Manager (TX AME – Substation Equipment & Diagnostics)

12. Revisions

Date	Rev	Compiler	Remarks
Nov 2021	3	S. Maphosa	Addressed comments from OUs and Grids.
April 2021	2	S Maphosa M Hlakudi	Changed the content from being Eskom requirements only to being a fully-fledged standard. Added ratings, design and test requirements
Feb 2012	1	G Strelec	Transmission and distribution division requirements combined in new revision. 4.1.1 Primary terminal connections changed to tinned copper studs with dimensions in relation to the continuous rating. 4.1.3.1 Insulation creepage rationalized to extra-heavy pollution class in accordance with SANS 60815. Protection class 'TPS' changed to class 'PX'. 4.2 Low ratio 200/1 metering CTs added for 66 kV and 132 kV applications. 3 150 A rated CT added for 132 kV. Transmission specific item added: BZ 2 400/1T. 4.3 Format for core arrangements and tapping requirements revised.

13. Development team

The following people were involved in the development of this document:

- Sibongile Maphosa

14. Acknowledgements

The development team would like to acknowledge all members of the Instrument Transformers Care Group who contributed to this standard.