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Title

Technical requirements Instrument transformers

E.ON Energidistribution AB Technical requirements for Instrument transformers

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1 General

1.1 Scope

These requirements cover the general demands of E.ON Energidistribution AB in respect of instrument transformers for voltage and current.

The requirements apply to the highest voltage for equipment 12-145 kV, rated frequency 50 Hz for indoor or outdoor designs.

These requirements are complement to the requirements set out in the Facility Directive Regional Network.

These requirements are a translation to the Swedish requirements D10-0015688. If the content of this document differs from the Swedish version, the Swedish requirements shall prevail.

1.2 Standards

The transformers shall be designed, manufactured and tested in accordance with the most recent edition of applicable Swedish standards. In the absence of such standards, the European Standard (EN) and IEC publications apply.

In the event of disparities between this document and the relevant standard, these Technical Requirements shall apply.

1.3 Labelling

Rating plates for instrument transformers shall contain all the rated data for the transformer. An additional rating plate shall be placed affixed and clearly visible in the secondary side junction box.

2 Changes relative to previous issue

Changes are marked with a vertical line in the right-hand margin.

3 Electrical and mechanical requirements

3.1 Design

Indoor instrument transformers and all cable current transformers shall be dry type.

Outdoor instrument transformers shall be of oil free type or contain minimum amount of oil. Cast resin are only allowed in water protection areas up to 72.5 kV.

Instrument transformers that contain oil shall have a hermetically sealed casing with expansion space for the oil and be equipped with an oil level indicator.

3.2 Core data, current transformers for phase currents

Rated primary current shall be selected to multiples of the following:
10, 12.5, 15, 20, 25, 30, 40, 50, 60 or 75 A.

The current transformer shall have interchangeable ratios with a factor of two between two primary currents, for example, 150-300 A. Changes between the two ratios shall be performed either on the primary side (externally) or on the secondary side.

Cable type current transformers shall have a fixed ratio.

Secondary current shall be 5 A for 12-36 kV, 2 A for the measurement cores in current transformers 52-145 kV and 1 A for relay cores 52-145 kV.

Current transformers shall normally be equipped with one measurement core. If the current transformer is used for customer measurements, it shall be equipped with two measurement cores.

Current transformers shall at a minimum be equipped with the relay cores specified below:

12-36 kV:	1 relay core
52-82.5 kV:	2 relay cores
145 kV:	3 relay cores

Relay cores shall be designed in class 5P20 and measuring cores in class 0.2S, Fs5. Class 0.2S shall be able to realize from 1 VA.

The current transformer's burden shall be optimized to respective facility plant. The burden shall be selected for multiples of 5 VA. Current transformers indoor in metal-enclosed medium voltage switchgear, the rated power must be at least 10 VA for both relay and measurement cores.

For remaining (other) current transformers, the rated power must be at least 15 VA.

Continuous thermal rated current shall be 120% of the highest rated primary current.

3.3 Cable core current transformers for residual current.

Cable core current transformers for residual current are installed in the medium voltage grids (12 to 36 kV) to feed earth fault protections.

The primary current shall be 100 A and the secondary current shall be 1 A, i.e. the ratio shall be 100/1.

The cable core current transformer shall have one relay core designed in class 5P20. There shall be no measurement core.

The rated output shall exceed 1 VA.

The inner diameter of the transformer shall be at least 180 mm.

3.4 Winding data voltage transformers

The following ratios are selected for the connection of the voltage transformer between phase and earth or between neutral-point and earth:

Highest voltage for equipment (kV)	Ratio primary winding (kV)	Ratio secondary winding (kV)	Ratio residual voltage winding (kV)
12	$11/\sqrt{3}$	$0.11/\sqrt{3}$	0.11/3
24	$22/\sqrt{3}$	$0.11/\sqrt{3}$	0.11/3
36	$33/\sqrt{3}$	$0.11/\sqrt{3}$	0.11/3
52	$44/\sqrt{3}$	$0.11/\sqrt{3}$	0.11/3
72.5	$55/\sqrt{3}$	$0.11/\sqrt{3}$	0.11/3
145	$143/\sqrt{3}$	$0.11/\sqrt{3}$	0.11/3

The residual voltage winding is designed in class 3P and the measurement winding in class 0.2 and 3P. The voltage transformer's burden is optimised according to the facility in question. However, accuracy shall be possible to maintain for a change in the burden with +50 % from the existing conditions. Class 0.2 shall be possible to realise down to 1 VA. The burden shall be selected to multiples of five.

Rated voltage factor for voltage transformers is stated in the table below.

Highest voltage for equipment (kV)	Rated volt. factor		
	Continuous	8 hours	30 seconds
12-36	1.2	1.9	
52-72.5	1.2		1.9
145	1.2		1.5

3.5 Electrical connections

In the secondary outlet box for instrument transformers there shall be clamps for earthing cable cross sections up to 6 mm².

Instrument transformers shall be equipped with the possibility to connect clamps for earthing with the following maximum cable cross sections:

Highest voltage for equipment (kV)	Clamp for Cu-line (mm ²)
12-72.5	1 x 95
145	2 x 120

3.5.1 Current transformers

Primary connections on current transformers shall be dimensioned after the highest primary current and designed the following to the following directions.

12-36 kV

Connections shall be designed for at least M10 screw.

52-145 kV

High voltage connections shall be made of aluminium or silver-plated copper/copper alloy as set out in appendix 1.

3.5.2 Voltage transformers

12-36 kV

Connections shall be possible to make with conductor or rails of copper or aluminium.

52-145 kV

High voltage connections shall be attached by copper or aluminium conductor.

3.6 Mechanical design

The instrument transformer shall be dimensioned for occurring static and dynamic forces in the most unfavourable direction.

12-36 kV

The attachment for instrument transformer shall be according to DIN 42600-8.

4 Functional requirements

The cable diameter in question shall be taken into consideration when designing cable type current transformers.

5 Testing

Unless otherwise specified, testing shall conform to the scope and the requirements for test results set down in applicable standards.

Test equipment used for delivery testing shall have documented traceability to accredited national and international laboratories.

Present measurement values shall be traceable to international units.

5.1 Testing of current transformers

Current transformers shall prior to delivery/installation be individually tested by the manufacturer according to the following:

Test	Tested for	Test result to be stated	
Current dependent	1, 5, 20, 100 and 120 % of In	Ratio error (%)	Angle error (min)
Burden dependent	1 VA, 25 and 100 % rated burden at above % of In	Ratio error (%)	Angle error (min)
Accuracy limit factor	Type test or all test	The constants a and b	

For current transformers with highest voltage for equipment 72.5-145 kV the insulation shall be measured ($\tan \delta$) at room temperature according to IEC 61869-1 chapter 7.4.3 and also if possible, up to full rated power frequency withstand voltage according to chapter 7.3.1.

5.2 Testing of voltage transformers

Voltage transformers shall prior to delivery/installation be individually tested by the manufacturer according to IEC 61869-1 chapter 7.3 and according to the following:

Test	Tested for	Test result to be stated	
Voltage dependent	80 and 120 % of Un	Voltage fault (%)	angle error (min)
Burden dependent	1 VA, 25 and 100 % of rated burden for the above % of Un	Voltage fault (%)	angle error (min)

6 Documentation

Current transformer's values for ALF and Rct shall be specified.
Details of thermal limit burden for voltage transformers shall be specified.
The FAT protocol shall be provided to the customer. The protocol shall include documented measure accuracy and measure uncertainty and traceability to the used accreditable laboratory.

7 Appendices

Appendix 1 Primary connections

Terminals										
For max current (A)	Cylindrical		Hole numbers	Flat						Notes
	diam (mm)	length (mm)		Sizes (mm)						
				a	b	c	d	e	fig	
Al										
400	30	125	2	75	19	40	14	10	1	
1250	30	125	4	75	17,5	40	14	15	2	
1600	40	125	-	-	-	-	-	-	-	
2500	60	125	-	-	-	-	-	-	-	
3150	-		9	125	22,5	40	14	35	3	4000A when double sided
4000	-		12	125	22,5	40	14	35	4	5000A when double sided
Cu										
1600	30	125	-	-	-	-	-	-	-	
2500	40	125	4	75	17,5	40	14	10	2	
4000	60	125	-	-	-	-	-	-	-	
6300	-	-	4	100	25	50	18	15	2	double sided
8000	-	-	4	125	30	65	18	18	2	double sided

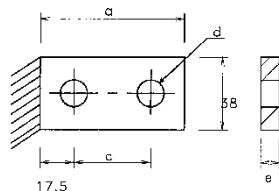


Fig 1

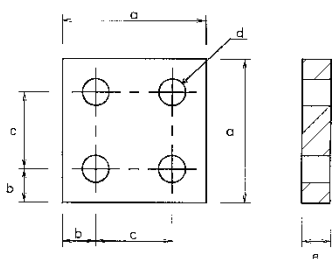


Fig 2

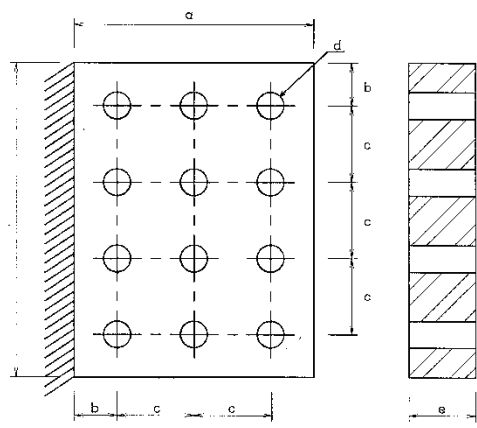


Fig 4

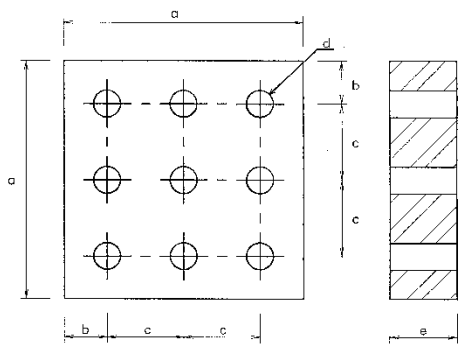


Fig 3

Note! The current value above refers to the maximum load current including the overload capacity of the apparatus.