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TECHNICAL SPECIFICATIONS OIL-IMMERSED DISTRIBUTION TRANSFORMERS

REVISION HISTORY

Revision	Date	Comment	Reviewed by
3.0	2022-02-12	Added isolation transformer 0.4/0.4 kV	Nätkommitté
2.0	2021-11-23	Added 1250 kVA. Change of impedance of 1000 kVA to standard 6%.	Nätkommitté
1.0	2021-08-12	Merging two separate technical specifications for Rural and Stockholm. Revised content.	Nätkommitté

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1 STANDARDS

SS-EN 60076 (all parts)	Power transformers
SS-EN 50588-1	Medium voltage transformers 50 Hz, with highest voltage for equipment not exceeding 36 kV – Part 1: General requirements
SS-EN ISO 12944 (all parts)	Surface treatment
SS-EN 50180	Insulators-Bushings above 1 kV up to 52 kV
SS-EN 50386	Insulators-Bushings up to 1 kV
SS-EN 50216 (parts -1/-4/-5/-11)	Transformer and Reactor accessories
SS-EN 60296	Insulating oils
SS-EN 60085	Electrical insulation — Thermal evaluation and designation
SS-EN 60505	Evaluation and qualification of electrical insulation systems
SS-EN 61100	Classification of insulating liquids according to fire point and net calorific value

2 TYPE

Distribution transformers for three-phase distribution networks, oil-immersed hermetically sealed without expansion vessel for installations in secondary substations or poles. To be operated as one single transformer or two parallel transformers and some distribution transformers with reactors.

3 COOLING

ONAN (oil natural, air natural)

4 DESIGN VOLTAGE

0.4 kV, 7.2 kV, 12 kV and 24 kV

5 FREQUENCY

50 Hz

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6 RATED POWER, VOLTAGE RATIO AND CONNECTIONS

Distribution transformer ONAN		
Rated power	Voltage ratio	Connections and clock hour figure
50, 100, 200, 315, 500, 800, 1000, 1250 kVA	11000 V $\pm 2 \times 2.5\%$ / 420 V	Dyn11
50, 100, 200, 315, 500, 800, 1000, 1250 kVA	22000 V $\pm 2 \times 2.5\%$ / 420 V	Dyn11
50, 100, 200, 315, 500, 800, 1000, 1250 kVA	6350-11000 V $\pm 2 \times 2.5\%$ / 420 V ⁽¹⁾	Dyn11
100, 200, 315, 500, 800, 1000, 1250 kVA	11000-22000 V $\pm 2 \times 2.5\%$ / 420 V ⁽¹⁾	Dyn11
50,100 kVA	420 V / 420 V	Dyn11
Distribution transformer with reactor ONAN		
Rated power	Voltage ratio	Connections and clock hour figure
100, 200, 315 kVA	11000 V $\pm 2 \times 2.5\%$ / 420 V	Znyn11+d
100, 200, 315 kVA	22000 V $\pm 2 \times 2.5\%$ / 420 V	Znyn11+d

⁽¹⁾ Switchable transformers

7 TRANSFORMER WITH REACTOR

Transformer with built-in reactor is able to withstand its own compensation current and power mains transformer rated load current in 5 minutes.

Relationship R / X of the total zero sequence impedances (measured from 22 or 11 kV side) shall be voltage independent and less than 2.5%.

The variation of zero sequence impedance, as a function of voltage (up to $U_m / \sqrt{3}$) shall be less than 2%. U_m = reactor rated voltage.

For the 22 kV system, 100, 200 and 315 kVA transformer with 15 A coil pursued.

For the 11 kV system, 100, 200 and 315 kVA transformer with 10 A coil pursued.

8 TERMINAL MARKINGS

Marking of terminals A, B, C for the high voltage terminals and n, a, b, c for the low voltage terminals from left to right when the transformer is viewed from the outside in the direction of the high voltage side.

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9 RATED WITHSTAND VOLTAGE FOR SHORT IMPULSES

Maximum values 60 kV (7,2 kV), 75 kV (12 kV) and 125 kV (24 kV) short impulse tests are to be conducted in connection with type testing.

Note: Maximum rated voltage, U_m , for isolation transformer (voltage ratio 420 V /420 V) is 12 kV.

10 RATED WITHSTAND VOLTAGE FOR SHORT PERIOD ALTERNATING VOLTAGE

20 kV actual value (7,2 kV), 28 kV actual value (12 kV) and 50 kV actual value (24 kV).

Note: Maximum rated voltage, U_m , for isolation transformer (voltage ratio 420 V /420 V) is 12 kV.

11 SHORT-CIRCUIT IMPEDANCE

Short-circuit impedance at a reference temperature of 75 °C according to table. Tolerance +0 and -10 %.

Rated power	Short-circuit impedance
50, 100, 200 kVA	3.5 %
315, 500 kVA	4 %
800 kVA	4.5 %
1000, 1250 kVA	6 %

12 SHORT-CIRCUIT SAFETY

The transformers shall withstand an external short-circuit current of 20 kA (7,2 kV), 20 kA (12 kV) and 16 kA (24 kV) for 1 second in the supply network.

Note: For 24 kV the requirement is higher than in SS-EN 60076-5.

13 INRUSH CURRENT

The Supplier shall state maximum, and typical, amplitude of the inrush current and duration of the inrush current.

Inrush currents shall not exceed the values as listed in the table below. The inrush current needs to be limited to work with the fuse used for each distribution transformer. The table below show maximum allowed current with 0.1 seconds duration for commonly used fuses by transformer size.

Rated power	Max inrush current, 12 kV	Max inrush current, 24 kV
50 kVA	44 A	21 A

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100 kVA	75 A	44 A
200 kVA	120 A	70 A
315 kVA	160 A	80 A
500 kVA	240 A	120 A
800 kVA	390 A	175 A
1000 kVA	450 A	240 A
1250 kVA	630 A	330 A

Note: Above table of maximum inrush current is not applicable for isolation transformer (voltage ratio 420 V /420 V).

14 SOUND LEVEL

Maximum sound power level (L_w) in dB(A) for all transformers.

Rated power	Max sound power level (L_w)
50 kVA	38 dB(A)
100 kVA	40 dB(A)
200 kVA	44 dB(A)
315 kVA	48 dB(A)
500 kVA	50 dB(A)
800 kVA	52 dB(A)
1000 kVA	54 dB(A)
1250 kVA	55 dB(A)

Note: Sound power levels are taken from SS-EN 50588-1.

Sound power level (L_w) and sound pressure level (L_p), both in dB(A) without zero positive tolerance specified in the tender.

Option for 800 kVA: Specified value -5 dB(A).

15 LOSSES

For all transformers covered by the Commission Regulation (EU) "Ecodesign": Maximum losses shall not exceed applicable values listed.

Maximum no load loss (P_0) for transformers AA_0 according to Table 2 in SS-EN 50588-1.

Maximum load loss (P_k) for transformers A_k according to Table 3 in SS-EN 50588-1.

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Rated power	No load loss (P0)	Load loss (Pk)
50 kVA	81 W	750 W
100 kVA	130 W	1250 W
200 kVA	225 W	2020 W
315 kVA	324 W	2800 W
500 kVA	459 W	3900 W
800 kVA	585 W	6000 W
1000 kVA	693 W	7600 W
1250 kVA	855 W	9500 W

Note: Switchable transformers can have slightly higher losses according to SS-EN 50588-1.

No-load losses (P0) specified for given rated voltage without zero positive tolerance. No-load current at the specified rated voltage is to be specified by the supplier.

Load losses (Pk) specified by the supplier at 1/1 current, at specified rated voltage and 75 °C winding temperature without zero positive tolerance.

16 OVERLOAD CAPACITY

At an air temperature of 40 °C and after continuous operation at the rated load, the transformer shall be able to be loaded with 125 % load for 2 hours, twice a day with an interval of 8 hours in between without reaching a damaging temperature with abnormal aging. The calculated temperature rise in the event of overload is to be specified by the supplier of the winding and of the oil.

17 HEATING AND OVERLOAD TESTS

The transformer is to be heat-tested under full load and at an overload level of 125 % for 2 hours.

18 WINDINGS

Winding material for HV and LV is specified in the tender.

19 HIGH VOLTAGE OUTLETS

The transformer shall be equipped with normal outdoor bushings, with M12 threaded tap and associated brass nuts and washers, for the mounting of cable connection.

Note: For isolation transformer (voltage ratio 420 V /420 V) both primary and secondary outlets shall be equipped with high voltage bushings. Connection palms must have ability of connecting with copper or aluminum conductors.

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20 LOW VOLTAGE OUTLETS

The transformer shall be fitted with normal outdoor bushings, low-voltage palm design specified in the tender by the supplier.

For 50 to 200 kVA: Flags with centre hole.

For 315 and 500 kVA: Flags with two holes.

For 800 kVA: Connection palms of aluminum shall have the possibility of connecting with copper. Hole pattern of the connection palm is a square with a hole in each corner, in total four holes. Minimum center distance in the pattern shall be 60 mm. Total minimum dimensions shall be L x W: 120 x 120 mm. The holes shall have a diameter of 18 mm.

For 1000 and 1250 kVA: Flags with four holes.

21 DE-ENERGIZED TAP-CHANGER

It shall be possible to operate transformer tap changer above the lid with five positions (+/-2x 2.5 %) for selection when in a voltage free state, and they shall be labeled in volts (V) not in percentages. They shall be easy to read from both sides. Numbered positions are acceptable if the numbers and the voltage values that they correspond to are given on the rating plate.

Note: Not applicable for isolation transformer (voltage ratio 420 V /420 V).

22 TEMPERATURE MEASUREMENT

For 800 kVA: Thermometer pockets shall be present at both ends at the high voltage outlet.

Option for 800 kVA: The transformer shall be equipped with a contact thermometer installed in one of the thermometer pockets. The thermometer shall have a scale 10-120 °C. It shall be easy to access the reset arrangement. Two adjustable signal contacts are to be provided with separate electrical circuits for 230 V and 5 A and a maximum value display. It shall later be possible to move contact thermometer to the other pocket, e.g. at installation.

Option for 800 kVA: The transformer shall be equipped with a temperature sensor Pt100 with 2-wire circuit, screw terminal block for connection of wire, with housing adapted for the transformer, installed in one of the thermometer pockets. It shall later be possible to move temperature sensor to the other pocket, e.g. at installation.

Option for 315, 500, 1000 and 1250 kVA: Thermometer pocket shall be present at the high voltage outlet. Temperature sensor Pt100 with 2-wire circuit, screw terminal block for connection of wire, with housing adapted for the transformer, installed in the thermometer pocket.

23 TRANSFORMER BOX

Hermetic, type of sealing specified in the tender. The case shall withstand endurance testing for repeated variations in pressure from ambient temperature -40 °C totally filled.

24 GASKETS

Gaskets shall be of cork-rubber, oil-resistant nitrile rubber, or the equivalent.

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25 OIL

Transformer oil shall be included in the delivery. Transformer oil shall be provided with an inhibitor and it shall be free of PCBs.

26 TAPS

Oil removal taps shall be fitted.

27 RATING PLATE

It shall be possible to place the rating plate at a freely chosen location around the transformer below the level of the cover. Note that the rating plate shall be according to standards. The values for losses (P0 and Pk) shall also be shown on the rating plate for transformer with reactor. Text written in Swedish or English.

28 LIFTING HOOKS

Hooks for lifting the complete transformer. Towing eyelets for pulling both longitudinally and transversely.

29 INSTALLATION

For 50 to 200 kVA (which can be used for pole mounted applications): The transformers shall be equipped with mounting bolts (M10) for transformer support. These mounting bolts shall be located on the low voltage terminals side.

Option for 500, 800, 1000 and 1250 kVA: Removable, plane, adjustable wheels in longitudinal and transverse directions. Wheels shall be made of steel. According to SS-EN 50216-4.

Option for 800 kVA: Rubber vibration damper under wheels adapted to transformer weight.

30 EARTHING

For 50 to 500 kVA, 1000 and 1250 kVA: According to standard.

For 800 kVA: Earthing outlets shall be mounted on both sides of the lower section of the transformer and on its cover in the vicinity of the low voltage outlets. Each outlet shall be suitable for connection of two 95 mm² Cu earth lines fitted with contact pressed cable lugs.

31 SURFACE TREATMENT

The transformer shall be surfaced according to a method, which at least protects against corrosion in an environment that is assigned to corrosively class C4, according to SS-EN ISO 12944. Metal parts in the sealing shall be made of materials protective against corrosion.

Transformers rated 50 to 200 kVA shall be hot dip galvanized.

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32 OIL FILLING

As per supplier standard.

33 WEIGHTS

Maximum total weight in table. Total weight and oil weight reported in tender.

Distribution transformer ONAN	
Rated power	Weight
50, 100, 200 kVA	1100 kg
315, 500, 800, 1000, 1250 kVA	3500 kg
Distribution transformer with reactor ONAN	
100, 200, 315 kVA	3500 kg

34 DIMENSIONS

Maximum dimensions in table. Dimensions reported in tender.

Distribution transformer ONAN			
Rated power	Length mm	Width mm	Height mm
50, 100, 200 kVA	1070	740	1200
315 kVA	1270	900	1400
500, 800 kVA	1600	1000	1700
1000, 1250 kVA	1800	1000	2000
Distribution transformer with reactor ONAN			
Rated power	Length mm	Width mm	Height mm
100, 200 kVA	1400	800	1700
315	1800	1000	2000

35 GENERAL ASSEMBLY DOCUMENTS

Documentation to be included with each delivery. One copy in paper form accompany each transformer in an appropriate way. One digital copy (in PDF format) to be sent to the person specified in the order form:

- Report on routine tests performed.

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- Guarantee for PCB free transformer oil.
- Assembly instructions containing a list of torques or pressure forces for screws that are part of the high voltage, low voltage and earthing connectors, together with instructions for handling.

Documentation to be enclosed with the invoice as a digital copy (in PDF format):

- Report on routine tests performed.

Documentation as a digital copy (in PDF format) for all transformers and options shall be delivered no later than three (3) months after contract signing. All updates shall also be delivered continuously. A new complete package of all drawings shall be delivered on request.

- Type protocols of heat tests and impulse voltage tests.
- Sound power level and sound pressure level report.
- Oil specification.
- Technical drawings as PDF format.
- Assembly instructions containing a list of torques or pressure forces for screws that are part of the high voltage, low voltage and earthing connectors, together with instructions for handling.