

# Technical Specification

## for

### Oil insulated Transformers

### $U_m \leq 24$ kV up to 1250 kVA

This technical specification is valid for the business unit E.ON Sweden of the market unit E.ON Nordic.

With this specification, technical determinations were made beyond existing publications.

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## 1. Scope

This requirement specification relates to oil-insulated distribution transformers in accordance with SS 427 02 01-1.

### Standards

The transformer shall comply with the requirements of SS 427 02 01-1. This requirement specification is a supplement, which in connection with each part of the standard notes specific items that will result in changes, additions or that require further explanation. Should the information provided in this requirement specification deviate from SS 427 02 01, the information in the specification will apply.

In addition to the list of standards provided in SS 427 02 01-1, reference is made in the requirement specification to the following standards:

SS-EN 60296 Fluids for electro technical applications-Unused mineral insulating oils for transformers and switchgear.

SS-EN 50180 Bushings above 1 kV up to 36 kV and from 250 A to 3,15 kA for liquid filled transformers.

SS-EN 50386 Bushings up to 1 kV and from 250 A to 5 kA, for liquid filled transformers.

SS-EN 60076-1 Power transformers – part 1 : General

SS-EN 60076-10 Power transformers - Determination of sound levels.

IEC 60076-7 Power transformers-part 7: Loading guide for oil-immersed power transformers.

SS ENISO 1461 Inorganic surface layer – Galvanizing – Guidelines and requirements

SFS 2646 Truncated lighting pulse test method  
(Finnish standard)

BSK 99 Steel structures  
DIN 42554 Thermometer pocket

## 2 Electrical data

### 2.1 Rated output

The rated power values are:

50-100-200-315-500-630-800-1000-1250 kVA

Continuous operation, overloadable according to IEC 60076-7

### 2.2 Maximum voltage

The maximum voltage values for equipment are:

a) For high-voltage winding:

7.2-12-24 kV.

## 2.3 Rated voltage

a) For high-voltage winding:

Rated voltage  $U_r$ , shall be in accordance with values given in Table I.

Table I

$U_m$ (kV)	7.2	12	24
$U_r$ (kV)	6.35	11	22

b) For low-voltage winding:

Rated voltage shall be 420 V.

## 2.4 Volt switching.

### 2.4.1 Tap changer for off-voltage switching

The tap changer shall have a switching area of  $\pm 2 \times 2.5\%$ .

The external parts of the switchgear shall be made from corrosion- and UV-resistant material.

The switchgear shall have an efficient position lock and shall be constructed so that maneuverability is not impaired by oxidation or bimetallic corrosion. In his tender, the supplier shall designate the make and type of switchgear with which the transformer is equipped.

### 2.4.2 Changing voltage

It shall be possible to conduct a voltage change with the switchgear above the closing cover. In regard to the construction of the switchgear, the same requirements apply as in point 2.4.1.

## 2.5 Coupling type

The transformer shall be designed with a Dyn 11 type of coupler

## 2.6 Short-circuit impedance

For 50-630 kVA: 4%

For more than 630 kVA 6%

## 2.7 Losses and noise levels

No load-losses and load losses values are calculated based on optimal cost effectiveness and cost per kilowatt.

Without positive tolerance

Noise level shall not exceed 54 dB(A). Measurements shall be made in accordance with IEC 60076-10.

## 2.8 Insulation and insulation testing

### 2.8.1 Insulation level

The transformer shall be designed with an insulation level in accordance with table 2 in IEC 60076-3, with the exception of the test voltage on the low-voltage side, which shall be 5 kV during alternating current tests.

### 2.8.2 Routine tests

Routine tests on all transformers shall be conducted in accordance with IEC 60076-1, clause 10.

### 2.8.3 Type tests

The purchaser has the right to demand new type tests on each new delivery.

The following two type tests shall be performed on all transformer sizes:

1. Temperature-rise test in accordance with IEC 60076-2
2. Insulation test, with short impulse, in accordance with IEC 60076-3

### 2.8.4 Special tests

#### Truncated lighting pulse

All transformer sizes ≤200 kVA shall be type tested with three truncated lighting pulses. The pulse wave should be negative and have a linear front slope of at least 2000 kV/μs. The test is conducted on a three-phase basis three times on each phase. Truncation is achieved through a spark-gap switch furnished by the purchaser. The air-gap for 11kV shall be 42 mm and 82 mm for 22 kV.

The test shall be carried out according to the Finnish standard SFS 2646.

A representative of the purchaser shall have the right to be present during the delivery test. The date and time of the test and the test program shall be advised no later than 14 days prior to the delivery test.

## 3 Design requirements

### 3.1 Type of oil system and degree of sealing

These requirement specifications relate only to hermetically sealed transformers.

The delivery shall include the required transformer oil, type Nytro 10X. This should be naphtha-based and furnished with a minimum concentration of 0.3 percent by weight of oxidation inhibitor, type ditertiary-butyl-para-cresol (DBPC). If another type, for example a paraffin-based oil is intended, this must be reported, both in the documentation and through notification on the rating plate of the transformer. The dielectric strength of the oil shall be at least 55 kV. The oil shall meet other requirements in accordance with SS-EN 60296.

The supplier shall provide a written guarantee that the transformer oil does not contain PCB. The PCB content must be below the limit of detectability. If on delivery an oil sample from the transformer contains PCB, the purchaser has the right to reject the transformer. The supplier is then liable to repay any payments already made and to recompense the purchaser for other expenses incurred.

The transformer shall be capable of accepting a maximum top oil temperature of +115 °C.

The transformer tank shall be tested for leaks with a penetrant fluid.

The tank must be designed for a minimum rupturing pressure of 0,6 bar.

The difference between operating pressure at nominal power and rupturing pressure must be at least 0,3 bar.

If a hermetically sealed transformer is equipped with a pressure switch, the switch must have an opening pressure that is 10% higher than the maximum pressure in the tank at a top-oil temperature of +115 °C.

An aperture for oil refilling purposes shall be provided in the transformer closing cover, with a threaded connection of at least M 20.

A drain valve with a threaded connection and a protective cover shall be available on all sizes of transformers. The drain valve shall be placed on the bottom of the transformer tank on the operations side. The operations side is the short side on the right, viewed from the high-voltage side. DIN 42551.

Both the refilling aperture and the drain valve shall be sealed.

### 3.2 Terminal and tapping markings

The terminal and tapping markings shall be in accordance with IEC 60616. From left to right, viewed from the high-voltage side: A-B-C for high voltage and n-a-b-c low-voltage terminals.

The terminals shall be marked with resistant metal plates. The texts shall be embossed or stamped on the metal plates. The plates shall be attached with metal fasteners to the transformer. Signs attached by glue are not permitted. These requirements also apply to signs for marking the position of such operating units as tap changers and voltage regulators.

### 3.3 Terminals

Bushing shall be carried out in accordance with SS-EN 50386 on the low-voltage side and SS-EN 50180 on the high-voltage side, with open bushing as standard. Plug-in type bushings shall be shown as options in the tender for ≥500 kVA transformers. Exterior live parts shall be constructed in copper or copper alloy. It shall be possible to replace the exterior porcelain insulator without the requirement of lifting the transformer out of its tank.

Transformers with a rated output of ≤315 kVA shall be delivered with three nuts and two plain washers for each connecting bolt. Spring washers are not permitted. The correct tightening torque for the nuts to the connecting bolts shall be stated on the transformer.

Transformers with a rated output of ≥ 500 kVA shall be designed to include the possibility of connecting cables with cable clips on the low-voltage side. The cable clips are fastened with one bolt per cable clip. Cable clip types E08 251 00 and E08 251 03. The number of cables with cable clips to be connected to each phase and natural is shown in table III. The LV contact flange shall then be adapted accordingly.

Table III

Rated output (kVA)	Phase (number x area in Cu mm <sup>2</sup> )	Zero (number x area in Cu mm <sup>2</sup> )
500	2 x 300	2 x 300
630-1000	2 x 400	2 x 400
1250	3 x 400	2 x 400

Screws, nuts and washers for the contact flange shall be of the same material as the flange, or of stainless steel of ISO-class F1 or A2. Spring washers are not permitted. The correct tightening torque for each screw joint shall be stated on the transformer.

Cable connection clips for the protective earthing/grounding of the transformer shall be fitted with caps. Transformers with a rated output of  $\leq$ 315 kVA shall be fitted with a connection clip for the protective earthing/grounding of the closing cover.

### 3.4 Signs

Rating sign displaying information in accordance with SS-EN 60076-1.

Rating signs and inventory signs shall be placed on aluminum mounting plates. The plates shall be mounted on the transformer by the supplier and must be capable of being moved from the transformer's operating side. The attachments for the plates shall be of stainless steel, of ISO-class F1 or A2.

On transformers with reconnectable windings for different voltage systems, the adjustable indicating device beside the rating sign shall be constructed of durable material and easily adjustable.

### 3.5 Corrosion protection

Transformers with a rated output of  $\leq$ 200 kVA shall be galvanized in accordance with the requirements of SS EN ISO 1461, at least class A. For transformers with a rated output of  $\geq$ 315 kVA painting or galvanizing is acceptable. However, it shall be possible to request that the 315 kVA is delivered galvanized. In the event of painting, the transformer tank shall be painted using a method and quality that will protect the tank against corrosion in a class A environment. Approved methods are described in table 8:72 in BSK 94.

Separate cooling radiators and smaller parts, such as consoles and so forth, shall be surface coated using the same methods as for the transformer tank.

Fasteners mounted on galvanized or painted parts shall be of stainless steel in accordance with ISO F1 or A2 requirements.

### 3.6 Lifting equipment, transport, fastening devices

The transformer shall be equipped with lifting devices enabling the complete transformer plus oil and mounted bushings. Lifting devices shall also exist to lift the core and windings out of the tank. The transformer  $\leq$ 315 kVA shall have a flat bottom.

The transformer  $\leq$ 315 kVA shall be able to be mounted both on the ground and at a pole according to EBR specification.

Total weight, including oil, for the transformer  $\leq$ 200 kVA may not exceed 1,100 kg.

The transformer  $\geq$  500 kVA shall have lift lugs to accommodate lifting straps.

To facilitate our inventory control each transformer with a rated output of  $\leq$ 315 kVA shall be delivered on a cargo pallet designed for handling by a forklift truck.

The transformer's production number shall be provided on any transport packaging material.

### 3.7 Monitoring devices

It shall be possible to equip hermetically sealed transformers with a rated output of  $\geq 315$  kVA s with pressure switches containing a release contact.

Transformers with a rated output of  $\geq 315$  kVA shall be equipped with a thermometer pocket for a signal thermometer in accordance with DIN 42554. An extra thermometer shall be provided, diagonally positioned, on transformers with a rated output of  $\geq 500$  kVA. It shall also be possible to equip transformers with a rated output of 200 kVA with a thermometer pocket. Those thermometer pockets that are not used shall be plugged or covered over.

The thermometer shall have been produced by Kihlströms or a similar supplier and shall have potential-free signal and release contacts.

## 4 Dimensions

### 4.1 Transport wheels

Transformers with a rated output of  $\geq 500$  kVA shall on request be delivered with smooth and reversible wheels for transporting lengthways and sideways.

a) The center distance shall be 850 mm in both directions.

### 4.2 External dimensions

The external dimensions of the transformers, including wheels and bushings shall not exceed the values in table IV.

Table IV

Rated output (kVA)	Length (mm)	Breadth (mm)	Height (mm)
50-100	1100	700	1400
200	1100	800	1400
315	1300	900	1500
500	1400	950	1600
630	1500	1000	1800
800	1600	1100	1800
1000	1900	1100	1800
1250	1900	1100	1800

## 5 Fittings

The transformers shall be provided with fittings in accordance with table V.

Table V

Fittings	Rated output kVA
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to 1250 kVA

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	50	100	200	315	500	630	800	1000	1250
Rating signs, Tap changer, earth clip, lifting equipment	X	X	X	X	X	X	X	X	X
Galvanized tank	X	X	X	O					
flat tank bottom	X	X	X	X					
Adjustable, smooth transport wheels					O	O	O	O	O
Lugs for tow lines					O	O	O	O	O
Fastener equipment for pole attachment	X	X	X	O					
Contact flange for cable clips					X	X	X	X	X
Plug-in type bushings					O	O	O	O	O
Bottom valve connect no. 20 DN22	X	X	X	X	X	X	X	X	X
Thermometer pocket				X	X	X	X	X	X
Extra thermometer pocket					X	X	X	X	X
Thermometer					O	O	X	X	X
Pressure switch						O	O	O	O

X= standard

O= delivery on request

## 6 Tender information, documentation

### 6.1 Tender

The tender shall contain the following information

- Key electrical data
- Name of company that will manufacture the transformers
- Type of coupler
- Short-circuit impedance
- No-load current
- No-load and charge losses
- Materials in windings
- Terminals/tapping points, bushings( type, earth/ground current, leakage path, materials in connections)
- Weight (total weight, oil weight)
- Construction drawings, preferably on diskette in CAD format
- Painting specifications or directions for the transformer tank
- Costs of tests in addition to routine tests
- Deviations from requirement specifications
- Written guarantee that the transformer noise level does not exceed 54 dB(A)
- Written guarantee that the transformer oil does not contain PCB
- Assembly instructions and maintenance instructions, with specified maintenance times Type designation of fittings and manufacturers
- Opportunities for dismantling and recovery/recycling of materials.

### 6.2 Documentation

When delivered, each transformer shall be accompanied by one copy of assembly instructions and maintenance instructions in Swedish for the transformer and its fittings. These documents shall be packed so that they remain unharmed through, for example, external damage during transit or as a result of weather conditions. The assembly instructions and maintenance instructions for the transformer and fittings shall also be available in electronic-form, i.e. on a diskette or CD. They must be written in Word or Excel format. The illustrations shall be in JPEG or GIF format.

The reports from routine test on the transformer in question, connection diagrams and final documentation for each delivery must be in the possession of the purchaser before any payments can be made. The text reports for all the transformers included in a delivery shall be compiled in a single document and sent to the purchaser. Construction drawings and diagrams shall also be delivered on diskettes or CDs in CAD format.