SLOVENSKI STANDARD
SIST EN 50588-1:2015

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Nadomešča:
SIST EN 50464-1:2007
SIST EN 50464-1:2007/A1:2012
SIST EN 50541-1:2011

Močnostni transformatorji srednje moči 50 Hz z najvišjo napetostjo naprave do 36 kV - 1. del: Splošne zahteve

Medium power transformers 50 Hz, with highest voltage for equipment not exceeding 36 kV - Part 1: General requirements

Mittelleistungstransformatoren 50 Hz, mit einer höchsten Spannung für Betriebsmittel nicht über 36 kV - Teil 1: Allgemeine Anforderungen

Transformateurs 50 Hz de moyenne puissance, de tension la plus élevée pour le matériel ne dépassant pas 36 kV - Partie 1: Exigences générales

Ta slovenski standard je istoveten z: **EN 50588-1:2015**

ICS:

29.180	Transformatorji. Dušilke	Transformers. Reactors

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EUROPEAN STANDARD

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English Version

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Contents

Foreword

This document (EN 50588-1:2015) has been prepared by CLC/TC 14 "Power transformers".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2016-06-25
- latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2018-06-25

This document supersedes EN 50464-1:2007 and EN 50541-1:2011.

EN 50588-1:2015 includes the following significant technical changes with respect to EN 50464-1:2007 and EN 50541-1:2011:

- both liquid filled and dry-type transformers are covered in the same document;
- the scope of applicability is extended in terms of rated power;
- new values of no load loss, load loss and sound power level for different values of rated power are specified;
- for transformers having rated power above 3 150 kVA, the concept of Peak Efficiency Index is introduced.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports requirements of Commission Regulation (EC).

For the relationship with requirements of Commission Regulation (EC) see informative Annex ZZ, which is an integral part of this document.

1 Scope

This European Standard covers medium power transformers. 'Medium power transformer' means a power transformer with a highest voltage for equipment higher than 1,1 kV, but not exceeding 36 kV and a rated power equal to or higher than 5 kVA but lower than 40 MVA.

National practices may require the use of highest voltages for equipment up to (but not including) 52 kV, when the rated voltage is less than 36 kV (such as U_m = 38,5 kV or U_m = 40,5 kV). This is considered to be an unusual case of a large power transformer, where the requirements are those for a medium power transformer with U_m = 36 kV.

NOTE 1 'Large power transformer' means a power transformer with a highest voltage for equipment exceeding 36 kV and a rated power equal or higher than 5 kVA, or a rated power equal to or higher than 40 MVA regardless of the highest voltage for equipment. Large power transformers are in the scope of EN 50629.

NOTE 2 Transformers with tap changer (DETC or OLTC) are included in this European Standard even if they have separate tapping winding.

The object of this European Standard is to set up requirements related to electrical characteristics and design of medium power transformers.

The following transformers are excluded from this European Standard:

- instrument transformers, specifically designed to supply measuring instruments, meters, relays and other similar apparatus;
- transformers with low-voltage windings specifically designed for use with rectifiers to provide a DC supply;
- transformers specifically designed to be directly connected to a furnace;
- transformers specifically designed for offshore applications and floating offshore applications;
- transformers specially designed for emergency installations;
- transformers and auto-transformers specifically designed for railway feeding systems;
- earthing or grounding transformers, this is, three-phase transformers intended to provide a neutral point for system grounding purposes;
- traction transformers mounted on rolling stock, this is, transformers connected to an AC or DC contact line, directly or through a converter, used in fixed installations of railway applications;
- starting transformers, specifically designed for starting three-phase induction motors so as to eliminate supply voltage dips;
- testing transformers, specifically designed to be used in a circuit to produce a specific voltage or current for the purpose of testing electrical equipment;
- welding transformers, specifically designed for use in arc welding equipment or resistance welding equipment;
- transformers specifically designed for explosion-proof and underground mining applications,
- transformers specifically designed for deep water (submerged) applications;
- medium Voltage (MV) to Medium Voltage (MV) interface transformers up to 5 MVA;
- large power transformers where it is demonstrated that for a particular application, technically feasible alternatives are not available to meet the minimum efficiency requirements set out by the commission regulation (EU) No 548/2014;
- large power transformers which are like for like replacements in the same physical location/installation for existing large power transformers, where this replacement cannot be achieved without entailing disproportionate costs associated to their transportation and/or installation.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50180 — *Bushings above 1 kV up to 52 kV and from 250 A to 3,15 kA for liquid filled transformers — Part 1: General requirements for bushings*

EN 50181 — *Plug-in type bushings above 1 kV up to 52 kV and from 250 A to 2,50 kA for equipment other than liquid filled transformers*

EN 50216 (all parts) — *Power transformer and reactor fittings*

EN 50386 — *Bushings up to 1 kV and from 250 A to 5 kA, for liquid filled transformers*

EN 50387 — *Busbar bushings up to 1 kV and from 1,25 kA to 5 kA, for liquid filled transformers*

EN 50464-4 — *Three-phase oil-immersed distribution transformers 50 Hz, from 50 kVA to 2 500 kVA with highest voltage for equipment not exceeding 36 kV — Part 4: Requirements and tests concerning pressurised corrugated tanks*

EN 60076 (all parts) — *Power transformers (IEC 60076, all parts)*

EN 60076-19 — *Power transformers — Part 19: Rules for the determination of uncertainties in the measurement of the losses on power transformers and reactors (IEC/TS 60076-19)*

EN 60085 — *Electrical insulation — Thermal evaluation and designation*

EN 60505 — *Evaluation and qualification of electrical insulation systems (IEC 60505)*

EN 61100 — *Classification of insulating liquids according to fire point and net calorific value (IEC 61100)*

IEC/TR 60616 — *Terminal and tapping markings for power transformers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 60076-1:2011 and the following apply.

3.1
load factor
k
ratio of actual input current over the rated current of transformer where the actual current and rated current are constant over time

Note 1 to entry: Normally $0 \leq k \leq 1$.

3.2
transmitted apparent power
kS_r
product of the load factor and the rated power

3.3
Efficiency Index
EI
ratio of the transmitted apparent power of a transformer minus electrical losses to the transmitted apparent power of the transformer

3.4
Peak Efficiency Index
PEI
highest value of efficiency index that can be achieved at the optimum value of load factor

Note 1 to entry: See Annex A for derivation.

3.5
load factor of Peak Efficiency Index
k_{PEI}
load factor at which Peak Efficiency Index occurs

Note 1 to entry: See Annex A for derivation.

3.6
declared value
regulatory value given in Clause 6 which is to be used for market surveillance activities

Note 1 to entry: Declared values and guaranteed values according to EN 60076-1 are two different concepts. Guaranteed values are related to contract, whereas declared values are related to compliance verifications with COMMISSION REGULATION (EU) No 548/2014.

4 Environmental classes

Classification of insulating liquids according to fire point and net calorific value is given in EN 61100. Climatic, environmental and fire behaviour classes for dry–type transformers are defined in EN 60076-11.

5 Electrical characteristics

5.1 Highest voltages for equipment for winding with U_m > 1,1 kV

Insulation levels and dielectric test shall be in accordance with the requirements of EN 60076-3.

The values of the highest voltage U_m for equipment are:

3,6 kV– 7,2 kV – 12 kV – 17,5 kV – 24 kV – 36 kV

NOTE National practices may require the use of highest voltages for equipment up to (but not including) 52 kV, when the rated voltage is less than 36 kV (such as U_m = 38,5 kV or U_m = 40,5 kV).

5.2 Rated voltage for winding with U_m ≤ 1,1 kV

For U_m ≤ 1,1 kV the preferred rated voltage value shall be chosen in the hereunder list:

400 V – 410 V – 415 V – 420 V – 433 V – 690 V

NOTE This document may be applied either as a whole or in part, to transformers with rated low voltages below 400 V and above 690 V.

The values for short duration power frequency withstand and/or for the lightning impulse withstand test between windings and earth need to be stated by the purchaser. The most usual values are respectively 10 kV and 30 kV.

5.3 Tapping

Taps can be provided with DETC or OLTC devices:

- DETC: De-energised tap changer
- OLTC: On load tap changer

For DETC the preferred tapping ranges are ± 2,5 % with 3 tap positions and ± 2 x 2,5 % with 5 tap positions. On special request ± 4 x 2,5 % with 9 tap positions can be provided. Tapping ranges greater than ± 10 % or with more than 9 tap positions are unusual and subject to specific agreement.

For transformer equipped with OLTC the tapping range shall be smaller than ± 15 % with a maximum of 17 tap positions. Tapping ranges greater than ± 15 % or with more than 17 tap positions are unusual and subject to specific agreement.

Tapping ranges outside the above definitions have to be specified by agreement between manufacturer and purchaser.

5.4 Connection designations for three phase transformers

Preferred connection designations, following IEV [421-10-09], shall be in accordance with the provisions of Table 1.

Table 1 — Connections

$S_r \leq 100$ kVA	100 kVA < S_r < 5 000 kVA	$S_r \geq 5\,000$ kVA
Yzn or Dyn	Dyn	YNd or Dyn or YNyn

The clock hour figure should be 5 or 11 for Dyn or Yzn and 0 for Yy.

Connections and clock hour figure shall be specified by the purchaser preferably amongst the choice given above.

6 Load loss, no load loss, PEI, sound power level, short-circuit impedance

6.1 General

The following tables give the maximum level of losses for single phase transformers with a rated power $S_r \leq 100$kVA, for three phase transformers with a rated power $S_r \leq 3\,150$ kVA and minimum Peak Efficiency Index for three phase transformers with rated power $S_r > 3\,150$ kVA and $S_r < 40\,000$ kVA.

The losses and Peak Efficiency Index classes remain the same for all highest voltage for equipment values (U_m) regardless of the additional loss corrections specified in 6.2.3 and 6.2.4.

Description and requirements for special cases are given in 6.4.

Several classes of losses are defined in this standard with a ranking of efficiency for no load loss and for load loss. The most efficient class for no load loss is class AAA_0, then AA_0, then A_0. For load loss the same logic is used with the most efficient class is A_k, then B_k, then C_k.

The names of the loss classes are the same for all of the highest voltage for equipment values (U_m) whatever the corrections done on the values described in the following clauses.

Other values of short-circuit impedance can be specified by the purchaser for particular system service conditions, e.g. in the case of parallel operations in all tables of this clause.

The sound power levels, given in the tables in Clause 6 are preferred and maximum values. The sound power levels can be specified by the purchaser or by agreement between manufacturer and purchaser for different values.

For liquid immersed transformer and for dry-type transformer, load loss, Peak Efficiency Index and short circuit impedance shall be given at the reference temperature defined in EN 60076-1.

To calculate and to compare the Peak Efficiency Index and the load loss of different transformers the correct reference temperature shall be taken according to their insulation system temperature (see EN 60076-1:2011, 11.1.1).

The insulation materials used in transformer shall have an insulation system temperature according to EN 60085 and EN 60505 and in compliance with the temperature rise limits for the transformer according to EN 60076-2, EN 60076-11 and EN 60076-14.

The symbols used are:

P_0: no load loss at rated voltage and rated frequency, on the rated tap according to EN 60076-1;

P_k: load loss at rated current and rated frequency on the rated tap corrected to reference temperature according to EN 60076-1;

L_{WA}: A weighted sound power level of transformers according to EN 60076-10.

6.2 Transformers with rated power $S_r \leq 3\,150$ kVA

6.2.1 General information

Figure 1 indicates clauses to be chosen according to the highest voltage for equipment values U_m on the primary and on the secondary windings.

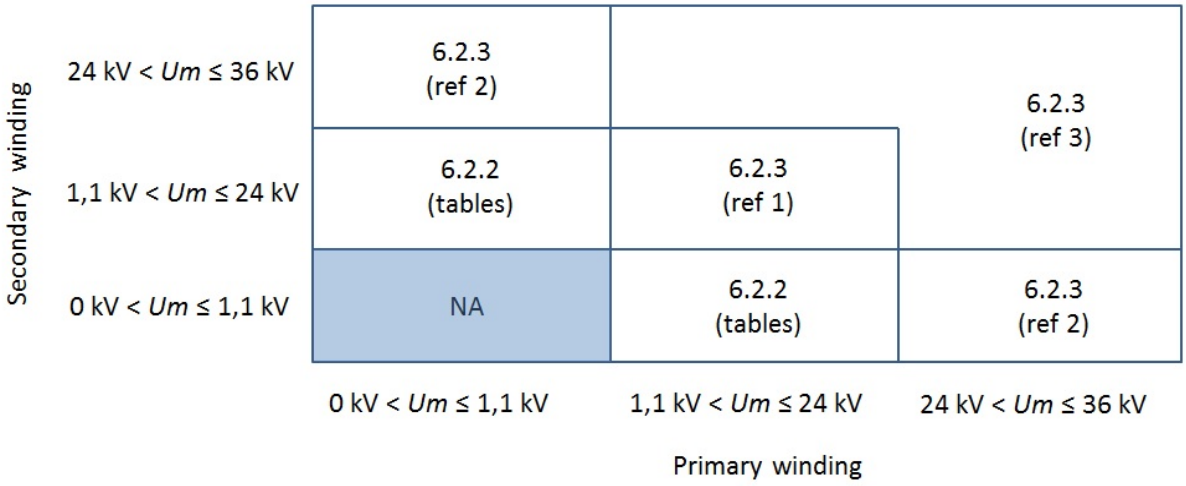

Figure 1 — Choice of clauses according to the highest voltage for equipment values U_m

Numbering into brackets are the references to the lines of Table 5.

The level of losses shall be matched to the highest voltage for equipment (U_m) according to Figure 1.

NOTE Higher insulation levels are usually associated with higher clearance which in turn involves higher level of losses.

6.2.2 One winding with $U_m \leq 24$ kV and the other one with $U_m \leq 1{,}1$ kV

The following tables are defined for step down or step up transformer with one winding with $U_m \leq 24$ kV and the other one with $U_m \leq 1{,}1$ kV.

Table 2 and Table 3 are for liquid immersed transformers and Table 4 for dry-type transformers.

For the transformers AAA_0 see special requirements in 9.5.

Table 2 — No load loss (P_0) and sound power level for liquid immersed transformers

Rated power	AAA_0	AA_0	L_{WA}	A_0	L_{WA}
kVA	W	W	dB(A)	W	dB(A)
≤ 25	35	63	36	70	37
50	45	81	38	90	39
100	75	130	40	145	41
160	105	189	43	210	44
250	150	270	46	300	47
315	180	324	48	360	49
400	220	387	49	430	50
500	260	459	50	510	51
630	300	540	51	600	52
800	330	585	52	650	53
1000	390	693	54	770	55
1250	480	855	55	950	56
1600	600	1080	57	1200	58
2000	730	1305	59	1450	60
2500	880	1575	62	1750	63
3150	1100	1980	63	2200	64

The sound power level L_{WA} for transformers AAA_0 has to be agreed between manufacturer and purchaser.