SLOVENSKI STANDARD
SIST EN 50541-1:2011

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Nadomešča:
SIST HD 538.1 S1:1997
SIST HD 538.1 S1:1997/A1:1997
SIST HD 538.2 S1:1997

Trifazni suhi distribucijski transformatorji, 50 Hz, od 100 do 3150 kVA, za napetosti, ki ne presegajo 36 kV - 1. del: Splošne zahteve in zahteve za suhi tip transformatorjev za napetosti, ki ne presegajo 36 kV

Three phase dry-type distribution transformers 50 Hz, from 100 kVA to 3 150 kVA, with highest voltage for equipment not exceeding 36 kV - Part 1: General requirements

Drehstrom-Trocken-Verteilungstransformatoren, 50 Hz, 100 kVA bis 3 150 kVA, mit einer höchsten Spannung für Betriebsmittel kleiner oder gleich 36 kV - Teil 1: Allgemeine Anforderungen

Transformateurs triphasés de distribution de type sec, 50 Hz, de 100 kVA à 3 150 kVA, avec une tension la plus élevée pour le matériel ne dépassant pas 36 kV - Partie 1: Prescriptions générales

Ta slovenski standard je istoveten z: **EN 50541-1:2011**

ICS:

29.180	Transformatorji. Dušilke	Transformers. Reactors

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EUROPEAN STANDARD

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English version

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 14, Power transformers.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50541-1 on 2011-01-02.

This document supersedes HD 538.1 S1:1992 + A1:1995 and HD 538.2 S1:1995.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2012-01-02
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2014-01-02

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1 Scope

This European Standard covers dry type transformers from 100 kVA to 3 150 kVA intended for operation in three phases distribution networks, for indoor continuous service, 50 Hz, natural cooling, with two windings:

– a primary (high voltage) winding with a highest voltage for equipment of 3,6 kV to 36 kV;

– a secondary (low voltage) winding with a highest voltage for equipment not exceeding 1,1 kV.

For outdoor application, special design or enclosure (enclosure with adapted IP and IK degrees protections) should be requested.

NOTE 1 This European Standard may be applied, as a whole or in part to transformers having windings with more than one rated voltage. In this case the rated power for each coupling ratio should be specified by the purchaser.

NOTE 2 For dry type transformers installed in power generating plants, additional requirements, not covered by this European Standard, and alternative requirements may be specified.

NOTE 3 For dry type transformers dedicated to wind turbines applications additive requirements are specified in EN 60076-16.

The object of this European Standard is to lay down requirements related to electrical characteristics, dimensions and designs of three phases distribution dry type transformers. These transformers should be in accordance with EN 60076-11 for general requirements.

2 Normative references

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

EN 60076-1	Power transformers - Part 1: General (IEC 60076-1)
EN 60076-3	Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air (IEC 60076-3)
EN 60076-10	Power transformers - Part 10: Determination of sound levels
EN 60076-11:2004	Power transformers - Part 11: Dry-type transformers (IEC 60076-11:2004)
EN 60076-16:201X [1)]	Power transformers - Part 16: Transformers for wind turbines application (IEC 60076-16)
EN 60529	Degrees of protection provided by enclosures (IP Code) (IEC 60529)
EN 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code) (IEC 62262)
EN 62271-202:2007	High-voltage switchgear and controlgear - Part 202: High voltage/low voltage prefabricated substation (IEC 62271-202:2006)

1) At draft stage.

3 Electrical characteristics

3.1 Rated power

The values of the rated power are:

100–160–200–250–315–400–500–630–800–1 000–1 250–1 600–2 000–2 500–3 150 kVA

The underlined values are preferred.

3.2 Highest voltages for equipment of windings

Insulation levels and dielectric tests shall be in accordance with the requirements of EN 60076-3 and EN 60076-11.

The values of the highest voltage for equipment are:

- for the high voltage winding:

  3,6 – 7,2 – 12 – 17,5 – 24 – 36 kV;

- for the low voltage winding:

  1,1 kV.

3.3 Rated voltages of windings

3.3.1 For the high-voltage winding

The rated value of the high voltage winding is above 1,1 kV up to and including 36 kV.

3.3.2 For the low voltage winding

The rated voltage shall be chosen among the following preferred values:

400 – 410 – 415 – 420 – 433 V

NOTE This European Standard may be applied either as a whole or in part, to transformers with rated voltage below 400 V and above 433 V.

3.4 Tapping

The high voltage windings can be provided with tapping.

The preferred tapping range is either ± 2,5 % or ± (2 × 2,5) % unless otherwise specified, but in any case maximum taps shall not exceed seven positions and the total maximum range shall not exceed 10 %.

The tapping range has to be specified by the purchaser or by agreement between manufacturer and purchaser.

Tapping selection shall be made off-circuit by the use of bolted links or off-circuit tap changer.

3.5 Connections

Vector group: connection shall be Dyn.

Clock hour figure shall be 5 or 11.

Connection and clock hour figure shall be specified by the purchaser at the enquiry stage in accordance with EN 60076-1.

NOTE This European Standard may be applied, either as a whole or in part, for transformers having connections other than those mentioned above.

3.6 Dimensioning of neutral connection of the low voltage winding

The neutral conductor and terminal of the low voltage winding shall be dimensioned for rated current and earth fault current, unless otherwise specified.

3.7 Short-circuit impedance

The preferred values of the short-circuit impedance at reference temperature are according to Table 2 to Table 6.

The reference temperature for the short-circuit impedance and load-loss shall be the permitted average winding rise as given in column 2 of Table 2 plus 20 °C.

NOTE Other values of short-circuit impedance may be specified by the purchaser for particular system service conditions, e.g. in the case of parallel options

3.8 Load loss, no load loss, sound power level and short-circuit impedance

3.8.1 General purpose

For transformers having preferred values of rated power in accordance with 3.1 the values of load loss (P_K), no load loss (P_0), short-circuit impedance and sound power level (L_{WA}) are stated in Table 2 to Table 6.

3.8.2 Load loss aspect

The reference temperature for the short-circuit impedance and load-loss shall be the permitted average winding rise as given in column 2 of Table 2 plus 20 °C.

Table 1 − Example of performance according to the standard reference temperature

Insulation System Temperature (IST)	**155 °C** Standard reference	**105 °C** Banned reference
Reference temperature	120 °C	75 °C
LV Ri² loss	4 600 W	4 000 W [a]
LV Eddy loss	140 W	160 W [a]
LV Stray loss	340 W	390 W
Total LV loss	5 080 W	4 550 W
HV RI² loss	5 300 W	4 600 W [a]
HV Eddy loss	660 W	760 W [a]
HV Stray loss	40 W	46 W
Total HV loss	6 000 W	5 406 W
Total calculated load loss LV+HV	**11 080 W**	**9 956 W**

[a] If reference temperature 75 °C is used for the calculation of 155 °C insulation system temperature instead of load loss reference temperature of 120°C then the errors on the results of measurement and therefore the guaranties are ~ 11 %.

For copper and aluminium conductors the method to correct the I²R loss from 75 °C to 120 °C according to the reference temperature is:

- K= (120+235)/(75+235)=1,145 for copper;
- K= (120+225)/(75+225)=1,15 for aluminium.

For EDDY Loss and Stray Loss the method to correct the loss from 75 °C to 120 °C according to the reference temperature is: K'=1/K.

Above Table 1 show if the banned temperature reference is used the announced guaranty of load loss is reduced by 11 % for the chosen example compared to the real load loss produced in service by the transformer at full load.

When a transformer has windings of different insulation system temperatures, the reference temperature relating to the winding having the higher insulation system temperature shall be used, see EN 60076-11:2004, Clause 17.

NOTE 1 LV winding designed with 130 °C insulation system temperature and HV winding designed with 155 °C insulation system temperature, in this case the reference temperature for the load loss will be 120 °C (insulation system temperature 155 °C) see EN 60076-11:2004, Clause 17.

NOTE 2 The guaranteed load loss at reference temperature as indicated in EN 60076-11:2004, Clause 17 for different insulation system temperature used in LV and HV windings gives a value in excess.

3.8.3 Sound power level

The sound pressure measurement (L_{PA}) under rated frequency and rated voltage and no load condition is base for sound power level (L_{WA}) calculation (see EN 60076-10). The calculated value (sound power level) is the maximum admitted value, no tolerance is allowed.

3.9 Tables of load loss, no load loss, sound level power and short-circuit impedance

3.9.1 Rated voltage ≤ 12 kV short-circuit impedance 4 %

Table 2 − Load loss, no load loss and sound power level

U_M	S_R	P_K	P_K	P_O	L_{WA}	P_O	L_{WA}	P_O	L_{WA}
		A_k	B_k	A_o		B_o		C_o	
kV	kVA	W	W	W	dB (A)	W	dB (A)	W	dB (A)
12	100	1 800	2 000	260	51	330	51	440	59
	160	2 500	2 700	350	54	450	54	610	62
	250	3 200	3 500	500	57	610	57	820	65
	400	4 500	4 900	700	60	880	60	1 150	68
	630	6 700	7 300	1 000	62	1 150	62	1 500	70

NOTE This European Standard applies also to transformers having Insulation System Temperature (IST) with temperature rise higher than IST of 180 °C. According to EN 60076-11:2004, Table 2; in this case the load loss will be calculated with proper temperature correction factors for rated temperature rises, for load loss guaranty and impedance voltage temperature reference (see 3.8).