
Three-phase dry-type distribution transformers 50 Hz, from 100 to 2500 kVA, with highest voltage for equipment not exceeding 36 kV - Part 1: General requirements and requirements for transformers with highest voltage for equipment not exceeding 24 kV

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Drehstrom-Trocken-Verteilungstransformatoren, 50 Hz, 100 bis 2500 kVA, mit einer höchsten Spannung für Betriebsmittel kleiner oder gleich 36 kV -- Teil 1: Allgemeine Anforderungen und Anforderungen für Transformatoren mit einer höchsten Spannung für Betriebsmittel kleiner oder gleich 24 kV

Transformateurs triphasés de distribution de type sec, 50 Hz, de 100 à 2500 kVA, avec une tension la plus élevée pour le matériel ne dépassant pas 36 kV -- Partie 1: Prescriptions générales et prescriptions pour les transformateurs avec une tension la plus élevée pour le matériel ne dépassant pas 24 kV

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en

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ENGLISH VERSION

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This Harmonization Document was approved by CENELEC on 1992-09-15. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for implementation of this Harmonization Document on a national level.

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

This Harmonization Document exists in three official versions (English, French, German).

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

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Foreword

This Harmonization Document was prepared by working group WG 1 of CENELEC TC 14, Power transformers.

It was approved by CENELEC as HD 538.1 S1 on 15 September 1992.

The following dates were fixed:

- latest date of announcement
of the HD at national level (doa) 1993-03-01
- latest date of publication of
a harmonized national standard (dop) 1993-09-01
- latest date of withdrawal of
conflicting national standards (dow) 1993-09-01

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given only for information. In this standard, annex A (National deviations) is informative and annex B (normative references) is normative.

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This document has been prepared to allow a standardized production in a series of units and to favour the interchange of products within the CENELEC countries and, if applicable, with other countries.

Every standard prepared by National Committees shall be in line with this CENELEC document, as far as the specific field of application is concerned.

This document comes into use as and when indicated in the tender and contractual documents.

When for special applications particular characteristics are required outside the standard features, the transformers can be specified and ordered individually in accordance with HD 464.

1 GENERAL

1.1 Scope

This Harmonization Document covers transformers from 100 to 2 500 kVA intended for operation in three-phase distribution networks. It applies to three-phase dry-type transformers for 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 24 kV.
- a secondary (low-voltage) winding with a highest voltage for equipment not exceeding 1,1 kV.

NOTE 1: This document 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 shall be specified by the purchaser.

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

1.2 Object

The object of this document is to lay down requirements related to electrical characteristics, dimensions and design. Other requirements may be specified in a National Standard.

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1.3 Compliance with current Harmonization Documents

Transformers shall be in accordance with Harmonization Document HD 464 S1.

2 ELECTRICAL CHARACTERISTICS

2.1 Rated power

The values of the rated power are:

100 - 160 - 200 - 250 - 315 - 400 - 500 - 630 - 800 - 1000 - 1250 - 1600 - 2000 - 2500 kVA.

The underlined values are preferred.

2.2 Highest voltages for equipment of windings

The values of the highest voltage for equipment are:

a) for the high-voltage winding:
 3,6 - 7,2 - 12 - 17,5 - 24 kV

b) for the low-voltage winding:
 1,1 kV

2.3 Rated voltages of windings

a) For the high-voltage winding:

The preferred ranges of values of the rated voltage U_r together with the relevant highest voltage for equipment U_m are given in Table I.

TABLE I

U_m (kV)	3,6	7,2	12	17,5	24
U_r (kV)	3 to 3,3	5 to 6,6	10 to 11,5	12 to 16	20 to 22

b) For the low-voltage winding:

The rated voltage shall be chosen from the following values:

400 - 410 - 420 - 433 V.

NOTE 1: According to HD 472 S1, the nominal voltages for low-voltage distribution systems shall evolve towards 400 V.

NOTE 2: Rated voltage 410 V is suitable for new transformers in the intermediary steps of bringing low-voltage systems, originally at 380 V, within the range $400 \text{ V} \pm 6\%$.

NOTE 3: This document may be applied, either as a whole or in part, to transformers with rated voltage below 400 V and above 433 V.

2.4 Tappings

The high voltage winding is normally provided with tappings corresponding to a tapping range of $+ 2,5\%$ or $+ 2 \times 2,5\%$ or $+ 2 \times 2,5\% - 3 \times 2,5\%$, to be specified by the purchaser.

These tappings shall be connected by means of links.

2.5 Connections

Connections shall be:

- for rated power below 250 kVA: Yzn or Dyn;
- for rated power of 250 kVA and above: Dyn.

The clock hour figure shall be 5 or 11.

Connections and clock figure shall be specified by the purchaser.

NOTE: This document may be applied, either as a whole or in part, for transformers having connections other than those mentioned above, when special network conditions occur.

2.6 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.

2.7 Losses, sound power level and impedance voltage

For transformers having preferred values of rated power in accordance with subclause 2.1, the values of load loss (P_k), no-load loss (P_o), impedance voltage and sound power level (L_{WA}) are stated in Table II.

TABLE II

U_m kV	S_r kVA	P_k 1) W	P_o W	L_{WA} 2) dB	Short-circuit impedance %	
12	100	2000	440	59	4	
	160	2700	610	62		
	250	3500	820	65		
	400	4900	1150	68		
	630	7300	1500	70		
	12	630	7600	1370	70	6
		1000	10000	2000	73	
		1600	14000	2800	76	
		2500	21000	4300	81	
					81	
24	250	3800	880	65	6	
	400	5500	1200	68		
	630	7800	1650	70		
	1000	11000	2300	73		
	1600	16000	3100	76		
	2500	23000	5000	81		
				81		

There is only one value of load loss for thermal classes E, B and F. A reduction of 10% for thermal class A and an increase of 7% for thermal class H are allowed.

- 1) Reference temperatures for load losses according to HD 464 S1 - clause 12 (for thermal classes A-E-B-F-H, 80-95-100-120-145 °C respectively).

This document applies also to transformers having thermal classes with temperature rises higher than class H, according to HD 464 S1. In this case the load losses will be calculated with proper temperature correction factors for nominal temperature rises.

- 2) Sound power level at rated frequency and voltage under no load conditions is given as a guidance only. To be specified in National Standards.

A National Standard may specify one "Second Series" of transformers having either no-load loss or load loss or both which are at least 15% lower than the values of Table II and, if necessary, impedance voltage may be varied.

If a National Standard considers non-preferred values of rated power or impedance voltage or other highest voltages for equipment (e.g. 17,5 kV), it shall specify the corresponding losses.

A National Standard may also allow the use of a capitalization formula to be declared by the purchaser. In such a case the reference temperature for load losses is the guaranteed temperature rise for windings plus 20°C ambient temperature. When a transformer has windings of different guaranteed temperature rises, only one reference temperature is to be used, that is, the one relating to the winding having the higher guaranteed temperature rise, unless otherwise agreed upon between purchaser and manufacturer.

The formula should be of the following type:

$$C_C = C_T + AP_o + BR_k$$

where:

C_C = Capitalized cost

C_T = Tendered price

A = Value indicated by the purchaser in tender invitation expressed in monetary value per watt corresponding to no-load losses

P_o = Guaranteed no-load losses in watts

B = Value indicated by the purchaser in tender invitation expressed in monetary value per watt corresponding to load losses

R_k = Guaranteed load losses in watts

Other terms may be introduced by a National Committee or by a purchaser in the formula, to take into account other technical and financial aspects.

2.8 Partial discharge

For transformers having encapsulated windings, PD measurement shall be according to HD 464 S1 clause 20.

2.9 Insulation levels and dielectric tests

Insulation levels and dielectric test shall be in accordance with the requirements of HD 464 S1, as further detailed below:

a) High-voltage winding:

The rated values of the short duration frequency withstand voltage and of the lightning impulse withstand voltage are given in Table V of HD 464 S1, list 1 or list 2 as required.

b) Low-voltage winding:

According to Table V of HD 464 S1, for the normal insulation level, only a short duration power frequency withstand voltage equal to 3 kV is specified.