
Three phase oil-immersed distribution transformers 50 Hz, from 50 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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UDC 621.314.212:621.3.025.3.026.645/.647 Supersedes HD 428 S1:1983 + A1:1990

Descriptors: Distribution transformers, electrical characteristics,
dimensions, impedance voltage, losses, rollers, sound levels

ENGLISH VERSION

Three phase oil-immersed distribution transformers
50 Hz, from 50 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

Transformateurs triphasés de
distribution immergés dans
l'huile, 50 Hz, de 50 à 2500 kVA,
de 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

Drehstromverteilungstransformatoren
der Energieversorgung, mit
Ölfüllung, 50 Hz, 50 - 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

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This Harmonization Document was approved by CENELEC on 1992-09-15.
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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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

FOREWORD

This Harmonization Document was prepared by working group WG 3 of CENELEC Technical Committee TC 14, Power transformers.

It was approved by CENELEC as HD 428.1 S1 on 15 September 1992.

This Harmonization Document replaces HD 428 S1:1983 and its amendment A1:1990.

The following dates were fixed:

- latest date of announcement
of the HD at national level (doa) 1993-03-01
- latest date of publication of
an identical 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 (A-deviations) is informative and annex B (normative references) is normative.

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Statement

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 398.

1. GENERAL

1.1 Scope

This harmonization document covers transformers from 50 to 2500 kVA intended for operation in three-phase distribution networks, for indoor or outdoor continuous service, 50 Hz, immersed in mineral-oil, natural cooling, with two windings:

- a primary (high-voltage) winding with a highest voltage for equipment from 3,6 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, either as a whole or in part, to transformers immersed in a synthetic insulating liquid.

NOTE 2: This document may be applied, either as whole or in part, to transformers having windings with more than one rated voltage. In this case the rated power for each rated voltage shall be specified by the purchaser.

NOTE 3: Oil-immersed transformers with other highest voltages for equipment could be matter of other parts of HD 428 series.

1.2 Object

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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.

1.3 Compliance with current harmonization documents

Transformers shall be in accordance with harmonization documents of the HD 398 series.

2. ELECTRICAL CHARACTERISTICS

2.1 Rated power

The values of the rated power are:

50 - 63 - 100 - 160 - 200 - 250 - 315 - 400 - 500 - 630 - 800 -
1000 - 1250 - 1600 - 2000 - 2500 kVA.

The underlined values are preferred.
National Standards may include also a number of non-preferred values among those mentioned above, including 25 kVA.

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 are related to the values of the highest voltage for equipment U_m as stated 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 $400 \text{ V} \pm \frac{6}{10} \%$.

NOTE 3: This document may be applied, either as a whole or in part, to transformers with rated voltages 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 $\pm 2,5\%$ or $\pm 2 \times 2,5 \%$ or $+ 2 \times 2,5 \%$ - $3 \times 2,5 \%$, to be specified by the purchaser. These tappings are connected to an off-circuit tap-changer.

Upon special agreement between purchaser and manufacturer, internal reconnecting links can be used as an alternative.

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, to transformers having connections other than those mentioned above.

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 Short-circuit impedance

The preferred values of the short-circuit impedance at a reference temperature of 75 °C are:

- below 630 kVA: 4%
- for 630 kVA: 4% or 6%
- above 630 kVA: 6%

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 operation.

2.8 Losses and sound power level

For transformers having preferred values of rated power and short-circuit impedance in accordance with subclauses 2.1 and 2.7, the values of losses and sound power levels are stated in Table II (load losses) and Table III (no-load losses and sound power levels).

TABLE II

Rated power kVA	List A P_k W	List B P_k W	List C P_k W	Short-circuit impedance %
50	1100	1350	875	4
100	1750	2150	1475	
160	2350	3100	2000	
250	3250	4200	2750	
400	4600	6000	3850	
630	6500	8400	5400	6
630	6750	8700	5600	
1000	10500	13000	9500	
1600	17000	20000	14000	
2500	26500	32000	22000	

P_k = load loss

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TABLE III

Rated power kVA	List A'		List B'		List C'		Short-circuit impedance %
	P_c W	L_{WA} dB	P_c W	L_{WA} dB	P_c W	L_{WA} dB	
50	190	55	145	50	125	47	4
100	320	59	260	54	210	49	
160	460	62	375	57	300	52	
250	650	65	530	60	425	55	
400	930	68	750	63	610	58	
630	1300	70	1030	65	860	60	6
630	1200	70	940	65	800	60	
1000	1700	73	1400	68	1100	63	
1600	2600	76	2200	71	1700	66	
2500	3800	81	3200	76	2500	71	

P_c = no-load loss

L_{WA} = sound power level

With respect to the listed loss values, deviations in the range of $\pm 5\%$ are admitted in National Standards. For list C, the admitted deviation is extended to $\pm 7.5\%$.

NOTE: For list C larger deviations, but not exceeding $\pm 10\%$, are admitted only as temporary national deviations.

The preferred coupling values should be those of the following list combinations:

A - A' , B - B' , C - B' , A - C' , C - C'

In National Standards one or more of the above combinations of losses taken from Table II and III (including the admitted deviations), are allowed.

The losses for transformers having rated power included among the non-preferred values (subclause 2.1) should be obtained by interpolation.

The sound power levels given in Table III are the maximum admitted (no tolerance). Lower sound power levels can be specified by the purchaser.

When the loss values stated in the above Tables II and III do not correspond to the actual evaluation of the energy cost, or in case of established practice in the market, or in case of special feature, the transformers can be requested and, by consequence, offered, with losses differing from the tabled losses. In such a case, a formula for capitalization of losses shall be stated in the request.

The formula should be of the following type:

$$C_C = C_T + AP_0 + BR_k$$

where:

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- 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 loss
 P_0 = Guaranteed no-load loss in watts
 B = Value indicated by the purchaser in tender invitation expressed in monetary value per watt corresponding to load loss
 R_k = Guaranteed load loss 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.

Within the limits of tolerances (HD 398.1), the application of penalties/bonus with regard to losses is left to the agreement between manufacturer and purchaser at the time of enquiry and order.

2.9 Insulation levels and dielectric tests

Insulation levels and dielectric tests shall be in accordance with the requirements of HD 398.3, as further detailed below:

a) High-voltage winding:

The rated values of the short duration power frequency withstand voltage and of the lightning impulse withstand voltage are given by Table II of HD 398.3, list 2 being used for the lightning impulse withstand voltage.