

Dry-type power transformers

**(Implementation of CENELEC HD 464
S1 incorporating amendments A1, A2,
A3, A4 and A5)**

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Committees responsible for this British Standard

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- Association of Consulting Engineers
- British Cable Makers Confederation
- British Railways Board
- Electricity Association
- Institution of Plant Engineers
- Transmission and Distribution Association (BEAMA Ltd.)

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National foreword

This British Standard has been prepared by Technical Committee PEL/14 and is the English language version of HD 464 S1 *Dry-type power transformers*, published by the European Committee for Electrotechnical Standardization (CENELEC). It was derived by CENELEC from IEC 60726:1982, published by the International Electrotechnical Commission (IEC).

Amendments A1:1988, A2:1991, A3:1992, A4:1995 and A5:2002 to HD 464 S1 have been included in the text. CENELEC common modifications have been implemented at appropriate places in the text and are indicated by a side line in the margin.

Cross-references

The British Standards which implement international publications referred to in this document may be found in the BSI Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the BSI Electronic Catalogue or of British Standards Online.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 36, an inside back cover and a back cover.

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June 1988

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Descriptors: Dry-type power transformers; requirements; testing; properties; definitions

English version

Dry-type power transformers

(includes amendment A1:1988, A2:1991, A3:1992, A4:1995 and A5:2002)
(IEC 60726:1982 + A1:1986, modified)

Transformateurs de puissance de type sec
(inclut les amendements A1:1988, A2:1991, A3:1992,
A4:1995 et A5:2002)
(CEI 60726:1982 + A1:1986, modifiée)

Trockentransformatoren
(enthält Änderungen A1:1988, A2:1991, A3:1992,
A4:1995 und A5:2002)
(IEC 60726:1982 + A1:1986, modifiziert)

This Harmonization Document was approved by CENELEC on 1988-06-28. 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 such 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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Ref. No. HD 464 S1:1988 + A1:1988 + A2:1991 + A3:1992 + A4:1995 + A5:2002 E



Foreword

1) General

This Harmonization Document was prepared by CENELEC TC 14, following the decisions taken in Milan on 6th June 1984, in Frankfurt am Main on 4th June 1985, in Zurich/Glattbrugg on 4th and 5th March 1986, in London on 22nd May 1987 and in compliance with the instructions given by 41st Technical Board on 29th February and 2nd March 1984.

The complete text of IEC 726 and Amdt 1 (1986) is endorsed as HD 464 S1 with the exception of common agreed CENELEC modifications to Clauses 2, 3, 4, 8, Table IV, Clauses 19, 20, 21, Section 6 and Appendix B.

2) National Deviations

Netherlands is introducing a B-deviation concerning the duration of the induced overvoltage test.

It is listed in an informative annex which does not form part of the Harmonization Document.

Foreword to A2:1991

On 22nd May 1987, during the meeting held in London, TC 14 appointed a Working Group (WG 2) in order “to determine the minimum test requirements to confirm the suitability of dry-type transformers manufactured to meet the Class 1 or Class 2 climatic conditions classified in Harmonization Document HD 464 S1, including the suitability for exposure to low ambient temperatures”.

To this task WG 2 devoted four meetings and TC 14 approved on 3rd March 1988 in Brussels in principle the guidelines of this document. The work having been completed, the resulting document was issued by the secretary of TC 14 and sent to the Central Secretariat for 6MP.

During the meeting of TC 14 held in Brussels on 1st and 2nd June 1989, the document has been revised and this version groups the following:

- additional common modifications to Publication IEC 726 in order to:
 - make some editorial variations to the French text;
 - modify Subclause 2.1 to state climatic conditions for storage and transport;
 - mention in Clause 8 the environmental, climatic and fire behaviour classes introduced in Appendix B;
 - introduce low temperature test and thermal shock test in Section 5;
 - redefine environmental and climatic classes in Appendix B;

- introduce fire behaviour classes in Appendix B;

- the revised text originally circulated with this Amendment (Annex ZA and Annex ZB). Annex ZC concerning trial guidance tests to prove suitability to F1 fire behaviour class will be added at a later stage;

- the previous prAMA to HD 464 S1 is withdrawn as a common modification and included as a B-deviation for France, Italy, United Kingdom and Spain.

The text of the draft was approved by CENELEC as amendment A2 to HD 464 S1 on 11 September 1990. (Amendment A1 is incorporated in HD 464 S1.)

The following dates were fixed:

- latest date of announcement of the HD at national level (doa) 1991-03-15
- latest date of publication of a new harmonized national standard (dop) 1991-09-15
- latest date of withdrawal of conflicting national standards (dow) 1991-09-15

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, Annex ZA, Annex ZB and Annex ZC are normative.

Foreword to A3:1992

During the meeting held in Brussels on 1-2 June 1989, CENELEC Technical Committee TC 14, Power transformers, decided to group possible tests to prove suitability to fire behaviour classes not in HD 464 S1 but in an annex to that document.

The text, prepared by Working Group WG1 of TC 14, was submitted to the Unique Acceptance Procedure (UAP) as prAC and was approved by CENELEC as amendment A3 to HD 464 S1 on 16 June 1992.

The following dates were fixed:

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

Foreword to A4:1995

This amendment, based on a proposal by UNIPED in agreement with COTREL, 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 amendment A4 to HD 464 S1:1988 on 1994-12-06.

The following dates were fixed:

- latest date by which the existence of the amendment has been announced at national level (doa) 1995-06-01
- latest date by which the amendment has to be implemented at national level by publication of a harmonized national standard or by endorsement (dop) 1995-12-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1995-12-01

Foreword to A5:2002

This amendment to the Harmonization Document HD 464 S1:1988 was prepared by the Technical Committee CENELEC TC 14, Power transformers.

The text of the draft was submitted to the formal vote and was approved by CENELEC as amendment A5 to HD 464 S1:1988 on 2002-02-01.

The following dates were fixed:

- latest date by which the existence of the amendment has been announced at national level (doa) 2002-08-01
- latest date by which the amendment has to be implemented at national level by publication of a harmonized national standard or by endorsement (dop) 2003-02-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2005-02-01

The reference of clauses, subclauses, notes, figures and annexes which are in addition to those in IEC 60726 is prefixed with the letter Z.

Annexes designated “normative” are part of the body of this standard. Annexes designated “informative” are given for information only. In this standard, Annex ZD is informative. Annex ZD has been added by CENELEC.

Section 1. General

1 Scope

This standard applies to dry-type power transformers (including auto-transformers) having values of highest voltage for equipment up to and including 36 kV.

The following small and special dry-type transformers are not covered by this standard:

- single-phase transformers rated at less than 1 kVA and polyphase transformers rated at less than 5 kVA;
- transformers having no windings with rated voltage U_n higher than 1 000 V;
- instrument transformers (covered by IEC Publications 60185: Current Transformers, and 60186: Voltage Transformers);
- transformers for static convertors (covered by IEC Publications 60084: Recommendations for Mercury-arc Convertors, 60119: Recommendations for Polycrystalline Semiconductor Rectifier Stacks and Equipment, and 60146: Semiconductor Convertors);
- starting transformers;
- testing transformers;
- traction transformers mounted on rolling stock;
- flameproof and mining transformers;
- welding transformers;
- voltage regulating transformers;
- small power transformers in which safety is a special consideration.

NOTE Where IEC standards do not exist for the transformers mentioned above or for other special transformers, this standard may be applicable as a whole or in parts.

With the publication of this standard, the requirements of IEC Publication 60076 apply to dry-type transformers only in so far as they are referred to in this standard.

Where reference is made to specific clauses and sub-clauses of various parts of IEC Publication 60076, it is to be understood that the editions are as follows:

60076-1, 60076-2, 60076-4, 60076-5:1976.
60076-3:1980.

2 Service conditions

2.1 Normal service conditions

This standard gives detailed requirements for transformers for use under the following conditions:

a) Altitude:

A height above sea-level not exceeding 1 000 m (3 300 feet).

NOTE For greater altitudes, see Sub-clause 2.2.

b) Temperature of cooling air:

Never exceeding 40 °C and never below:

- 25 °C in the case of outdoor transformers;
- 5 °C in the case of indoor transformers.

NOTE Both outdoor and indoor dry-type transformers are suitable for transport and storage at ambient temperatures down to –25 °C.

In addition, an ambient air temperature never exceeding the following values:

- 30 °C average in any one day;
- 20 °C average in any one year.

NOTE For higher temperatures, see Sub-clause 2.2.

c) Wave-shape of supply voltage:

A supply voltage of which the wave-shape is approximately sinusoidal.

d) Symmetry of polyphase supply voltages:

For polyphase transformers, supply voltages which are approximately symmetrical.

e) Environmental conditions:

Indoor installation without condensation according to ambient class 0 of Appendix B.

2.2 Provision for unusual service conditions

The purchaser shall specify in his enquiry any service conditions not covered by the normal service conditions in Sub-clause 2.1 (see Appendix B).

Supplementary requirements, within defined limits, for the rating and testing of transformers designed for other than normal service conditions listed in Sub-clause 2.1, such as high temperature of cooling air or altitude above 1 000 m (3 300 feet) are given in Sub-clauses 10.2, 10.3 and 11.2.

For temperature conditions outside the limits covered by the supplementary requirements and special operating conditions, for example restricted cooling air circulation, the temperature rise is to be subject to agreement between the manufacturer and the purchaser.

3 Definitions

For the purpose of this standard, the following definitions apply. Other terms used have the meanings ascribed to them in IEC Publications 60076-1: Power Transformers — Part 1: General, or 60050: International Electrotechnical Vocabulary (I.E.V.).

3.1 Dry-type transformer

a transformer in which the core and windings are not immersed in an insulating liquid

NOTE The cooling of a dry-type transformer may be natural, natural/forced or forced circulation (see Clause 9).

3.1.1

encapsulated-winding dry-type transformer

a dry-type transformer having one or more windings encapsulated with solid insulation

3.1.2

non-encapsulated-winding dry-type transformer

a dry-type transformer having none of the windings encapsulated with solid insulation

3.2 Terms relating to the containment of a dry-type transformer

3.2.1

sealed dry-type transformer

an air or gas-immersed dry-type transformer within a sealed protective enclosure so constructed that there can be no interchange between its contents and the external atmosphere, i.e. the transformer is non-breathing

NOTE The gas in a gas-immersed transformer remains in a gaseous state throughout the range of transformer operations.

3.2.2

totally enclosed dry-type transformer

an air immersed dry-type transformer within a protective enclosure so constructed that the ambient air does not circulate to cool the core and windings, but which can breathe to atmosphere

3.2.3

enclosed dry-type transformer

a dry-type transformer within a protective enclosure so constructed that the ambient air may circulate so as to cool the core and windings directly

3.2.4

non-enclosed dry-type transformer

a dry-type transformer without a protective enclosure in which the core and windings are cooled by ambient air

4 Tappings

As in Section 1 of IEC Publication 60076-4: Power Transformers, Part 4: Tappings and Connections, but where tappings are required the preferred tapping range is $\pm 5\%$ in 2.5% steps, i.e. $\pm 2.5\%$, $\pm 5\%$, by means of off-circuit links or tap selectors.

5 Connections

See Section 2 of IEC Publication 60076-4.

6 Ability to withstand short-circuit

IEC Publication 60076-5: Power Transformers — Part 5: Ability to Withstand Short-circuit, applies to the transformers covered by this standard.

