

Converter transformers —

Part 2: Transformers for HVDC applications

The European Standard EN 61378-2:2001 has the status of a
British Standard

ICS 29.180

National foreword

This British Standard is the official English language version of EN 61378-2:2001. It is identical with IEC 61378-2:2001.

The UK participation in its preparation was entrusted to Technical Committee PEL/14, Power transformers, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 August 2001

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 24, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

Convertor transformers
Part 2: Transformers for HVDC applications
(IEC 61378-2:2001)

Transformateurs de conversion
Partie 2: Transformateurs pour
applications CCHT
(CEI 61378-2:2001)

Stromrichtertransformatoren
Teil 2: Transformatoren für
HGÜ-Anwendungen
(IEC 61378-2:2001)

This European Standard was approved by CENELEC on 2001-01-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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

Foreword

The text of document 14/384/FDIS, future edition 1 of IEC 61378-2, prepared by IEC TC 14, Power transformers, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61378-2 on 2001-01-01.

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) 2001-11-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2004-01-01

Annexes designated "normative" are part of the body of the standard.

In this standard, annex ZA is normative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61378-2:2001 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60310 NOTE: Harmonized as EN 60310:1996 (not modified).

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CONVERTOR TRANSFORMERS –

Part 2: Transformers for HVDC applications

1 General

1.1 Scope

This part of IEC 61378 applies to oil-immersed three-phase and single-phase convertor transformers for use in HVDC power transmission. It applies to transformers having two, three or multiple windings.

This standard does not apply to

- convertor transformers for industrial applications (see IEC 61378-1);
- convertor transformers for traction applications (see IEC 60310).

1.2 Service conditions

1.2.1 General

Convertor transformers in this standard shall comply with the service conditions stated in IEC 60076-1, except where it is clearly not applicable to convertor transformers or when other requirements are specified herein. It is assumed that the transformer operates in an approximately symmetrical three-phase system, unless otherwise stated.

1.2.2 Temperature

If any part of the transformer (for example, the valve bushings) protrudes into the valve hall, the maximum temperature in the valve hall shall be specified in addition to the normal ambient temperature.

1.2.3 Load current

The currents flowing through the transformers contain harmonics. Residual d.c. currents also flow through the valve windings. The supplier shall be provided with the harmonic content and the magnitude of the residual d.c. currents in the enquiry and have it confirmed during the contract stage.

1.2.4 Direction of power flow

Unless otherwise specified, the transformer shall be designed for both rectifier and inverter operation.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61378. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61378 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60076-1:1993, *Power transformers – Part 1: General*

IEC 60076-2:1993, *Power transformers – Part 2: Temperature rise*

IEC 60076-3:2000, *Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air*

IEC 60076-5:1976, *Power transformers – Part 5: Ability to withstand short-circuit*

IEC 60076-8:1997, *Power transformers – Part 8: Application guide*

IEC 60076-10:—, *Power transformers and reactors – Part 10: Determination of sound levels* ¹⁾

IEC 60137:1995, *Insulated bushings for alternating voltages above 1 000 V*

IEC 60146-1-1:1991, *Semiconductor convertors – General requirements and line commutated convertors – Part 1-1: Specifications of basic requirements*

IEC/TR 60146-1-2:1991, *Semiconductor convertors – General requirements and line commutated convertors – Part 1-2: Application guide*

IEC 60214:1989, *On-load tap-changers*

IEC 60270:—, *Partial discharge measurements* ¹⁾

IEC 60354:1991, *Loading guide for oil-immersed power transformers*

IEC 60567:1992, *Guide for the sampling of gases and of oil from oil-filled electrical equipment and for the analysis of free and dissolved gases*

IEC 61378-1:1997, *Convertor transformers – Part 1: Transformers for industrial application*

3 Definitions

For the purpose of this part of IEC 61378, the definitions of IEC 60050 (IEV) apply. Additional definitions of more specific transformer and convertor terms are given in IEC 60076-1 and IEC 60146-1-1, respectively. Where some of these terms are at variance with earlier definitions of the same terms, found in the IEV, the terms specified in IEC 60076-1 and IEC 60146-1-1 will take precedence.

¹⁾ To be published.

4 List of variables

I_1	rated current
I_x	load-loss test current at frequency f_x
I_{LN}	r.m.s. value of the in-service load current in the winding under consideration
I_h	current at harmonic order number h
I_{eq}	equivalent sinusoidal r.m.s. current giving the winding in-service load loss
h	harmonic order number
U_1	rated voltage
S_R	rated power
P_1	total load losses at fundamental frequency (50 Hz or 60 Hz)
P_x	load loss measured at frequency f_x
$I_1^2 R$	ohmic losses at rated current
R	d.c. resistance of windings including internal leads
P_{WE1}	eddy losses in windings at fundamental frequency
P_{SE1}	stray losses in structural parts (excluding windings) at fundamental frequency
P_N	total service load loss
f_1	rated frequency and also the fundamental frequency
f_x	frequency ≥ 150 Hz used to determine the distribution of eddy losses
f_h	frequency at harmonic order number h
F_{WE}	enhancement factor for winding eddy losses
F_{SE}	enhancement factor for stray losses in structural parts
K_h	ratio of the current I_h to the rated current I_1
U_{ac}	a.c. separate source test voltage for the valve windings (r.m.s. value)
U_m	highest system voltage of the line winding
U_{dm}	highest d.c. voltage per valve bridge
U_{dc}	d.c. separate source test voltage for the valve windings
U_{pr}	polarity-reversal test voltage for the valve windings (d.c. voltage)
U_{vm}	maximum phase to phase a.c. operating voltage of the valve windings of the convertor transformer
N	number of six-pulse bridges in series from the neutral of the d.c. line to the rectifier bridge connected to the transformer

"Valve side" and "line side" define the external connections of the transformer windings. Line side refers to the winding connected to the a.c. network and valve side to the winding connected to the convertor.