

Power transformers -- Part 6: Reactors

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EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>Käesolev Eesti standard EVS-EN 60076-6:2008 sisaldab Euroopa standardi EN 60076-6:2008 ingliskeelset teksti.</p> <p>Standard on kinnitatud Eesti Standardikeskuse 19.08.2008 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.</p> <p>Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 22.07.2008.</p> <p>Standard on kättesaadav Eesti standardiorganisatsioonist.</p>	<p>This Estonian standard EVS-EN 60076-6:2008 consists of the English text of the European standard EN 60076-6:2008.</p> <p>This standard is ratified with the order of Estonian Centre for Standardisation dated 19.08.2008 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.</p> <p>Date of Availability of the European standard text 22.07.2008.</p> <p>The standard is available from Estonian standardisation organisation.</p>
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English version

**Power transformers -
Part 6: Reactors
(IEC 60076-6:2007)**

Transformateurs de puissance -
Partie 6: Bobines d'inductance
(CEI 60076-6:2007)

Leistungstransformatoren -
Teil 6: Drosselspulen
(IEC 60076-6:2007)

This European Standard was approved by CENELEC on 2008-06-01. 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.

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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 14/538/CDV, future edition 1 of IEC 60076-6, prepared by IEC TC 14, Power transformers, was submitted to the IEC-CENELEC Parallel Unique Acceptance Procedure and was approved by CENELEC as EN 60076-6 on 2008-06-01.

This European Standard supersedes EN 60289:1994 + A11:2002.

EN 60076-6:2008 includes the following significant technical changes with respect to EN 60289:1994:

- wide extension of the “Definitions”, “Rating” and “Tests” clauses,
- more consequent distinction between definition and rating,
- “Tests” subclauses take into account the latest revisions of relevant EN 60076 standards,
- dielectric testing of reactors is now in line with dielectric testing of transformer according to EN 60076-3:2001,
- consequent distinction between oil-immersed and dry-type reactor,
- document offers an easier handling and is a more stand-alone document than EN 60289,
- introduction of the discharge reactor as part of Clause 9,
- introduction of the turn-to-turn overvoltage test for dry-type reactors (Annex E),
- important background information given by newly introduced informative annexes,
 - Annex A (informative) – Information on shunt reactor switching and on special applications
 - Annex B (informative) – Magnetic characteristic of reactors
 - Annex C (informative) – Mutual reactance, coupling factor and equivalent reactances of three-phase reactors
 - Annex D (informative) – Temperature correction of losses for liquid-immersed gapped-core and magnetically shielded air-core reactors
 - Annex F (informative) – Short-circuit testing
 - Annex G (informative) – Resistors – Characteristics, specification and tests.

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) | 2009-03-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2011-06-01 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60076-6:2007 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60143	NOTE Harmonized in EN 60143 series (not modified).
IEC 60168	NOTE Harmonized as EN 60168:1994 (not modified) + A1:1997 (not modified) + A2:2000 (not modified).
IEC 60273	NOTE Harmonized as HD 578 S1:1992 (not modified).
IEC 60529	NOTE Harmonized as EN 60529:1991 (not modified).
IEC 60871-1	NOTE Harmonized as EN 60871-1:2005 (not modified).
IEC 61378-1	NOTE Harmonized as EN 61378-1:1998 (not modified).
IEC 61378-2	NOTE Harmonized as EN 61378-2:2001 (not modified).
IEC 62271-110	NOTE Harmonized as EN 62271-110:2005 (not modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60060-1 + corr. March	1989 1990	High-voltage test techniques - Part 1: General definitions and test requirements	HD 588.1 S1	1991
IEC 60076-1 (mod) A1	1993 1999	Power transformers - Part 1: General	EN 60076-1 A1 + A11 + A12	1997 2000 1997 2002
IEC 60076-2 (mod)	1993	Power transformers - Part 2: Temperature rise	EN 60076-2	1997
IEC 60076-3 + corr. December	2000 2000	Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air	EN 60076-3	2001
IEC 60076-4	2002	Power transformers - Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors	EN 60076-4	2002
IEC 60076-5	2006	Power transformers - Part 5: Ability to withstand short circuit	EN 60076-5	2006
IEC 60076-7	2005	Power transformers - Part 7: Loading guide for oil-immersed power transformers	-	-
IEC 60076-8	1997	Power transformers - Part 8: Application guide	-	-
IEC 60076-10	2001	Power transformers - Part 10: Determination of sound levels	EN 60076-10	2001
IEC 60076-11	2004	Power transformers - Part 11: Dry-type transformers	EN 60076-11	2004
IEC 60137	- ¹⁾	Insulated bushings for alternating voltages above 1 000 V	EN 60137	2003 ²⁾
IEC 60270	- ¹⁾	High-voltage test techniques - Partial discharge measurements	EN 60270	2001 ²⁾
IEC 60721-2-6	- ¹⁾	Classification of environmental conditions - Part 2: Environmental conditions appearing in nature - Earthquake vibration and shock	HD 478.2.6 S1	1993 ²⁾
IEC/TR 60815	- ¹⁾	Guide for the selection of insulators in respect of polluted conditions	-	-

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60905	1987	Loading guide for dry-type power transformers	-	-
IEC/TR3 60943	1998	Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals	-	-

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INTRODUCTION

This part of IEC 60076 is intended to provide the basis for the specification and testing of the types of reactor given in the scope. The document also gives some important information on certain reactor applications to aid the preparation of a reactor specification.

Wherever possible, references to technical Clauses in the other parts of IEC 60076 which are relevant to power transformers have been made. However, because reactors have some fundamental differences to transformers there are special considerations that apply to the specification, testing and application of reactors. These are included in this part of IEC 60076.

Clauses 1 to 6 form the general parts of the document, which apply to all types of reactor. Clauses 7 to 12 deal individually with each different type of reactor. Generally, only one of the Clauses 7 to 12 will apply to a specific reactor.

This part of IEC 60076 has more than one definition Subclause. The general definitions given in Clause 3 apply to the whole document. Each of the Clauses 7 to 12 dealing with a certain type of reactor includes a definition Subclause relevant and applying only to that Clause.

Clauses 7 to 12 have been given a uniform structure. Within this structure, the Rating Subclause sets out the minimum information that a purchaser shall supply with the reactor specification. The test Subclause in each Clause defines the relevant tests that can be applied to that particular type of reactor and may include some additional items that shall be agreed on at the time of order.

Annexes A, B, C, D, F and G provide further information for certain reactor applications and testing. Annex E describes the dielectric turn-to-turn test.

This part of IEC 60076 covers both dry-type and liquid-immersed reactors and where Clauses or Subclauses apply to only one type this is made clear.

Where possible, the requirements of this part of IEC 60076 have been harmonised with the equivalent IEEE standard.

POWER TRANSFORMERS –

Part 6: Reactors

1 Scope

This part of IEC 60076 applies to the following types of reactors:

- shunt reactors;
- series reactors including current-limiting reactors, neutral-earthing reactors, power flow control reactors, motor starting reactors, arc-furnace series reactors;
- filter (tuning) reactors;
- capacitor damping reactors;
- capacitor discharge reactors;
- earthing transformers (neutral couplers);
- arc-suppression reactors;
- smoothing reactors for HVDC and industrial application;

with the exception of the following reactors:

- reactors with a rating less than 1 kvar single-phase and 5 kvar three-phase;
- reactors for special purposes such as high-frequency line traps or reactors mounted on rolling stock.

Where IEC standards do not exist for small or special reactors, this part of IEC 60076 may be applicable as a whole or in part.

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.

IEC 60060-1:1989, *High-Voltage test techniques – Part 1: General definitions and test requirements*

IEC 60076-1:1993, *Power transformers – Part 1: General*
Amendment 1 (1999)

IEC 60076-2:1997, *Power transformers – Part 2: Temperature rise*

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

IEC 60076-4:2002, *Power transformers – Part 4: Guide to lightning impulse and switching impulse testing – Power transformers and reactors*

IEC 60076-5:2006, *Power transformers – Part 5: Ability to withstand short-circuit*

IEC 60076-7:2005, *Power transformers – Part 7: Loading guide for oil-immersed power transformers*

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

IEC 60076-10:2005, *Power transformers – Part 10: Determination of sound levels*

IEC 60076-11:2004, *Power transformers – Part 11: Dry-type transformers*

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

IEC 60270, *High-voltage test techniques – Partial discharge measurements*

IEC 60721-2-6, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature. Earthquake vibration and shock*

IEC 60815, *Guide for the selection of insulators in respect of polluted conditions*

IEC 60905:1987, *Loading guide for dry-type power transformers*

IEC 60943:1998, *Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

The definitions given in this Clause are of a general nature. Additional definitions are given in those Clauses of this part of IEC 60076 which are specific to a particular type of reactor or which are given a particular meaning when related to that type of reactor.

There are frequent references to technical Clauses in IEC 60076 concerning transformers and transformer testing. The terminology of those standards may not always be strictly relevant in the context of reactors. For example “induced a.c. withstand voltage test” is a test on a reactor where there is a test voltage across the winding although it is not “induced” from another winding, but applied directly from the test source.

3.1 Types of reactor

3.1.1

shunt reactor

reactor connected phase-to-earth, phase-to-neutral or between phases in a power system to compensate for capacitive current

3.1.2

current-limiting reactor

reactor connected in series in a power system to limit the current under system fault conditions

3.1.3

neutral-earthing reactor

reactor connected between the neutral of a power system and earth to limit the line-to-earth current under system earth fault conditions to a desired value