

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Power transformers –
Part 11: Dry-type transformers

Transformateurs de puissance –
Partie 11: Transformateurs de type sec

STANDARD PREVIEW
(standards.iteh.ai)
IEC 60076-11:2018
<https://standards.iteh.ai/catalog/standards/sist/4f01aca6-8980-4da4-9074-7142085e4078/iec-60076-11-2018>



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2018 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 21 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.



IEC 60076-11

Edition 2.0 2018-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Power transformers –
Part 11: Dry-type transformers

Transformateurs de puissance –
Partie 11: Transformateurs de type sec

STANDARD PREVIEW
(standards.iteh.ai)

IEC 60076-11:2018
<https://standards.iteh.ai/catalog/standards/sist/4f01aca6-8980-4da4-9074-7142085e4078/iec-60076-11-2018>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.180

ISBN 978-2-8322-5910-8

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
1 Scope.....	8
2 Normative references.....	8
3 Terms and definitions	9
4 Service conditions	10
4.1 General.....	10
4.2 Normal service conditions	10
4.3 Electromagnetic compatibility (EMC).....	11
5 Rating and general requirements	12
5.1 General.....	12
5.2 Rated power	12
5.2.1 General	12
5.2.2 Definition of the rated power with fans cooling or heat exchangers	12
5.2.3 Transformer IP00 (without enclosure)	12
5.2.4 Transformer with enclosure	12
5.2.5 Preferred values of rated power.....	13
5.2.6 Loading beyond rated power	13
5.3 Provision for unusual service conditions	13
5.4 Transportation and storage.....	14
5.4.1 Transport limitation	14
5.4.2 Transport acceleration	14
5.4.3 Temperature and environment conditions for transport and storage.....	14
5.5 Rated voltage and rated frequency	15
5.5.1 Rated voltage	15
5.5.2 Rated frequency.....	15
5.6 Operation at higher than rated voltage	15
5.7 Highest voltage for equipment U_m and dielectric tests levels.....	15
5.8 Identification according to cooling method	15
5.8.1 General	15
5.8.2 Identification symbols.....	15
5.8.3 Arrangement of symbols.....	16
5.9 Guaranteed temperature rise at rated conditions.....	16
5.10 Additional information required for enquiry.....	16
5.11 Sound level.....	16
5.12 Components and materials	16
6 Tappings	16
7 Connections	17
8 Ability to withstand short circuit.....	17
9 Rating plate.....	17
9.1 Rating plate fitted to the transformer.....	17
9.2 Rating plate fitted to the transformer enclosure.....	18
10 Temperature-rise limits	18
10.1 Normal temperature-rise limits.....	18
10.2 Reduced temperature rises for transformers designed for high cooling medium temperatures or special cooling medium conditions.....	19

10.3	High altitude temperature rise correction.....	19
11	Insulation levels.....	19
11.1	General.....	19
11.2	Transformers for use at high altitudes.....	20
12	Climatic, environmental and fire behaviour classes.....	21
12.1	Climatic classes.....	21
12.2	Environmental classes.....	21
12.2.1	Transformers for indoor application with or without enclosure and for outdoor application with enclosure.....	21
12.2.2	Dry-type transformers without enclosure for outdoor application.....	22
12.3	Fire behaviour classes.....	22
12.4	Test criteria for climatic, environmental and fire behaviour classes.....	23
13	Seismic.....	23
13.1	General.....	23
13.2	General seismic class approach.....	24
13.2.1	Generalities.....	24
13.2.2	The standard amplitude method.....	24
13.2.3	The calculated amplitude method.....	25
14	Test.....	26
14.1	General requirements for tests.....	26
14.2	Routine tests.....	27
14.2.1	Measurement of winding resistance.....	27
14.2.2	Measurement of voltage ratio and check of phase displacement.....	27
14.2.3	Measurement of short-circuit impedance and load loss.....	27
14.2.4	Measurement of no-load loss and current.....	28
14.2.5	Applied voltage test (AV).....	28
14.2.6	Induced voltage withstand test (IVW).....	28
14.2.7	Partial discharge measurement.....	28
14.3	Type tests.....	30
14.3.1	Full wave lightning impulse test (LI).....	30
14.3.2	Temperature-rise test.....	31
14.4	Special tests.....	34
14.4.1	Partial discharge measurement for transformers operated under a single phase line-to-earth fault condition.....	34
14.4.2	Measurement of sound level.....	35
14.4.3	Short-circuit test.....	35
14.4.4	Climatic tests.....	35
14.4.5	Environmental test.....	37
14.4.6	Fire behaviour test.....	39
14.4.7	Seismic test.....	45
14.4.8	Special test for transformers equipped with amorphous core.....	46
15	Tolerances.....	46
16	Protection against direct contact.....	47
17	Degrees of protection provided by enclosures.....	47
18	Earthing terminal.....	47
19	Information required with enquiry and order.....	47
Annex A (informative)	Installation and safety of dry-type transformers.....	48
A.1	Manuals.....	48

A.2	Installation	48
A.2.1	General	48
A.2.2	Intrinsic safety	48
A.2.3	Installation precautions	48
A.2.4	Installation design	49
Annex B (informative) Environmental test for evaluation of outdoor transformers without enclosure		50
B.1	General.....	50
B.2	Salt-fog and UV-radiation chamber test	50
B.2.1	Test description	50
B.2.2	Acceptance criteria:	52
B.3	Core and clamp coating test	52
B.3.1	Test description	52
B.3.2	Acceptance criteria	52
B.4	Field test.....	52
B.4.1	Test description	52
B.4.2	Acceptance criteria	53
Annex C (normative) Cooling of transformer in naturally ventilated room		54
C.1	Assumptions	54
C.2	Data for the calculation of ventilation	55
C.3	Output	55
C.4	Numerical application for a 1 000 kVA transformer.....	56
Annex D (normative) Calculation of the losses with different reference temperatures and/or winding material		57
Bibliography		60
Figure 1 – Basic measuring circuit for the partial discharge test for a single-phase transformer.....		29
Figure 2 – Basic measuring circuit for the partial discharge test for a three-phase transformer.....		29
Figure 3 – Voltage application for routine partial discharge test.....		30
Figure 4 – Example of back-to-back method – Single phase		33
Figure 5 – Example of back-to-back method – Three-phase		33
Figure 6 – Voltage application for special partial discharge test		35
Figure 7 – Test chamber		41
Figure 8 – Test chamber details		42
Figure B.1 – Salt fog multi-parameter ageing cycle		51
Figure C.1 – Heat dissipation in a natural ventilated room.....		54
Table 1 – Letter symbols.....		15
Table 2 – Winding temperature-rise limits.....		18
Table 3 – Test voltage levels.....		19
Table 4 – Applied voltage level correction factor.....		20
Table 5 – Sequence of tests.....		23
Table 6 – Approximate acceleration level and performance level.....		25
Table 7 – Ground acceleration level (<i>AG</i>)		26

iTeH STANDARD PREVIEW
 (standards.iteh.ai)
<https://standards.iteh.ai/catalog/standards/sis/401aca6-8980-4da4-9074-7142085e4078/iec-60076-11-2018>
 IEC 60076-11:2018

Table 8 – Recommended super elevation factors (<i>K</i>)	26
Table 9 – Direction factors (<i>D</i>)	26
Table 10 – Climatic class features	35
Table 11 – Environmental classes	38
Table 12 – Dimension of the chamber	40
Table B.1 – Outdoor environmental classes	50

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[IEC 60076-11:2018](https://standards.iteh.ai/catalog/standards/sist/4f01aca6-8980-4da4-9074-7142085e4078/iec-60076-11-2018)

<https://standards.iteh.ai/catalog/standards/sist/4f01aca6-8980-4da4-9074-7142085e4078/iec-60076-11-2018>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

POWER TRANSFORMERS –**Part 11: Dry-type transformers****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60076-11 has been prepared by IEC technical committee 14: Power transformers.

This second edition cancels and replaces the first edition published in 2004 and constitutes a technical revision.

The main changes with regard to the previous edition are as follows:

- Extension of the scope up to 72,5kV
- Enclosure management in regards of the performance
- Management of the dielectric and thermal features with altitude
- New climatic classes for a better adaptation of customers' need
- Establishment of the relation between location and environmental classes
- For fire behaviour classes, limitation at 1 000 kVA and process of test more robust

- Introduction of Seismic class
- Recommendations for amorphous transformers

The text of this International Standard is based on the following documents:

FDIS	Report on voting
14/964/FDIS	14/972/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60076 series, published under the general title *Power transformers*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

ITeH STANDARD PREVIEW
(standards.iteh.ai)

The contents of the corrigendum of March 2019 have been included in this copy.

<https://standards.iteh.ai/catalog/standards/sist/4f01aca6-8980-4da4-9074-142083c4078/iec-60076-11-2018>

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

POWER TRANSFORMERS –

Part 11: Dry-type transformers

1 Scope

This part of IEC 60076 applies to dry-type power transformers (including auto-transformers) having values of highest voltage for equipment up to and including 72,5 kV and at least one winding operating at greater than 1,1 kV.

This document does not apply to:

- gas-filled dry-type transformers where the gas is not air;
- single-phase transformers rated at less than 5 kVA;
- polyphase transformers rated at less than 15 kVA;
- instrument transformers;
- starting transformers;
- testing transformers;
- traction transformers mounted on rolling stock;
- flameproof and mining transformers;
- welding transformers;
- voltage regulating transformers; [IEC 60076-11:2018](https://standards.iteh.ai/catalog/standards/sist/4f01aca6-8980-4da4-9074-100000000000/iec-60076-11-2018)
- small power transformers in which safety is a special consideration.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-3-3, *Environmental testing – Part 3-3: Guidance – Seismic test methods for equipments*

IEC 60071-1, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2, *Insulation co-ordination – Part 2: Application guidelines*

IEC 60076-1:2011, *Power transformers – Part 1: General*

IEC 60076-2, *Power transformers – Part 2: Temperature rise for liquid-immersed transformers*

IEC 60076-3:2013, *Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air*

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

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

IEC 60076-12:2008, *Power transformers – Part 12: Loading guide for dry-type power transformers*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

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

IEC 60332-3-10, *Tests on electric cables under fire conditions – Part 3-10: Test for vertical flame spread of vertically-mounted bunched wires or cables – Apparatus*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721-3-4, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weatherprotected locations*

IEC TS 60815-1, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

IEC 61378-1, *Converter transformers – Part 1: Transformers for industrial applications*

IEC 62271-202, *High-voltage switchgear and controlgear – Part 202: High-voltage/low-voltage prefabricated substation*

[IEC 60076-11:2018](#)

ISO 12944-6, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 6: Laboratory performance test methods*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

dry-type transformer

transformer of which the magnetic circuit and windings are not immersed in an insulating liquid

3.2

totally enclosed dry-type transformer

transformer in an un-pressurised enclosure cooled by the circulation of the internal air having no intentional exchange with external air

3.3

enclosed dry-type transformer

transformer in a ventilated enclosure cooled by the circulation of the external air

3.4

non-enclosed dry-type transformer

transformer supplied without a protective enclosure cooled by natural or forced air ventilation

4 Service conditions

4.1 General

The requirements of IEC 60076-1 apply to dry-type transformers only in so far as they are referred to in this document.

4.2 Normal service conditions

a) Altitude:

See IEC 60076-1.

b) Temperature of cooling air and water:

See IEC 60076-1.

For water cooled transformers, specification of the water (temperature, water flow, etc.) has to be defined by agreement between manufacturer and purchaser if the temperature of the water is different from that specified in IEC 60076-1 and IEC 60076-2

NOTE Liquids other than water can be used as a cooling medium then all technical data of the liquid has to be defined by agreement between manufacturer and purchaser

c) Wave-shape of supply voltage:

A sinusoidal supply voltage with a total harmonic content not exceeding 5 % and an even harmonic content not exceeding 1 %.

The purchaser shall specify the magnitude and frequency of any harmonic voltages present in the supply that exceed these limits.

The manufacturer should take into account these harmonics in determination of additional core losses and also regarding the saturation of the core.

d) Load current harmonic content:

At the enquiry stage the purchaser shall specify the magnitude and frequency of each of the harmonic current components generated by the load.

The manufacturer shall consider the additional losses caused by harmonic currents in calculating the temperature rise of the windings and the effects on the other metallic parts of the transformer.

The manufacturer shall calculate the additional loss by using the method of IEC 61378-1 or by using a method like finite element by agreement between manufacturer and purchaser.

If the total harmonic content of the load current exceeds 5 %, then the extra losses due to these harmonic currents shall be taken into account by increasing the test current for the temperature rise test. The temperature rise with these losses shall not exceed the corresponding limit specified in Table 2 when tested in accordance with 14.3.2.

e) Symmetry of three-phase supply voltages:

See IEC 60076-1.

f) Installation environment:

This standard defines specific classes for environment:

- 1) for climatic conditions;
- 2) for humidity and pollution;
- 3) for fire behaviour;
- 4) for seismic disturbance;

- 5) environmental conditions within the following definitions according to IEC 60721-3-4:
- i) biological conditions 4B1;
 - ii) chemically active substances 4C2;
 - iii) mechanically active substances 4S3;
 - iv) mechanical conditions 4M4.
- g) For transformers intended to be installed indoors, some of these environmental conditions might not be applicable.
- h) Inrush current:
System inrush current limitations, if any, (maximum value, duration) shall be given at the enquiry stage by the purchaser.
- i) Frequency of energization:
If frequency of energization is greater than 24 times a year, then purchaser shall specify the number of energizations per year at the enquiry stage.
- j) Protection from water and liquids:
The transformer shall be protected against dripping water or flooding by water and other liquids.
- k) Special electrical and environmental conditions around the transformer:
IEC 60076-3 recommends general minimum clearances between transformer live parts and conductive parts in the installation.
Any part of the installation made of insulation material becomes conductive when moistened with rain water, salt water or other conductive liquids. Partial discharges in the surroundings of the transformer can decrease the dielectric strength of the air.
Therefore the clearances between these installations parts and the live parts of the transformer shall meet the clearances recommended in IEC 60076-3.
<https://standards.iteh.ai/catalog/standards/sist/4f01aca6-8980-4da4-9074-112483e97e4a/iec-60076-11-2018>
NOTE An agreement between purchaser and manufacturer is needed to reduce the clearances between transformer live parts and conductive parts in the installation.
- l) Level of vibration:
Vibrations of the structure where the transformer is to be installed shall be taken into account when designing the transformer and special consideration shall be given in the stress transferred to connection terminals.
The purchaser shall specify vibration spectrum at the enquiry stage. The procedure of vibration test, if any, should be agreed at enquiry stage between purchaser and manufacturer.
- m) Corrosion protection:
Depending on the type of the installation, the purchaser should choose a protection class defined in ISO 12944 or as agreed between purchaser and manufacturer.
- n) Maintenance
The user shall follow the manufacturer guide line for maintenance and specially avoid an accumulation of dust or pollution on the transformer by a regular cleaning.

4.3 Electromagnetic compatibility (EMC)

Transformers shall be considered as passive elements in respect to emission and immunity to electromagnetic disturbances.

5 Rating and general requirements

5.1 General

The manufacturer shall assign ratings to the transformer, which shall be marked on the rating plate, see Clause 9. These ratings shall be such that the transformer can deliver its rated current under steady loading conditions without exceeding the limits of temperature rise specified in Clause 10, assuming that the applied primary voltage is equal to the rated voltage and that the supply is at rated frequency.

5.2 Rated power

5.2.1 General

The rated power refers to continuous loading. This is a reference value for guarantees and tests concerning load losses, temperature rises and short-circuit impedance.

NOTE A two-winding transformer has only one value of rated power, identical for both windings. When the transformer has rated voltage applied to the primary winding, and rated current flows through the terminals of that winding, the transformer receives the relevant rated power for both windings.

The rated power corresponds to continuous duty; nevertheless, dry-type transformers complying with this standard can be overloaded and guidance on overloads is given in IEC 60076-12.

5.2.2 Definition of the rated power with fans cooling or heat exchangers

The transformer shall have an assigned rated power for each winding which shall be marked on the rating plate. The rated power refers to continuous loading. This is a reference value for guarantees and tests concerning load losses and temperature rises.

If different values of apparent power are assigned under different circumstances, for example with different methods of cooling, the highest of these values is the rated power.

When additional cooling by means of fans is provided, the rated power without fans shall be subject to agreement between purchaser and supplier.

5.2.3 Transformer IP00 (without enclosure)

The transformer shall have an assigned rated power for each winding which shall be marked on the rating plate.

5.2.4 Transformer with enclosure

This subclause defines rated power and the distance between enclosures and live parts when the transformer is equipped with an enclosure.

Two cases are defined:

- a) The transformer in an enclosure is manufactured, tested in the enclosure and then delivered on site:
 - The clearances between the live parts and the enclosure shall be defined by the manufacturer. The dielectric tests shall be performed with the enclosure as a routine test.
 - If the clearance between the live part and the enclosure meets the requirement of IEC 60076-3 the dielectric routine test shall be performed either with enclosure or without enclosure.

- It is permitted to disassemble the enclosure for transportation reasons. In this case the dis-assembled clearances between the live parts and the enclosure shall meet the requirements of IEC 60076-3.
 - There shall be no reduction (de-rating) of the rated power.
- b) Transformer and enclosure are delivered on site separately, or later:
- There are two methods to determine the thermal performance of enclosure:
 - The de-rating of the rated power is determined by IEC 62271-202. Then the thermal class of enclosure shall be declared by the manufacturer of the enclosure (seller of the package).
 - The enclosure is calculated using Annex C of this document.
 - The clearance between the live part and the enclosure shall meet the requirement of IEC 60076-3.
 - Enclosure shall have a rating plate and the manufacturer of the enclosure or seller of the package is responsible for determining the rated power of the transformer with the enclosure.

5.2.5 Preferred values of rated power

The preferred values shall be in accordance with IEC 60076-1 starting from 50 kVA.

5.2.6 Loading beyond rated power

The loading guides for dry-type transformers in IEC 60076-12 and the requirements in IEC 60076-1 shall apply.

5.3 Provision for unusual service conditions

The purchaser shall identify in his enquiry any service conditions not covered by the normal service conditions in 4.2. Examples of such conditions are:

- high or low ambient temperature outside the limits prescribed in 4.2;
- restricted ventilation;
- altitude in excess of the limit prescribed in 4.2;
- damaging fumes and vapours;
- steam;
- humidity in excess of the limit prescribed in 4.2;
- dripping water;
- salt spray;
- conductive pollution;
- excessive and abrasive dust;
- high harmonic content of the load current prescribed in 4.2;
- distortion of the supply voltage waveform prescribed in 4.2;
- fast transient overvoltage over the limits prescribed in 11.1;
- associated power factor correction and method of capacitor switching to limit inrush current;
- superimposed DC current;
- seismic qualification which would otherwise require special considerations in the design;
- extreme mechanical shock and vibrations;
- transport and storage conditions not covered by the normal condition described in 5.7;