

**Power transformers -- Part 14: Liquid-immersed power transformers using high-temperature insulation materials**

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

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English version

**Power transformers -  
Part 14: Liquid-immersed power transformers  
using high-temperature insulation materials  
(IEC 60076-14:2013)**

Transformateurs de puissance -  
Partie 14: Transformateurs de puissance  
immergés dans du liquide utilisant des  
matériaux d'isolation haute température  
(CEI 60076-14:2013)

Leistungstransformatoren -  
Teil 14: Flüssigkeitsgefüllte  
Leistungstransformatoren mit  
Hochtemperatur-Isolierstoffen  
(IEC 60076-14:2013)

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## Foreword

The text of document 14/755/FDIS, future edition 1 of IEC 60076-14, prepared by IEC/TC 14 "Power transformers" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60076-14:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-07-21
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-10-21

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The text of the International Standard IEC 60076-14:2013 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 60076-4	NOTE	Harmonized in EN 60076-4.
IEC 60216-1	NOTE	Harmonized as EN 60216-1.
IEC 60317	NOTE	Harmonized in EN 60317 series.
IEC 60422	NOTE	Harmonized as EN 60422.
IEC 60505	NOTE	Harmonized as EN 60505.
IEC 60567	NOTE	Harmonized as EN 60567.
IEC 60599	NOTE	Harmonized as EN 60599.
IEC 60641-3	NOTE	Harmonized in EN 60641-3 series.
IEC 60674-3	NOTE	Harmonized in EN 60674-3 series.
IEC 60819-3	NOTE	Harmonized in EN 60819-3 series.
IEC 60851-4	NOTE	Harmonized as EN 60851-4.
IEC 60867	NOTE	Harmonized as EN 60867.
IEC 60893-3	NOTE	Harmonized in EN 60893-3 series.

IEC 60970	NOTE	Harmonized as EN 60970.
IEC 61039	NOTE	Harmonized as EN 61039.
IEC 61100	NOTE	Harmonized as EN 61100.
IEC 61203	NOTE	Harmonized as EN 61203.
IEC 61212-3	NOTE	Harmonized in EN 61212-3 series.
IEC 61629-1	NOTE	Harmonized as EN 61629-1.

## Annex ZA

(normative)

### Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60076-1	-	Power transformers - Part 1: General	EN 60076-1	-
IEC 60076-2	-	Power transformers - Part 2: Temperature rise for liquid-immersed transformers	EN 60076-2	-
IEC 60076-5	-	Power transformers - Part 5: Ability to withstand short circuit	EN 60076-5	-
IEC 60076-7	-	Power transformers - Part 7: Loading guide for oil-immersed power transformers	-	-
IEC 60076-16	-	Power transformers - Part 16: Transformers for wind turbines applications	EN 60076-16	-
IEC 60085	-	Electrical insulation - Thermal evaluation and designation	EN 60085	-
IEC 60137	-	Insulated bushings for alternating voltages above 1 000 V	EN 60137	-
IEC 60214-1	-	Tap-changers - Part 1: Performance requirements and test methods	EN 60214-1	-
IEC 60296	-	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear	EN 60296	-
IEC 60836	-	Specifications for unused silicone insulating liquids for electrotechnical purposes	EN 60836	-
IEC 61099	-	Insulating liquids - Specifications for unused synthetic organic esters for electrical purposes	EN 61099	-
IEC 61378-1	-	Convertor transformers - Part 1: Transformers for industrial applications	EN 61378-1	-
IEC 61378-2	-	Convertor transformers - Part 2: Transformers for HVDC applications	EN 61378-2	-

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## INTRODUCTION

This part of IEC 60076 standardizes liquid-immersed transformers that use high-temperature insulation. As a system, the solid insulation may encompass a broad range of materials with varying degrees of thermal capability. The insulating and cooling liquids also vary substantially, ranging from mineral oil to a number of liquids that also have a range of thermal capability.

This international standard is not intended to stand alone, but rather builds on the information and guidelines documented in other parts of the IEC 60076 series. Accordingly, this document follows two guiding principles. The first principle is that liquid-immersed transformers are well known and are well defined in other parts of this series and therefore, the details of these transformers are not repeated in this international standard, except where reference has value, or where repetition is considered appropriate for purposes of emphasis or comparison.

The second principle is that the materials used in normal liquid-immersed transformers, typically kraft paper, pressboard, wood, mineral oil, paint and varnish, which operate within temperature limits given in IEC 60076-2, are well known and are considered normal or conventional. All other insulation materials, either solid or liquid that have a thermal capability higher than the materials used in this well-known system of insulation materials are considered high-temperature. Consequently, this standard or normal insulation system is defined as the “conventional” insulation system for comparison purposes and these normal thermal limits are presented for reference to illustrate the differences between other higher-temperature systems.

This international standard addresses loading, overloading, testing and accessories in the same manner. Only selected information for the “conventional” transformers is included for comparison purposes or for emphasis. All other references are directed to the appropriate IEC document.

## POWER TRANSFORMERS –

### Part 14: Liquid-immersed power transformers using high-temperature insulation materials

#### 1 Scope

This part of IEC 60076 applies to liquid-immersed power transformers employing either high-temperature insulation or combinations of high-temperature and conventional insulation, operating at temperatures above conventional limits.

It is applicable to:

- power transformers in accordance with IEC 60076-1;
- convertor transformers according to IEC 61378 series;
- transformers for wind turbine applications in accordance with IEC 60076-16;
- arc furnace transformers;
- reactors in accordance with IEC 60076-6.

This part of IEC 60076 may be applicable as a reference for the use of high-temperature insulation materials in other types of transformers and reactors.

#### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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

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

IEC 60076-16, *Power transformers – Part 16: Transformers for wind turbine applications*

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

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

IEC 60214-1, *Tap-changers – Part 1: Performance requirements and test methods*

IEC 60296, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

IEC 60836, *Specifications for unused silicone insulating liquids for electrotechnical purposes*

IEC 61099, *Specifications for unused synthetic organic esters for electrical purposes*

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

IEC 61378-2, *Convertor transformers – Part 2: Transformers for HVDC applications*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those given in IEC 60076-1 and IEC 60076-2 apply.

#### 3.1

##### **insulation system**

system composed of solid insulating materials and an insulating liquid

#### 3.2

##### **temperature index**

###### **TI**

numerical value of the temperature in degrees Celsius derived from the thermal endurance relationship at a time of 20 000 h (or other specified time)

[SOURCE: IEC 60050-212:2010, 212-12-11, modified – Notes 1 and 2 have been deleted]

#### 3.3

##### **thermal class**

designation of Electrical Insulation Materials (EIM) or Electrical Insulation Systems (EIS) equal to the numerical value of the maximum used temperature in degrees Celsius for which the EIM/EIS is appropriate

Note 1 to entry: See IEC 60085.

#### 3.4

##### **conventional**

modifier applied to temperature-rise limits, insulation materials or insulation systems operating at temperature limits defined by IEC 60076-2

#### 3.5

##### **kraft paper**

paper made almost entirely from pulp of high mechanical strength, manufactured from soft-wood by the sulphate process

[SOURCE: IEC 60050-212:2010, 212-16-03]

#### 3.6

##### **thermally upgraded paper**

###### **TUP**

cellulose-based paper which has been chemically modified to reduce the rate at which the paper decomposes

Note 1 to entry: See IEC 60076-2 for the complete definition.

Note 2 to entry: This note applies to the French language only.

#### 3.7

##### **high-temperature**

temperature rise limits and/or insulation materials applied in systems consisting of solid materials and/or liquid, capable of operating at higher temperatures than conventional