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TAP-changers – Part 2: Application guidelines

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FOREWORD

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International Standard IEC/IEEE 60214-2 has been prepared by IEC technical committee 14: Power transformers, in cooperation with the Transformers Committee of the IEEE Power and Energy Society, under the IEC/IEEE Dual Logo Agreement between IEC and IEEE.

This publication is published as an IEC/IEEE Dual Logo standard.

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

This edition includes the following significant technical changes with respect to the previous edition:

a) title has been updated from "Application guide" to "Application guidelines";
b) tap-changers for gas-filled transformers have been added;
c) description of typical circuits for regulation has been added;
d) description of basic arrangements of tapped windings with on-load tap-changers and de-energized tap-changers has been added;
e) types of tap-changers are explained in more detail (e.g. vacuum type on-load tap-changer) and new types have been added (e.g. step-voltage regulator, advance retard switch (ARS), on-load tap-changers for distribution transformers);
f) selection of tap-changers (on-load and de-energized) are described in more detail with respect to applications and parameters, which have to be considered (e.g. current wave shapes, operating pressure, temperature conditions, overloading conditions, continuous consecutive operations);
g) storage and installation has been considered;
h) field service, including commissioning, operation, maintenance and monitoring, has been considered;
i) safety aspects have been updated.

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

FDIS	Report on voting
14/1000/FDIS	14/1006/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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60214 series, published under the general title *Tap-changers*, can be found on the IEC website.

The IEC Technical Committee and IEEE Technical Committee have decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

The recommendations in these application guidelines represent advice to the tap-changer manufacturer, the transformer manufacturer, and the end user. When using these guidelines, the recommendations and instructions of the tap-changer manufacturer should prevail.

These guidelines apply to typical tap-changers currently in production at the time of publication. However, much of the information is applicable to older designs.

It is stressed that the responsibility for the correct application of the fully assembled tap-changers in connection with the transformer lies with the manufacturer of the transformer.

TAP-CHANGERS –

Part 2: Application guidelines

1 Scope

This part of IEC 60214 is intended to assist in the selection of tap-changers designed in accordance with IEC 60214-1 or IEEE Std C57.131 for use in conjunction with the tapped windings of transformers or reactors. Requirements, references and definitions relevant to either IEC 60214-1 or IEEE Std C57.131 are given and their use is described in Clause 4. It is also intended to assist in understanding the various types of tap-changers and their associated equipment available. These application guidelines cover on-load tap-changers (resistor and reactor types) and de-energized tap-changers.

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.

2.1 IEC references

IEC 60050-421, *International Electrotechnical Vocabulary (IEV) – Chapter 421: Power transformers and reactors* (available at www.electropedia.org)

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

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

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

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

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

IEC 60076-21, *Power transformers – Part 21: Standard requirements, terminology, and test code for step-voltage regulators*

IEC 60156, *Insulating liquids – Determination of the breakdown voltage at power frequency – Test method*

IEC 60214-1:2014, *Tap-changers – Part 1: Performance requirements and test methods*

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

IEC 60567, *Oil-filled electrical equipment – Sampling of gases and analysis of free and dissolved gases – Guidance*

IEC 60814, *Insulating liquids – Oil-impregnated paper and pressboard – Determination of water by automatic coulometric Karl Fischer titration*

2.2 IEEE references

ASTM D877 / D877M-2013, *Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes*

ASTM D1533, *Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration*

ASTM D3487, *Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus*

IEEE Std C57.12.00™-2015, *IEEE Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers*

IEEE Std C57.12.01™, *IEEE Standard for General Requirements for Dry-Type Distribution and Power Transformers*

IEEE Std C57.12.90™, *IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers*

IEEE Std C57.15™, *Power transformers – Part 21: Standard requirements, terminology, and test code for step-voltage regulators*

IEEE Std C57.91™, *IEEE Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators*

IEEE Std C57.131™-2012, *IEEE Standard Requirements for Tap Changers*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-421, IEC 60214-1 and IEC 60076-21 apply for IEC-specified tap-changers. For IEEE-specified tap-changers, the terms and definitions given in IEEE Std C57.131 and IEEE Std C57.15 apply. For all tap-changers, the following apply and take precedence.

ISO, IEC and IEEE 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
- IEEE Dictionary Online: available at http://dictionary.ieee.org

3.1.1
mechanically linear
de-energized tap-changer, where the stationary contacts are arranged in a line (or series of lines) and the moving contacts operate in an inline manner to connect with the stationary contacts

Note 1 to entry: The definition only applies to the general operational characteristics of the switch, not to the type of contacts or actual operating mechanism.

3.1.2
mechanically rotary
de-energized tap-changer, where the stationary contacts are arranged along a circumference surrounding a central axis and the moving contacts operate in a rotational manner around that same central axis

Note 1 to entry: The definition only applies to the general operational characteristics of the switch, not to the type of contacts or actual operating mechanism.

3.1.3
fritting
electrically intimate metal-to-metal contact created by the dielectric breakdown of a very thin film of oil, oxides, sulfites, etc.

3.1.4
continuous consecutive operation
uninterrupted operation with the driving mechanism operating at its normal speed

3.2 Abbreviated terms

ARS	Advance retard switch
DETC	De-energized tap-changer
DGA	Dissolved and free gases analysis
EAF	Electrical arc furnace
GIC	Geomagnetic induced current
HV	High-voltage
HVDC	High-voltage direct current
IGBT	Insulated-gate bipolar transistor
LCSET	Lowest cold start energizing temperature (see IEC 60296)
LV	Low-voltage
OLTC	On-load tap-changer
PD	Partial discharge
PST	Phase-shifting transformer
VI	Vacuum interrupter
VSR	Variable shunt reactor

4 Use of normative references

This document can be used with either IEC or IEEE normative references but the references shall not be mixed. The purchaser shall include in the enquiry and order which normative references are to be used. If the choice of normative references is not specified, then IEC standards shall be used except for tap-changers intended for installation in North America where IEEE standards shall be used.

If only one alternative is given in a certain part of the document, i.e. only IEC reference(s) or only IEEE reference(s), then that/these reference(s) is/are valid independently of the choice of normative references.