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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Tap-changers –
Part 1: Performance requirements and test methods

Changeurs de prises –
Partie 1: Prescriptions de performances et méthodes d'essai

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FOREWORD

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International Standard IEC 60214-1 has been prepared by IEC technical committee 14: Power transformers.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

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

- incorporation of requirements on vacuum type on-load tap-changers,
- incorporation of requirements on gas insulated tap-changers,
- changes in the type tests to fit with the service conditions,
- reference to the newest edition of IEC 60076-3:2013.

This bilingual version (2014-12) corresponds to the monolingual English version, published in 2014-05.

The text of this standard is based on the following documents:

CDV	Report on voting
14/746/CDV	14/767A/RVC

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

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with 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 committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site 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- withdrawn,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.

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TAP-CHANGERS –

Part 1: Performance requirements and test methods

1 Scope

This part of IEC 60214 applies to on-load tap-changers of both resistor and reactor types, de-energized tap-changers, and their motor-drive mechanisms.

It applies mainly to tap-changers immersed in mineral insulating oil according to IEC 60296 but may also be used for tap-changers with air or gas insulation or immersed in other insulating liquids insofar as conditions are applicable.

It applies mainly to tap-changers with arcing contacts but may also be used for arcing-free on-load tap-changers (such as electronic switching) insofar as conditions are applicable.

This part of IEC 60214 applies to power and distribution transformers of all types and also to reactors.

It does not apply to transformers and reactors mounted on railway rolling stock.

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 60050 (all parts), *International Electrotechnical Vocabulary* (available at http://www.electropedia.org)

IEC 60050-421, *International Electrotechnical Vocabulary – Chapter 421: Power transformers and reactors*

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

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

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

IEC 60076-21:2011, *Power transformers – Part 21: Standard requirements, terminology, and test code for step-voltage regulators*

IEC 60137:2008, *Insulated bushings for alternating voltages above 1 000 V*

IEC 60214-2:2004, *Tap-changers – Part 2: Application guide*

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-421 as well as the following apply.

3.1
on-load tap-changer
OLTC
device for changing the tap connections of a winding, suitable for operation while the transformer is energized or on load

Note 1 to entry: On-load tap-changers are sometimes called load tap-changers (LTC).

3.2
non-vacuum type on-load tap-changer
on-load tap-changer with contacts that break and make the load and circulating currents and where the arcing takes place in a liquid or gas, the tap-changer itself being placed in liquid or gas

Note 1 to entry: This definition does not apply to arcing-free on-load tap-changers.

3.3
vacuum type on-load tap-changer
on-load tap-changer where vacuum interrupters (VI) break and make the load and circulating currents, the tap-changer itself being placed in a different medium such as liquid or gas

3.4
tap selector
device designed to carry, but not to make or break, current, used in conjunction with a diverter switch to select tap connections

3.5
diverter switch
switching device used in conjunction with a tap selector to carry, make and break currents in circuits which have already been selected

Note 1 to entry: Diverter switches are sometimes called arcing switches.

3.6
selector switch
switching device capable of carrying, making and breaking current, combining the duties of a tap selector and a diverter switch

Note 1 to entry: Selector switches are sometimes called arcing tap switches.

Note 2 to entry: In non-vacuum type selector switches the selection of tap connections (tap selector duty) and the diversion of the through-current (diverter switch duty) are carried out by the same contacts.

Note 3 to entry: In vacuum type selector switches the selection of tap connections (tap selector duty) and the diversion of the through-current (diverter switch duty) are carried out by different contacts.

3.7
de-energized tap-changer
DETC
device for changing the tap connections of a winding, suitable for operation only while the transformer is de-energized (isolated from the system)

Note 1 to entry: De-energized tap-changers are sometimes called off-circuit tap-changers.

Note 2 to entry: De-energized tap-changers are sometimes abbreviated as DTC.

3.8
change-over selector
device designed to carry, but not to make or break, through-current, used in conjunction with the tap selector or selector switch to enable its contacts and the connected taps to be used more than once when moving from one extreme position to the other

3.9
coarse change-over selector
change-over selector connecting the tap winding to either the main winding or the coarse winding or parts thereof

3.10
reversing change-over selector
change-over selector connecting either end of the tap winding to the main winding

3.11
transition impedance
resistor or reactor consisting of one or more units bridging the tap in use and the tap next to be used, for the purpose of transferring load from one tap to the other without interruption or appreciable change in the load current, at the same time limiting the circulating current for the period that both taps are used

Note 1 to entry: For reactor type tap-changers, the transition impedance (reactor) is commonly called a preventive auto transformer. Reactor type tap-changers normally use the bridging position as a service position (mid-point or centre tapped reactor tap-changers) and, therefore, the reactor is designed for continuous operation.

3.12
preventive auto transformer
auto transformer (or centre tapped reactor) used in on-load tap-changing and regulating transformers, or step voltage regulators to limit the circulating current when operating on a position in which two adjacent taps are bridged, or during the change of tap between adjacent positions

3.13
equalizer winding
winding on the same magnetic circuit (core) as the excitation and tap winding of a reactor type regulating transformer with approximately half the number of turns of each tap section

3.14
drive mechanism
means by which the drive to the tap-changer is actuated

Note 1 to entry: The mechanism may include an independent means of storing energy to control the operation.

3.15
set of contacts
pair of individual fixed and moving contacts or a combination of such pairs operating substantially simultaneously

3.16
diverter switch and selector switch main contacts <of a resistor type tap-changer>
set of through-current carrying contacts which usually by-passes the main switching contact and only commutates any current (sparking often occurs)

3.17
diverter switch and selector switch main switching contacts <of a resistor type tap-changer>
set of contacts which has no transition resistor between the transformer winding and the contacts and makes and breaks current (arcing will occur)

Note 1 to entry: In case of vacuum type tap-changers, these contact systems are replaced by vacuum interrupters.

3.18
diverter switch and selector switch transition contacts, <of a resistor type tap-changer>
set of contacts which is connected in series with a transition resistor and makes or breaks current (arcing will occur)

Note 1 to entry: In case of vacuum type tap-changers, these contact systems are replaced by vacuum interrupters.

3.19
transfer contacts <of a reactor type tap-changer>
set of contacts that makes or breaks current

Note 1 to entry: Where by-pass contacts are not provided, the transfer contact is a continuous current-carrying contact.

3.20
by-pass contacts <of a reactor type tap-changer>

set of through-current carrying contacts that commutates the current to the transfer contacts without any arc (sparking may occur)

3.21
bridging position
position of a reactor type tap-changer with the selector and transfer contacts being on two adjacent taps and with the output terminal being electrically in the middle between two adjacent taps

3.22
non-bridging position
position of a reactor type tap-changer with the selector and transfer contacts being on the same tap

3.23
circulating current
that part of the current that flows through the transition impedance at the time when two taps are momentarily bridged during a tap-change operation for a resistor type tap-changer or when bridged in an operating position for a reactor type tap-changer

Note 1 to entry: The circulating current is due to the voltage difference between the taps.

3.24
switched current
prospective current to be broken during switching operation by each set of main switching or transition contacts (resistor type tap-changer) or transfer contacts (reactor type tap-changer) incorporated in the diverter switch or the selector switch

3.25
recovery voltage
power-frequency voltage which appears across each set of main switching or transition contacts (resistor type tap-changer) or transfer contacts (reactor type tap-changer) of the diverter switch or selector switch after these contacts have broken the switched current

3.26
tap-change operation
complete sequence of events from the initiation to the completion of a tap-change from one service tap position to an adjacent position

3.27
cycle of operation
movement of the tap-changer from one end of its range to the other end and the return to its original position

3.28
rated insulation level
withstand values of the impulse and applied voltages to earth, and where appropriate between phases, and between those parts where insulation is required

3.29
rated through-current
I_r
current flowing through an on-load tap-changer towards the external circuit, which the apparatus is capable of transferring from one tap to the other at the relevant rated step voltage and which can be carried continuously while meeting the requirements of this standard

3.30
maximum rated through-current
I_{rm}
highest rated through-current for which the tap-changer is designed for and all the current related tests are based on

3.31
rated step voltage
U_{ir}
for each value of rated through-current, the highest permissible voltage between terminals which are intended to be connected to successive taps of the transformer

3.32
relevant rated step voltage
highest step voltage permitted in connection with a given rated through-current

3.33
maximum rated step voltage
U_{irm}
highest value of the rated step voltage for which the tap-changer is designed

3.34
rated frequency
frequency of the alternating current for which the tap-changer is designed

3.35
number of inherent tap positions
highest number of tap positions for half a cycle of operation for which a tap-changer can be used according to its design

Note 1 to entry: The term “tap positions” is generally given as the ± value of the relevant number, for example, ±11 positions. They are in principle also valid for the motor-driven mechanism. When using a “number of tap positions” in connection with a transformer, this always refers to the number of service tap positions of the transformer.

3.36
number of service tap positions
number of tap positions for half a cycle of operation for which a tap-changer is used in the transformer

Note 1 to entry: The term “tap position” is generally given as the ± values of the relevant number, for example, ±11 positions. They are in principle also valid for the motor-driven mechanism. When using the term “number of tap positions” in connection with a transformer, this always refers to the number of service tap positions of the transformer.

3.37
type test
test made on a tap-changer which is representative of other tap-changers, to demonstrate that these tap-changers comply with the specified requirements not covered by the routine tests: a tap-changer is considered to be representative of others if it is built to the same drawings using the same techniques and same materials

Note 1 to entry: In general a type test can be carried out on a tap-changer or the components of a tap-changer or a family of tap-changers or components.

Note 2 to entry: A family of tap-changers is a number of tap-changers based on the same design and having the same characteristics, with the exception of the insulation levels to earth and possibly between phases, the number of steps and in the case of OLTCs the value of the transition impedance.

Note 3 to entry: Design variations that are clearly irrelevant to a particular type test would not require that type test to be repeated.

Note 4 to entry: Design variations that cause a reduction in values and stresses relevant to a particular type test do not require a new type test if accepted by the purchaser and the manufacturer.

3.38
routine test
test to which each individual tap-changer is subjected

Note 1 to entry: In general a routine test can be carried out on a tap-changer or the components of a tap-changer.

3.39
motor-drive mechanism
driving mechanism which incorporates an electric motor and a control circuit

3.40
step-by-step control <of a motor-drive mechanism>
device for stopping the motor-drive mechanism after completion of a tap-change, independently of the operating sequence of the control switch

3.41
tap position indicator
device for indicating the tap position of the tap-changer

3.42
tap-change in progress indicator
device for indicating that the motor-drive mechanism is running

3.43
limit switches
devices for preventing operation of the tap-changer beyond either end position, but allowing operation in the opposite direction