INTERNATIONAL STANDARD

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2003-02

Tap-changers –

Part 1: Performance requirements and test methods

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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TAP-CHANGERS –

Part 1: Performance requirements and test methods

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60214-1 has been prepared by IEC technical committee 14: Power transformers

This first edition of IEC 60214-1 cancels and replaces IEC 60214 published in 1989. This first edition constitutes a technical revision.

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

FDIS	Report on voting
14/457/FDIS	14/462/RVD

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

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

IEC 60214 consists of the following parts, under the general title *Tap-changers*:

Part 1: Performance requirements and test methods

Part 2: Application guide *(under consideration)*

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

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- withdrawn;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

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, off-circuit tap-changers, and their motor drive mechanisms. It applies mainly to tap-changers immersed in transformer oil according to IEC 60296 but may also be used for tap-changers with gas insulation or immersed in other insulating liquids insofar as conditions are applicable.

It 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 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, *High voltage test techniques*

IEC 60076-1:2000, *Power transformers – Part 1: General*

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

IEC 60137, *Insulated Bushings for alternating voltages above 1 000 volts*[1]

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

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

IEC 60296, *Specification for unused mineral insulating oils for transformers and switchgear*

IEC 60354, *Loading guide for oil-immersed transformers*

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

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1 To be published.

2 At present under revision, document currently IEC 60542.

3 Terms and definitions

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

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

3.2
tap selector
device designed to carry, but not to make or break, current, used in conjunction with a diverter switch to select tap connections

3.3
diverter switch
switching device used in conjunction with a tap selector to carry, make or break currents in circuits which have already been selected

NOTE Diverter switches are sometimes called arcing switches.

3.4
selector switch
switching device capable of making, carrying and breaking current, combining the duties of a tap selector and a diverter switch

NOTE Selector switches are sometimes called arcing tap switches.

3.5
off-circuit tap-changer
device for changing the tap of a winding, suitable for operation only when the transformer is de-energized

3.6
change-over selector
device designed to carry, but not to make or break, current, used in conjunction with the tap selector or selector switch to enable its contacts and the connection taps to be used more than once when moving from one extreme position to the other

3.7
coarse change-over selector
change-over selector connecting the tapped winding to either the coarse winding or the main winding or parts thereof

3.8
reversing change-over selector
change-over selector connecting either end of the tapped winding to the main winding

3.9
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 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.

3.10
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

3.11
equalizer winding
winding on the same magnetic circuit (core) as the excitation and tapped winding of a reactor type regulating transformer with approximately half the number of turns of each tap section

3.12
drive mechanism
means by which the drive to the tap-changer is actuated

NOTE The mechanism may include an independent means of storing energy to control the operation.

3.13
set of contacts
pair of individual fixed and moving contacts or a combination of such pairs operating substantially simultaneously

3.14
diverter switch and selector switch main contacts (resistor type tap-changer)
set of through-current-carrying contacts which has no transition impedance between the transformer winding and the contacts and does not switch any current

3.15
diverter switch and selector switch main switching contacts (resistor type tap-changer)
set of contacts which has no transition impedance between the transformer winding and the contacts and makes and breaks current

3.16
diverter switch and selector switch transition contacts (resistor type tap-changer)
set of contacts which is connected in series with a transition impedance and makes or breaks current

3.17
transfer contacts (reactor type tap-changer)
set of contacts that makes or breaks current

NOTE Where by-pass contacts are not provided, the transfer contact is a continuous current-carrying contact.

3.18
by-pass contacts (reactor type tap-changer)
set of through-current-carrying contacts that commutates the current to the transfer contacts without any arc

3.19
bridging contacts
moveable current-carrying contacts that bridge between two fixed contacts when on-position

3.20
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. The circulating current is due to the voltage difference between the taps.

3.21
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

3.22
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

3.23
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

3.24
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

3.25
rated insulation level
withstand values of the impulse and separate source AC withstand voltages to earth, and where appropriate between phases, and between those parts where insulation is required

3.26
rated through-current (I_u)
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

3.27
maximum rated through-current (I_{um})
highest rated through-current for which the tap-changer is designed for and which forms the basis for all current related tests

3.28
rated step voltage (U_i)
for each value of rated through-current, highest permissible voltage between terminals which are intended to be connected to successive taps of the transformer

3.29
relevant rated step voltage
highest step voltage allowable in connection with a given rated through-current

3.30
maximum rated step voltage (U_{im})
highest value of the rated step voltage for which the tap-changer is designed

3.31
rated frequency
frequency of the alternating current for which the tap-changer is designed

3.32
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 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.

3.33
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 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.

3.34
type test
test made on a tap-changer or the components of a tap-changer or a range of tap-changers or components all based on the same design, to prove compliance with this standard

NOTE A range 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 the value of the transition impedance.

3.35
routine test
test made on each completed tap-changer, the design of which has been verified by type test, to establish that the tap-changer is without manufacturing defects

3.36
motor drive mechanism
driving mechanism which incorporates an electric motor and a control circuit

3.37
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

3.38
tap position indicator
device for indicating the tap position of the tap-changer

3.39
tap-change in progress indicator
device for indicating that the motor-drive mechanism is running