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INTERNATIONAL STANDARD

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High-voltage switchgear and controlgear –
Part 101: Synthetic testing

Appareillage à haute tension –
Partie 101: Essais synthétiques

IEC 62271-101:2021-07(en-fr)

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High-voltage switchgear and controlgear – Part 101: Synthetic testing

Appareillage à haute tension – Partie 101: Essais synthétiques

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 101: Synthetic testing

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International Standard IEC 62271-101 has been prepared by subcommittee 17A: Switching devices, of IEC technical committee 17: High-voltage switchgear and controlgear.

This third edition cancels and replaces the second edition published in 2012 and Amendment 1:2017. This edition constitutes a technical revision.

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

a) alignment with the third edition of IEC 62271-100:2021;
b) update this document with the last methods and techniques used for synthetic tests;

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

FDIS	Report on voting
17A/1312/FDIS	17A/1315/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

This publication shall be read in conjunction with IEC 62271-100:2021, to which it refers. The numbering of the subclauses of Clause 7 is the same as in IEC 62271-100. However, not all subclauses of IEC 62271-100 are addressed; merely those where synthetic testing has introduced changes.

A list of all the parts in the IEC 62271 series, under the general title *High-voltage switchgear and controlgear*, 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 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.

The contents of the corrigendum of October 2021 have been included in this copy.

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HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 101: Synthetic testing

1 Scope

This part of IEC 62271 mainly applies to AC circuit-breakers within the scope of IEC 62271-100. It provides the general rules for testing AC circuit-breakers, for making and breaking capacities over the range of test duties described in 7.102 to 7.111 of IEC 62271-100:2021, by synthetic methods.

It has been proven that synthetic testing is an economical and technically correct way to test high-voltage AC circuit-breakers according to the requirements of IEC 62271-100 and that it is equivalent to direct testing.

The methods and techniques described are those in general use. The purpose of this document is to establish criteria for synthetic testing and for the proper evaluation of results. Such criteria will establish the validity of the test method without imposing restraints on innovation of test circuitry.

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 62271-100:2021, *High-voltage switchgear and controlgear – Part 100: Alternating-current circuit-breakers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62271-100 and the following 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
direct test
test in which the applied voltage, the current and the transient and power-frequency recovery voltages are all obtained from a circuit having a single-power source, which can be a power system or special alternators as used in short-circuit testing stations or a combination of both

3.2
synthetic test
test in which all of the current, or a major portion of it, is obtained from one source (current circuit), and in which the applied voltage and/or the recovery voltages (transient and power frequency) are obtained wholly or in part from one or more separate sources (voltage circuits)

3.3
auxiliary circuit-breaker
circuit-breaker forming part of a synthetic test circuit used to put the test circuit-breaker into the required relation with various circuits

3.4
current circuit
part of the synthetic test circuit from which all or the major part of the power-frequency current is obtained

3.5
voltage circuit
part of the synthetic test circuit from which all or the major part of the applied voltage and/or recovery voltage is obtained

3.6
prospective current
current that would flow in the circuit if each pole of the test and auxiliary circuit-breakers were replaced by a conductor of negligible impedance

Note 1 to entry: Compared with IEC 60050-441:2000, 441-17-01, the domain between brackets has been deleted. In the definition. The words "the switching device or the fuse" have been replaced by "the test and auxiliary circuit-breakers", and the Note to entry has been deleted.

3.7
actual current
current through the test circuit-breaker

Note 1 to entry: The actual current is a prospective current modified by the arc voltage of the test and auxiliary circuit-breakers.

3.8
post-arc current
current which flows through the arc gap of a circuit-breaker after the arc voltage have reached zero and the transient recovery voltage begins to rise

3.9
current injection method
synthetic test method in which the voltage circuit is applied to the test circuit-breaker before power-frequency current zero

3.10
initial transient making current
ITMC
transient current which flows through the circuit-breaker at the moment of voltage breakdown prior to the initiation of current from the current circuit during making

3.11
injected current
current supplied by the voltage circuit of a current injection circuit when it is connected to the circuit-breaker under test

3.12
voltage injection method
synthetic test method in which the voltage circuit is applied to the test circuit-breaker after power-frequency current zero

3.13
reference system conditions
conditions of an electrical system having the parameters from which the rated and test values of IEC 62271-100 are derived

3.14
time delay of making device
t_m
time interval, during synthetic making test, between the instant of breakdown of the applied voltage and the initiation of current from the current circuit

3.15
pre-strike
voltage breakdown between the contacts during a making operation which initiates current flow

3.16
intermediate asymmetry
level of asymmetry in the other two phases having a reduced (intermediate) level of asymmetry when in a three-phase system the short-circuit current is initiated simultaneously in all phases and maximum asymmetry is obtained in one of the phases

3.17
rate-of-decay of dielectric strength
RDDS
voltage withstand reduction between the contacts as a function of time or contact gap during closing

[SOURCE: IEC TR 62271-302:2010, 3.7.5, modified – The words "between the contacts" have been added after "reduction" and "of a circuit-breaker" have been deleted at the end.]

4 Synthetic testing techniques and methods for short-circuit breaking tests

4.1 Basic principles and general requirements for synthetic breaking test methods

4.1.1 General

Any particular synthetic method chosen for testing shall adequately stress the test circuit-breaker. Generally, the adequacy is established when the test method meets the requirements set forth in the following paragraphs and subclauses of 4.1, 4.2 and 4.3.

A circuit-breaker has two basic positions: closed and open. In the closed position a circuit-breaker conducts full current with negligible voltage drop across its contacts. In the open position it conducts negligible current but with full voltage across the contacts. This defines the two main stresses, the current stress and the voltage stress, which are separated in time.

If closer attention is paid to the voltage and current stresses during the interrupting process (Figure 1), three main intervals can be recognized.

– High-current interval

  The high-current interval is the time from contact separation to the start of the significant change in arc voltage. The high-current interval precedes the interaction and high-voltage intervals.

– Interaction interval

  The interaction interval is the time from the start of the significant change in arc voltage prior to current zero to the time when the current including the post-arc current, if any, ceases to flow through the test circuit-breaker (see also 14.2.4 of IEC TR 62271-306:2012/AMD1:2018).