SLOVENSKI STANDARD
SIST EN 60427:2000

01-september-2000

Nadomeġļa:
SIST EN 60427:1998

Synthetic testing of high-voltage alternating current circuit-breakers (IEC 60427:2000)

Synthetic testing of high-voltage alternating current circuit-breakers

Synthetische Prüfung von Hochspannungs-Wechselstrom-Leistungsschaltern

Essais synthétiques des disjoncteurs à courant alternatif à haute tension

Ta slovenski standard je istoveten z: EN 60427:2000

ICS:

29.130.10	Visokonapetostne stikalne in krmilne naprave	High voltage switchgear and controlgear

SIST EN 60427:2000 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60427

May 2000

ICS 29.130.10

Supersedes EN 60427:1992 + A1:1993 + A2:1995

English version

Synthetic testing of high-voltage alternating current circuit-breakers
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Essais synthétiques des disjoncteurs
à courant alternatif à haute tension
(CEI 60427:2000)

Synthetische Prüfung von
Hochspannungs-Wechselstrom-
Leistungsschaltern
(IEC 60427:2000)

This European Standard was approved by CENELEC on 2000-02-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 60427:2000 E

Foreword

The text of document 17A/559/FDIS, future amendment to IEC 60427:1989, prepared by SC 17A, High-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A3 to EN 60427:1992 on 2000-02-01.

The text of this document, together with that of IEC 60427:1989 and its amendments 1:1992 and 2:1995, was published by IEC as the third edition of IEC 60427 in April 2000. According to a decision of principle taken by the Technical Board of CENELEC, the approval of EN 60427:1992/A3 has been converted into the approval of a new EN 60427.

This European Standard supersedes EN 60427:1992 and its amendments A1:1993 and A2:1995.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2001-02-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-02-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annexes EE, GG and ZA are normative and annexes AA, BB, CC, DD, FF and HH are informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60427:2000 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60050-441	1984	International Electrotechnical Vocabulary (IEV) Chapter 441: Switchgear, controlgear and fuses	-	-
IEC 60056 (mod)	1987	High-voltage alternating-current circuit-breakers	HD 348 S7[1)]	1998
IEC 61633	1995	High-voltage alternating current circuit-breakers - Guide for short-circuit and switching test procedures for metal-enclosed and dead tank circuit-breakers	-	-

1) HD 348 S7 includes A3:1996 to IEC 60056.

NORME INTERNATIONALE

INTERNATIONAL STANDARD

CEI
IEC
60427

Troisième édition
Third edition
2000-04

Essais synthétiques des disjoncteurs à courant alternatif à haute tension

Synthetic testing of high-voltage alternating current circuit-breakers

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE XB

Pour prix, voir catalogue en vigueur
For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SYNTHETIC TESTING OF HIGH-VOLTAGE ALTERNATING CURRENT CIRCUIT-BREAKERS

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.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60427 has been prepared by subcommittee 17A: High voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.

This third edition cancels and replaces the second edition published in 1989, amendment 1 (1992), amendment 2 (1995). This third edition constitutes a technical revision.

The text of this standard is based on the second edition, amendment 1, amendment 2 and the following documents:

FDIS	Report on voting
17A/559/FDIS	17A/565/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 not been drafted in complete accordance with the ISO/IEC Directives, Part 3.

This publication shall be read in conjunction with IEC 60056 (1987). The numbering of the subclauses of clause 6 is the same as in IEC 60056. The annexes and their figures are named AA, BB, etc.

Annexes EE and GG form an integral part of this standard.

Annexes AA, BB, CC, DD, FF and HH are for information only.

The committee has decided that the contents of this publication will remain unchanged until 2005-01-01. At this date, the publication will be

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

INTRODUCTION

During the past few decades experience has been gained with synthetic testing techniques and methods. It has been proven that synthetic testing is an economical and technically correct way to test high-voltage a.c. circuit-breakers according to the requirements of IEC 60056.

This is why it was decided to include synthetic testing methods, after a thorough revision of the first edition of IEC 60427, as equivalent to the direct test methods.

SYNTHETIC TESTING OF HIGH-VOLTAGE ALTERNATING CURRENT CIRCUIT-BREAKERS

1 Scope

This International Standard applies to a.c. circuit-breakers within the scope of IEC 60056. It provides the general rules for testing a.c. circuit-breakers, for making and breaking capacities over the range of test-duties described in 6.102 to 6.111 of IEC 60056, by synthetic methods.

NOTE Circuits for the test duties described in 6.111 have not yet been standardized. However, present methods are given in annex GG.

The methods and techniques described are those in general use. The purpose of this standard 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 normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(441):1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*

IEC 60056:1987, *High-voltage alternating current circuit-breakers*

IEC 61633:1995, *High-voltage alternating current circuit-breakers – Guide for short-circuit and switching test procedures for metal-enclosed and dead tank circuit-breakers*

3 Definitions

For the purposes of this International Standard the definitions of IEC 60056 and the following definitions apply:

3.1
direct test
a 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 may be a power system or special alternators as used in short-circuit testing stations or a combination of both

3.2
synthetic test
a 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
test circuit-breaker
the circuit-breaker under test (see 6.102.2 of IEC 60056)

3.4
auxiliary circuit-breaker(s)
the circuit-breaker(s) forming part of a synthetic test circuit used to put the test circuit-breaker into the required relation with various circuits

3.5
current circuit
that part of the synthetic test circuit from which all or the major part of the power-frequency current is obtained

3.6
voltage circuit
that part of the synthetic test circuit from which all or the major part of the test voltage is obtained

3.7
prospective current (of a circuit and with respect to a circuit-breaker)
the 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 [IEV 441-17-01, modified]

3.8
actual current
the current through the test circuit-breaker (prospective current modified by the arc-voltage of the test and auxiliary circuit-breakers)

3.9
distortion current
a calculated current equal to the difference between the prospective current and the actual current

3.10
post-arc current
the current which flows through the arc-gap of a circuit-breaker immediately after the current and arc-voltage have fallen to zero and the transient recovery voltage has begun to rise

3.11
current-injection method
a synthetic test method in which the voltage circuit is applied to the test circuit-breaker before power-frequency current-zero

3.12
injected current
the current supplied by the voltage circuit of a current injection circuit when it is connected to the circuit-breaker under test

3.13
voltage-injection method
a synthetic test method in which the voltage circuit is applied to the test circuit-breaker after power-frequency current-zero

3.14
reference system conditions
the conditions of an electrical system having the parameters from which the rated and test values of IEC 60056 are derived

4 Synthetic testing techniques and methods – Short-circuit breaking tests

4.1 Basic principles and general requirements for synthetic breaking test methods

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 subclauses.

Basic intervals

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 annex BB.2).

– High-voltage interval

  The high-voltage interval is the time from the moment when the current including the post-arc current, if any, ceases to flow through the test circuit-breaker to the end of the test.

4.1.1 High-current interval

During this interval the test circuit-breaker shall be stressed by the test circuit in such a way that the starting conditions for the interaction interval, within tolerances to be specified, are the same as under reference system conditions.

In synthetic test circuits the ratio of the power-frequency voltage of the current circuit to the arc-voltage is low in comparison with tests at reference system conditions due to:

– the voltage of the current circuit being a fraction of the system voltage;
– the fact that the arc-voltages of the test circuit-breaker and of the auxiliary circuit-breaker are added.