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INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches

Appareillage à haute tension – Partie 102: Sectionneurs et sectionneurs de terre à courant alternatif

IEC 62271-102:2001/A1:2011

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

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FOREWORD

This amendment has been prepared by subcommittee 17A: High-voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.

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

FDIS	Report on voting
17A/972/FDIS	17A/978/RVD

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

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- withdrawn,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.

The contents of the corrigendum of January 2012 have been included in this copy.

1.2 Normative references

Add the following new references to the existing list:

IEC 62271-1:2007, *High-voltage switchgear and controlgear – Part 1: Common specifications*

IEC 62271-100:2008, *High-voltage switchgear and controlgear – Part 100: Alternating-current circuit-breakers*

3.4.101
disconnector

Replace the content of Notes 1 and 2 as follows:

NOTE 1 "Negligible current" implies currents such as the capacitive currents of bushings, busbars, connections, very short lengths of cable, currents of permanently connected grading impedances of circuit-breakers and currents of voltage transformers and dividers (see also IEC 62271-305). For rated voltages of 420 kV and below, a current not exceeding 0,5 A is a negligible current for the purpose of this definition; for rated voltage above 420 kV and currents exceeding 0,5 A, the manufacturer should be consulted. "No significant change in voltage" refers to such applications as the by-passing of induction voltage regulators or circuit-breakers and bus transfer.

NOTE 2 For a disconnector having a rated voltage of 52 kV and above, a rated ability of bus transfer current switching may be assigned.

3.4.105
earthing switch

Replace the existing text by the following:

IEV 441-14-11 is applicable with the following additional notes

NOTE 101 An earthing switch having a rated voltage of 52 kV and above may have a rating for switching and carrying induced currents.

NOTE 102 These devices may sometimes be operated against short-circuit. The different classes of earthing switches are related to the number of short-circuit making operations.

NOTE 103 For special applications such as fault initiating earthing switches the test procedures and the number of tests may be agreed upon between the manufacturer and the user.

3.4.105.1
earthing switch class E0

Replace the existing definition by the following new definition:

earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, without a short-circuit making capability

3.4.105.2
earthing switch class E1

Replace the existing definition by the following new definition:

earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, with the capability to withstand two short-circuit making operations

3.4.105.3
earthing switch class E2

Replace the existing term, definition and note by the following new term, definition and note:

earthing switch class E2 (for earthing switches up to and including 52 kV)
earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, with the capability to withstand five short-circuit making operations

NOTE The increased number of making operations in Class E2 is restricted to voltages up to and including 52 kV only depending on the operating conditions and the protection systems typical to such networks.

Add, after definition 3.4.105.3, the following new definitions 3.4.105.4, 3.4.105.5 and 3.4.105.6:

3.4.105.4
earthing switch class M0 (for earthing switches)
earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, with the capability to withstand 1 000 operating cycles

3.4.105.5
combined function earthing switch
earthing switch having a common contact system for earthing and at least one of the following functions:

- disconnecting;
- making and/or breaking of load currents;
- making and/or breaking of currents up to the rated short-circuit current

3.4.105.6
toggle point
point beyond which any further movement of the charging mechanism causes the stored energy to be released

3.6.106
dependent manual operation (of a mechanical switching device)

Add the following note:

NOTE 101 Earthing switches with dependent manual operations should not be rated for short circuit making capability.

4.5 Rated short-time withstand current (I_k)

Replace the existing text of this subclause by the following new text:

Subclause 4.5 of IEC 62271-1 is applicable with the following addition.

The rated short-time withstand current of an earthing switch forming an integral part of a combined function earthing switch shall be equal to the rated short-time withstand current of the combined function earthing switch, unless otherwise specified.

4.6 Rated peak withstand current (I_p)

Replace the existing text of this subclause by the following new text:

Subclause 4.6 of IEC 62271-1 is applicable with the following addition.

The rated peak withstand current of an earthing switch forming an integral part of a combined function earthing switch shall be equal to the rated peak withstand current of the combined function earthing switch, unless otherwise specified.

4.101 Rated short-circuit making current

Add the following new text after the existing text of this subclause:

The rated short-circuit making current of an earthing switch forming an integral part of a combined function earthing switch shall be equal to the rated peak making current of the combined function earthing switch, unless otherwise specified.

4.107 Rated values of electrical endurance for earthing switches

Replace the existing text by the following new text and Table 7:

Table 3b provides a classification of earthing switch for electrical endurance.

Table 7 – Classification of earthing switch for electrical endurance

Class	Type of earthing switch
E0	Earthing switches with no making capability
E1	Earthing switches with capability to withstand two short-circuit making operations
E2	Earthing switches with capability to withstand five short-circuit making operations

6.101 Test to prove the short-circuit making performance of earthing switches

Replace the existing Subclauses 6.101.1, 6.101.2 and 6.101.3 by the following new Subclauses 6.101.1, 6.101.2, 6.101.3, 6.101.4, 6.101.5, 6.101.6, 6.101.7, 6.101.8, 6.101.9, 6.101.10 and 6.101.11:

6.101.1 General test conditions

Earthing switches of class E1 or E2 according to definition 3.4.105, having a short-circuit making current capability, shall be subjected to two (class E1) or five (class E2) making operations respectively, in a making test series in accordance with the procedures of 6.101.7.

In case of combined function earthing switches, the short-circuit making tests shall first be performed in the contact positions for other functions, in accordance with the relevant standards, followed by the short-circuit making tests of the earthing function, without intermediate maintenance.

Alternatively, the short-circuit making tests of the combined function earthing switch according to the specified class can be performed on a new combined function earthing switch preceded by at least one short-circuit making test of the other function followed by the short-circuit making tests of the earthing function without intermediate maintenance.

6.101.2 Arrangement of the earthing switch for tests

The earthing switch shall be tested under the representative conditions of installation and use, concerning the connections, support, enclosure and dimensions.

Its operating device shall be operated in the manner prescribed and in particular, if it is electrically, hydraulically or pneumatically operated, it shall be operated at the minimum supply voltage or pressure.

For gas-filled earthing switches, the tests shall be performed at the minimum functional pressure of the gas for insulation and making operation.

NOTE 1 For convenience of testing the supply voltage to the coil for the closing operation may be increased to obtain a consistent closing time, provided it does not increase the closing speed of the contacts.

NOTE 2 For convenience of testing in order to obtain accurate closing times an electrically or pneumatically released latch may be introduced at the toggle point.

NOTE 3 Earthing switches with independent manual operation may be operated by an arrangement provided for the purpose of making remote control possible.

NOTE 4 For testing purposes, it may be necessary to measure the travel characteristics, for example by using a travel recorder.

6.101.3 Test frequency

Earthing switches shall be tested at rated frequency, with a tolerance of ± 10 %.

However, tests with a peak factor of 2,6 or above, at a supply frequency of 50 Hz or 60 Hz cover the requirements of both frequencies.

6.101.4 Test voltage

The test voltage shall be as follows:

a) For three-phase tests, the average value of the applied voltage phase-to-phase shall not be less than the rated voltage U_r and shall not exceed this value by more than 10 % without the consent of the manufacturer. The differences between the average value and the applied voltages of each pole shall not exceed 5 %;

b) For single-phase tests, the applied voltage shall not be less than the phase-to-earth value $U_r/\sqrt{3}$, and shall not exceed this value by more than 10 % without the consent of the manufacturer. For earthing switches with a difference between the instants of contacts touching during closing exceeding a half of a cycle of the rated frequency, the applied voltage shall not be less than 1,5 times the phase-to-earth value $U_r/\sqrt{3}$ for non-effectively earthed neutral systems and 1,3 times for phase-to-earth value $U_r/\sqrt{3}$ for effectively earthed neutral systems.

For convenience of testing or due to limitation of test facilities, alternative test methods can be followed. The alternative test methods are given in Annex G.

6.101.5 Test short-circuit making current

The short-circuit current during making test shall be expressed in terms of the peak current and the symmetrical r.m.s. current. For earthing switches, the symmetrical r.m.s. value of current in each phase at 0,2 s shall be at least 80 % of the rated short-time withstand current. The prospective peak current must be equal to the rated short-circuit making current (I_{ma}) with the tolerance of –0 % and +5 %.

The duration of the short-circuit current shall be at least 0,2 s.

The earthing switch shall be able to make the current with the pre-arcing occurring at any point on the voltage wave. Two extreme cases are specified as follows:

a) making at the peak of the voltage wave, (with a tolerance of -30 electrical degrees to +15 electrical degrees) leading to a symmetrical short-circuit current and the longest pre-arcing time;

b) making at the zero of the voltage wave, without pre-arcing, leading to a fully asymmetrical short-circuit current.

NOTE Test b) can be carried out at reduced applied voltage in order to obtain the fully asymmetrical short-circuit current.

6.101.6 Test circuits

Making tests shall be performed using the three-phase test circuit or the single-phase test circuit.

Three-phase tests cover:

– the interaction between the different phases;

– the stresses on the operating mechanism (in the case of a common operating mechanism).

Three-pole earthing switches shall be tested in a three-phase circuit. However, single-phase testing of earthing switches with rated voltages > 52 kV is allowed in the following cases:

a) multi-enclosure type or open-air type earthing switches with separately stored closing energy for each pole;

b) earthing switches operated pole-after-pole.

For testing purpose, the severity of making tests in circuits with unearthed neutral or solidly earthed neutral are considered to be equivalent. Therefore, three-phase short-circuit making tests may be performed with any one of the test circuits in order to cover applications in both effectively and non-effectively earthed neutral systems.

6.101.7 Test procedures

For class E1, the tests shall be performed with a sequence of two C-operations with one single no-load O in between, i.e. C – O(no-load) – C, unless the test laboratory needs more no-load between the closing operations.

For class E2 earthing switches, the test sequence is 2C – x – 2C – y – 1C, where x and y represent arbitrary number of no-load tests. The 2C operations consists of C – O(no-load) – C, unless the test laboratory needs more no-load tests between the closing operations. There is no requirement on the time interval between the two closing operations.

No maintenance is allowed during a test sequence.

Due to non-simultaneity of poles or different instants of initiation of pre-arcs in the different poles a peak making current, which is higher than the rated value, may occur in one pole.

This is particularly the case if, in one pole, the current begins to flow a few milliseconds later than in the other two poles. If the earthing switch fails during such an event, this is considered to be a failure of the earthing switch.

The requirements with regard to the making current and the pre-arcing time as specified in Table 8 shall be achieved during the tests.

Table 8 – Requirements on making current and pre-arcing time

Class E1	Class E2
2 tests	5 tests
at least 1 test fulfilling the requirements of 6.101.5 a)	at least 2 tests fulfilling the requirements of 6.101.5 a)
at least 1 test fulfilling the requirements of 6.101.5 b)	at least 2 tests fulfilling the requirements of 6.101.5 b)
NOTE Normally the speed of closing of the contacts of the earthing switches with short-circuit making capability is high enough that both maximum pre-arcing and maximum peak current can be reached within a same test, however at different phases.	

6.101.8 Behaviour of earthing switches when making short-circuit currents

The following applies during the making tests.

a) Enclosed earthing switches having a rated short-circuit making current shall, when making the short-circuit, not project flames, liquids, gases nor particles outside the enclosure;

b) Open type earthing switches, flame or metallic particles shall not be projected beyond the boundaries specified by the manufacturer endangering any operator outside these boundaries.

6.101.9 Condition of earthing switch after short-circuit making tests

After performing the specified operations, mechanical parts, parts related to the electrical field control (for example field electrodes of a GIS earthing switch) and insulators of the earthing switch shall be practically in the same condition as before. The insulating properties shall not be degraded. The short-circuit making performance and short-time current withstand performance can be impaired.

NOTE The useful life of the earthing switch with regard to short-circuit making and short time current withstand capability is normally considered to be at the end, after the specified number of making operations necessitating maintenance or replacement.

To verify this requirement, the earthing switch shall meet the following inspection conditions:

a) Mechanical conditions: After each operation only light welding of contacts is permitted. However, the earthing switch shall be able to open and close under the conditions given in 5.5 and 5.6, with the rated values for power operated devices or with 120 % of the values given for manually operated devices in 5.105 using the normal operating handle;

b) Electrical continuity: Visual inspection after the no-load operation is usually sufficient for checking the electrical continuity of the earthing switch. In case of doubt the electrical continuity shall be measured according to 6.10.3 of IEC 62271-1.

c) Dielectric requirements: Visual inspection is usually sufficient for checking the above requirement. In case of doubt, a voltage test as condition check according to 6.2.11 is to be performed. As an alternative 6.2.11 of IEC 62271-100 may be used for rated voltages above 72,5 kV. The minimum functional pressure of the gas for insulation shall be used, if applicable. For earthing switches which are sealed-for-life, the voltage test as condition check is mandatory.

6.101.10 Invalid tests

In the case of an invalid test, it may become necessary to perform a greater number of short-circuit making tests than required by this standard. An invalid test is one where one or more test parameters demanded by the standard are not met. This includes, for example, current, voltage and time factors as well as point-on-wave requirements (if specified) and the additional features in synthetic testing.

The deviation from the standard could make the test less or more severe. Four different cases are considered in Table 9.

The invalid part of the test-duty may be repeated without reconditioning of the earthing switch. In those cases, the test report shall include reference to the invalid test. However, in the case of a failure of the earthing switch during such additional tests, or at the discretion of the manufacturer, the earthing switch may be reconditioned and the complete test-duty repeated. If any record of an individual operation cannot be produced for technical reasons, individual operations are not considered invalid, provided that evidence can be given in another manner that the earthing switch did not fail and the required testing values were fulfilled.

Table 9 – Invalid tests

Test conditions related to standard	Earthing switch passed	Earthing switch failed
More severe	Test valid, result accepted	Test to be repeated with correct parameters Modification of the design of the earthing switch not required
Less severe	Test to be repeated with correct parameters Modification of the design of the earthing switch not required	Modification of the design of the earthing switch required, aiming for improvement of the making capability All tests to be repeated on the modified earthing switch

6.101.11 Type test reports

The results of all type tests shall be recorded in type-test reports containing sufficient data to prove compliance with this rating. Sufficient information should be included so that the essential parts of the earthing switch tested can be identified. Refer to 6.1.2 of IEC 62271-1.

The test report shall contain the information specified in 6.101.2, 6.101.4, 6.101.5, 6.101.6 and 6.101.7.

Typical oscillographic or similar records shall be provided so that the following can be determined:

– the making current expressed as a peak value and the r.m.s. value at 0,2 s;

– the applied voltages;

– instantaneous value of voltages at the moment of the making;

– pre-arcing time.

General information concerning the supporting structure of the earthing switch should be included. Information regarding the operating devices employed during the tests should, where applicable, be recorded.

Annex A – Design and testing of position indicating devices

A.6.105.1.3 Disconnectors and earthing switches with independent power/manual operation with strain limiting device

Replace the title of the existing Subclause A.6.105.1.3 by the following new title:

A.6.105.1.3 Disconnectors and earthing switches with dependent power/manual operation with strain limiting device