SLOVENSKI STANDARD
SIST EN 60865-1:2012

01-maj-2012

Nadomešča:
SIST EN 60865-1:1998

Kratkostični toki - Izračun učinkov - 1. del: Definicije in računski postopki (IEC 60865-1:2011)

Short-circuit currents - Calculation of effects - Part 1: Definitions and calculation methods

Kurzschlussströme - Berechnung der Wirkung - Teil 1: Begriffe und Berechnungsverfahren

Courants de court-circuit - Calcul des effets - Partie 1: Définitions et méthodes de calcul

Ta slovenski standard je istoveten z: EN 60865-1:2012

ICS:

17.220.01	Elektrika. Magnetizem. Splošni vidiki	Electricity. Magnetism. General aspects

SIST EN 60865-1:2012 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60865-1

March 2012

ICS 17.220.01; 29.240.20

Supersedes EN 60865-1:1993

English version

Short-circuit currents - Calculation of effects - Part 1: Definitions and calculation methods

(IEC 60865-1:2011)

Courants de court-circuit - Calcul des effets - Partie 1: Définitions et méthodes de calcul (CEI 60865-1:2011)

Kurzschlussströme - Berechnung der Wirkung - Teil 1: Begriffe und Berechnungsverfahren (IEC 60865-1:2011)

This European Standard was approved by CENELEC on 2011-11-28. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 60865-1:2012 E

Foreword

The text of document 73/152/CDV, future edition 3 of IEC 60865-1, prepared by IEC/TC 73 "Short-circuit currents" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60865-1:2012.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2012-09-23
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2014-11-28

This document supersedes EN 60865-1:1993.

EN 60865-1:2012 includes the following significant technical changes with respect to EN 60865-1:1993:

— The determinations for automatic reclosure together with rigid conductors have been revised.

— The influence of mid-span droppers to the span has been included.

— For vertical cable-connection the displacement and the tensile force onto the lower fixing point may now be calculated.

— Additional recommendations for foundation loads due to tensile forces have been added.

— The subclause for determination of the thermal equivalent short-circuits current has been deleted (it is now part of EN 60909-0).

— The regulations for thermal effects of electrical equipment have been deleted.

— The standard has been reorganized and some of the symbols have been changed to follow the conceptual characteristic of international standards.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 60865-1:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 61936-1	NOTE	Harmonized as EN 61936-1.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

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 60909	Series	Short-circuit currents calculation in three-phase a.c. systems	EN 60909	Series
IEC 60909-0	-	Short-circuit currents in three-phase a.c. systems - Part 0: Calculation of currents	EN 60909-0	-
IEC 60949	-	Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects	-	-
IEC 60986	-	Short-circuit temperature limits of electric cables with rated voltages from 6 kV (U_m = 7,2 kV) up to 30 kV (U_m = 36 kV)	-	-
IEC 61660-2	-	Short-circuit currents in d.c. auxiliary installations in power plants and substations - Part 2: Calculation of effects	EN 61660-2	-

IEC 60865-1

Edition 3.0 2011-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods

Courants de court-circuit – Calcul des effets – Partie 1: Définitions et méthodes de calcul

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX XA

ICS 17.220.01; 29.240.20

ISBN 978-2-88912-771-9

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SHORT-CIRCUIT CURRENTS – CALCULATION OF EFFECTS –

Part 1: Definitions and calculation methods

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. 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 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 IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60865-1 has been prepared by IEC technical committee 73: Short-circuit currents.

This third edition cancels and replaces the second edition published in 1993. This edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

- The determinations for automatic reclosure together with rigid conductors have been revised.
- The influence of mid-span droppers to the span has been included.
- For vertical cable-connection the displacement and the tensile force onto the lower fixing point may now be calculated.
- Additional recommendations for foundation loads due to tensile forces have been added.

- The subclause for determination of the thermal equivalent short-circuits current has been deleted (it is now part of IEC 60909-0).
- The regulations for thermal effects of electrical equipment have been deleted.
- The standard has been reorganized and some of the symbols have been changed to follow the conceptual characteristic of international standards.

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

CDV	Report on voting
73/152/CDV	73/153/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.

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

A list of all parts of the IEC 60865 series, under the general title, *Short-circuit currents – Calculation of effects* 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.

SHORT-CIRCUIT CURRENTS – CALCULATION OF EFFECTS –

Part 1: Definitions and calculation methods

1 Scope

This part of IEC 60865 is applicable to the mechanical and thermal effects of short-circuit currents. It contains procedures for the calculation of

– the electromagnetic effect on rigid conductors and flexible conductors,

– the thermal effect on bare conductors.

For cables and insulated conductors, reference is made, for example, to IEC 60949 and IEC 60986. For the electromagnetic and thermal effects in d.c. auxiliary installations of power plants and substations reference is made to IEC 61660-2.

Only a.c. systems are dealt with in this standard.

The following points should, in particular, be noted:

a) The calculation of short-circuit currents should be based on IEC 60909. For the determination of the greatest possible short-circuit current, additional information from other IEC standards may be referred to, e.g. details about the underlying circuitry of the calculation or details about current-limiting devices, if this leads to a reduction of the mechanical stress.

b) Short-circuit duration used in this standard depends on the protection concept and should be considered in that sense.

c) These standardized procedures are adjusted to practical requirements and contain simplifications which are conservative. Testing or more detailed methods of calculation or both may be used.

d) In Clause 5 of this standard, for arrangements with rigid conductors, only the stresses caused by short-circuit currents are calculated. Furthermore, other stresses can exist, e.g. caused by dead-load, wind, ice, operating forces or earthquakes. The combination of these loads with the short-circuit loading should be part of an agreement and/or be given by standards, e.g. erection-codes.

   The tensile forces in arrangements with flexible conductors include the effects of dead-load. With respect to the combination of other loads the considerations given above are valid.

e) The calculated loads are design loads and should be used as exceptional loads without any additional partial safety factor according to installation codes of, for example, IEC 61936-1 [1][1].

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 60909 (all parts) *Short-circuit current calculation in three-phase a.c. systems*

---

1 Figures in square brackets refer to the bibliography.

IEC 60909-0, *Short-circuit currents in three-phase a.c. systems – Part 0: Calculation of currents*

IEC 60949, *Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects*

IEC 60986, *Short-circuit temperature limits of electric cables with rated voltages from 6 kV (U_m = 7,2 kV) up to 30 kV (U_m = 36 kV)*

IEC 61660-2, *Short-circuit currents in d.c. auxiliary installations in power plants and substations – Part 2: Calculation of effects*

3 Terms, definitions, symbols and units

3.1 Terms and definitions

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

3.1.1
main conductor
conductor or arrangement composed of a number of conductors which carries the total current in one phase

3.1.2
sub-conductor
single conductor which carries a certain part of the total current in one phase and is a part of the main conductor

3.1.3
fixed support
support of a rigid conductor in which moments are imposed in the regarded plane

3.1.4
simple support
support of a rigid conductor in which no moments are imposed in the regarded plane

3.1.5
connecting piece
any additional mass within a span which does not belong to the uniform conductor material, includingamong others, spacers, stiffening elements, bar overlappings, branchings, etc.

3.1.6
spacer
mechanical element between sub-conductors, rigid or flexible, which, at the point of installation, maintains the clearance between sub-conductors

3.1.7
stiffening element
special spacer intended to reduce the mechanical stress of rigid conductors

3.1.8
relevant natural frequency
f_{cm}
first natural frequency of the free vibration of a single span beam without damping and natural frequency of order ν of beams with ν spans without damping

3.1.9
short-circuit tensile force
$F_{t,d}$
maximum tensile force (design value) in a flexible main conductor due to swing out reached during the short-circuit

3.1.10
drop force
$F_{f,d}$
maximum tensile force (design value) in a flexible main conductor which occurs when the span drops down after swing out

3.1.11
pinch force
$F_{pi,d}$
maximum tensile force (design value) in a bundled flexible conductor during the short-circuit due to the attraction of the sub-conductors in the bundle

3.1.12
duration of the first short-circuit current flow
T_{k1}
time interval between the initiation of the short-circuit and the first breaking of the current

3.1.13
thermal equivalent short-circuit current
I_{th}
r.m.s. value of current having the same thermal effect and the same duration as the actual short-circuit current, which can contain d.c. component and can subside in time

3.1.14
thermal equivalent short-circuit current density
S_{th}
ratio of the thermal equivalent short-circuit current and the cross-section area of the conductor

3.1.15
rated short-time withstand current density, S_{thr}, for conductors
r.m.s. value of the current density which a conductor is able to withstand for the rated short time

3.1.16
duration of short-circuit current
T_k
sum of the time durations of the short-circuit current flow from the initiation of the first short-circuit to the final breaking of the current in all phases

3.1.17
rated short-time
T_{kr}
time duration for which a conductor can withstand a current density equal to its rated short-time withstand current density

3.2 Symbols and units

All equations used in this standard are quantity equations in which quantity symbols represent physical quantities possessing both numerical values and dimensions.

The symbols used in this standard and the SI-units concerned are given in the following lists.

A	Cross-section of one main-conductor	m^2
A_s	Cross-section of one sub-conductor	m^2
a	Centre-line distance between conductors	m
a_m	Effective distance between main conductors	m
a_{min}	Minimum air clearance	m
a_s	Effective distance between sub-conductors	m
a_{1n}	Centre-line distance between sub-conductor 1 and sub-conductor n	m
a_{1s}	Centre-line distance between sub-conductors	m
b_h	Maximum horizontal displacement	m
b_m	Dimension of a main conductor perpendicular to the direction of the force	m
b_s	Dimension of a sub-conductor perpendicular to the direction of the force	m
C_D	Dilatation factor	1
C_F	Form factor	1
c_m	Dimension of a main conductor in the direction of the force	m
c_s	Dimension of a sub-conductor in the direction of the force	m
c_{th}	Material constant	$m^4/(A^2s)$
d	Outer diameter of a tubular or flexible conductor	m
E	Young's modulus	N/m^2
E_{eff}	Actual Young's modulus	N/m^2
e	Factor for the influence of connecting pieces	1
F	Force acting between two parallel long conductors during a short-circuit	N
F'	Characteristic electromagnetic force per unit length on flexible main conductors	N/m
F_m	Force between main conductors during a short-circuit	N
F_{m2}	Force between main conductors during a line-to-line short-circuit	N
F_{m3}	Force on the central main conductor during a balanced three-phase short-circuit	N
$F_{r,d}$	Force on support of rigid conductors (peak value, design value)	N
$F_{f,d}$	Drop force of one main conductor (design value)	N
$F_{pi,d}$	Pinch force of one main conductor (design value)	N
F_s	Force between sub-conductors during a short-circuit	N
F_{st}	Static tensile force of one flexible main conductor	N
$F_{t,d}$	Short-circuit tensile force of one main conductor (design value)	N