

SLOVENSKI STANDARD

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Application guide for calculation of short-circuit currents in low voltage radial systems (IEC 60781:1989)

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ENGLISH VERSION

APPLICATION GUIDE FOR CALCULATION OF SHORT-CIRCUIT
CURRENTS IN LOW-VOLTAGE RADIAL SYSTEMS
(IEC 781:1989)

Guide d'application pour le
calcul des courants de
court-circuit dans les réseaux
à basse tension radiaux
(CEI 781:1989)

Berechnung von Kurzschlußströmen
in unvermaschten Drehstrom-
Niederspannungsstrahlennetzen;
Anwendungsleitfaden
(IEC 781:1989)

This Harmonization Document was approved by CENELEC on 1991-03-15.
CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations
which stipulate the conditions for implementation of this Harmonization Document
on a national level.

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

This Harmonization Document exists in three official versions (English, French,
German).

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

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

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

FOREWORD

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 781:1989 could be accepted without textual changes, has shown that no CENELEC common modifications were necessary for the acceptance as Harmonization Document.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as HD 581 S1 on 15 March 1991.

The following dates were fixed:

- latest date of announcement
of the HD at national level (doa) 1991-09-01
- latest date of publication of
a harmonized national standard (dop) 1992-03-01
- latest date of withdrawal of
conflicting national standards (dow) 1992-03-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annex ZA is normative.

ENDORSEMENT NOTICE

The text of the International Standard IEC 781:1989 was approved by CENELEC as a Harmonization Document without any modification.

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ANNEX ZA (normative)

OTHER INTERNATIONAL PUBLICATIONS QUOTED IN THIS STANDARD WITH THE REFERENCES OF THE RELEVANT EUROPEAN PUBLICATIONS

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

IEC Publication	Date	Title	EN/HD	Date
38 (mod)	1983	IEC standard voltages	HD 472 S1*	1989
50		International Electrotechnical Vocabulary (IEV)	-	-
50(131)	1978	Chapter 131: Electric and magnetic circuits	-	-
50(151)	1978	Chapter 151: Electrical and magnetic devices	-	-
50(441)	1984	Chapter 441: Switchgear, controlgear and fuses	-	-
909	1988	Short-circuit current calculation in three-phase a.c. systems	-	-

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* Title of HD: Nominal voltages for low voltage public electricity supply systems

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Première édition
First edition
1989-01

**Guide d'application pour le calcul
des courants de court-circuit
dans les réseaux à basse tension radiaux**

**Application guide for calculation
of short-circuit currents in low-voltage
radial systems**

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Numéro de référence
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CEI/IEC 781:1989

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

APPLICATION GUIDE FOR CALCULATION OF SHORT-CIRCUIT
CURRENTS IN LOW-VOLTAGE RADIAL SYSTEMS

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This guide has been prepared by IEC Technical Committee No. 73: Short-circuit currents.

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

Six Months' Rule	Report on Voting
73(CO)9	73(CO)10

Full information on the voting for the approval of this guide can be found in the Voting Report indicated in the above table.

The following IEC publications are quoted in this guide:

- Publications Nos. 38 (1983): IEC standard voltages.
 50: International Electrotechnical Vocabulary (IEV).
50 (131) (1978): Chapter 131: Electric and magnetic circuits.
50 (151) (1978): Chapter 151: Electrical and magnetic devices.
50 (441) (1984): Chapter 441: Switchgear, controlgear and fuses.
909 (1988): Short-circuit current calculation in three-phase a.c. systems.

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APPLICATION GUIDE FOR CALCULATION OF SHORT-CIRCUIT CURRENTS IN LOW-VOLTAGE RADIAL SYSTEMS

1. Scope

This application guide specifies a standardized procedure developed from IEC Publication 909 for the calculation of short-circuit currents in three-phase a.c. systems operating at nominal frequency (50 or 60 Hz) when the short circuit occurs in low-voltage radial systems and when the simplifying conditions given in Clause 3 are met.

In order to facilitate application by non-specialist engineers, an example calculated using the recommended forms is included.

2. Object

It is the object of this application guide to present a practical method to be used when calculating short-circuit currents in low-voltage networks. The method corresponds strictly with IEC Publication 909 and leads to conservative results with sufficient accuracy.

Two short-circuit currents which differ in magnitude are to be calculated:

- the *maximum* short-circuit current which causes the maximum thermal and electromagnetic effects on electrical equipment and determines the required capacity or rating;
- the *minimum* short-circuit current which may be a basis for the adjustment of protective devices.

3. General calculation methods and calculation assumptions

The calculation of short-circuit currents according to this application guide is based on the following conditions:

- The short circuit is far-from-generator and is supplied at *one* point by an electricity supply network.
- The low-voltage network considered is unmeshed.
- The values of the source voltage and the impedances of all electrical equipment are assumed to be constant.
- Contact resistances and fault impedances are not taken into account.
- The short circuit is simultaneous in all poles, if multiphase.
- Short-circuit currents are not calculated for internal faults in one of several parallel cables.
- For the duration of the short circuit there is no change in the circuits involved. The number of phases involved remains the same e.g. a three-phase short circuit remains three-phase during the time of the short circuit.
- Line capacitances and parallel admittances of passive elements are disregarded.
- Double earth faults at different locations are disregarded.
- The conditions for disregarding the influence of motors, given in Sub-clause 7.3, must be met. If not, see IEC Publication 909.
- Transformer tap-changers are assumed to be in the main position.
- According to Sub-clause 4.10.2: $\underline{Z}_{(1)} = \underline{Z}_{(2)}$.

For more detailed information see IEC Publication 909.

4. Definitions

For the purpose of this application guide, the following definitions apply. Reference is made to the International Electrotechnical Vocabulary (IEV) [IEC Publication 50] when applicable.

4.1 *Short circuit*

The accidental or intentional connection, by a relatively low resistance or impedance, of two or more points in a circuit which are normally at different voltages (IEV 151-03-41).

4.2 *Far-from-generator short circuit*

A short circuit during which the magnitude of the symmetrical a.c. component of the prospective short-circuit current remains essentially constant.

4.3 *Short-circuit current*

An over-current resulting from a short circuit due to a fault or an incorrect connection in an electric circuit (IEV 441-11-07).

Note. — It is necessary to distinguish between the short-circuit current at the short-circuit location and in the network branches.

4.4 *Prospective (available) short-circuit current*

The current that would flow if the short circuit were replaced by an ideal connection of negligible impedance without any change of the supply.

4.5 *Initial symmetrical short-circuit current I_k''*

The r.m.s. value of the a.c. symmetrical component of a prospective (available) short-circuit current applicable at the instant of short circuit if the impedance remains at zero-time value (see Figure 1).

4.6 *Peak short-circuit current i_p*

The maximum possible instantaneous value of the prospective (available) short-circuit current.

Note. — The magnitude of the peak short-circuit current varies in accordance with the moment at which the short circuit occurs. The calculation of the peak three-phase short-circuit current i_p applies for that phase-conductor and that moment in which the greatest possible short-circuit current exists.

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4.7 *Symmetrical short-circuit breaking current I_b*

The r.m.s. value of an integral cycle of the symmetrical a.c. component of the prospective short-circuit current at the instant of contact separation of the first pole of a switching device.

4.8 *Steady-state short-circuit current I_k*

The r.m.s. value of the short-circuit current which remains after the decay of the transient phenomena (see Figure 1).

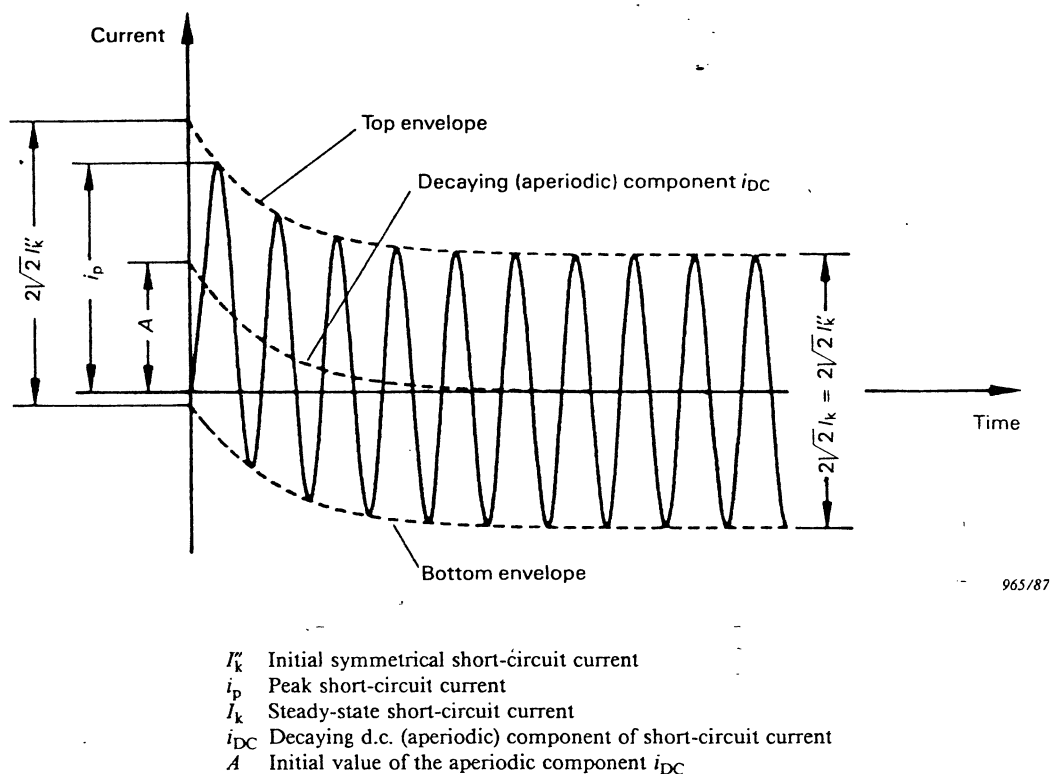


FIG. 1. — Short-circuit current of a far-from-generator short circuit (schematic diagram).

4.9 Nominal system voltage U_n

Voltage (line-to-line) by which a system is designated and to which certain operating characteristics are referred. Values are listed in IEC Publication 38.

4.10 Short-circuit impedances of electrical equipment

4.10.1 Positive-sequence short-circuit impedance $Z_{(1)}$ of electrical equipment

The ratio of the line-to-neutral voltage to the short-circuit current of the corresponding phase of an electrical equipment when fed by a symmetrical positive-sequence system of voltages.

Note. — Index of symbol $Z_{(1)}$ may be omitted if there is no possibility of confusion with the negative-sequence and the zero-sequence short-circuit impedances.

4.10.2 Negative-sequence short-circuit impedance $Z_{(2)}$ of electrical equipment

The ratio of the line-to-neutral voltage to the short-circuit current of the corresponding phase of an electrical equipment when fed by a symmetrical negative-sequence system of voltages.

Note. — In this application guide, covering far-from-generator short circuits, it is assumed that $Z_{(2)} = Z_{(1)}$ in all cases.

4.10.3 Zero-sequence short-circuit impedance $Z_{(0)}$ of electrical equipment

The ratio of the line-to-earth voltage to the short-circuit current of one phase of an electrical equipment when fed by an a.c. voltage source, if the three paralleled phase conductors are used for the outgoing current and a fourth line and/or earth is joint return.