SLOVENSKI STANDARD
oSIST prEN IEC 60205:2024

01-junij-2024

Izračun efektivnih parametrov magnetnih sestavnih delov

Calculation of the effective parameters of magnetic piece parts

Berechnung der effektiven Kernparameter magnetischer Formteile

Calcul des paramètres effectifs des pièces magnétiques

Ta slovenski standard je istoveten z: **prEN IEC 60205:2024**

ICS:

29.100.10 Magnetne komponente Magnetic components

oSIST prEN IEC 60205:2024 **en**

51/1486/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 60205 ED5**	
DATE OF CIRCULATION: **2024-04-12**	CLOSING DATE FOR VOTING: **2024-07-05**
SUPERSEDES DOCUMENTS: **51/1456/CD, 51/1478/CC**	

IEC TC 51 : MAGNETIC COMPONENTS, FERRITE AND MAGNETIC POWDER MATERIALS

SECRETARIAT: Japan	SECRETARY: Mr Naoki Kawakubo
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY

☒ SUBMITTED FOR CENELEC PARALLEL VOTING ☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

Attention IEC-CENELEC parallel voting

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant “In Some Countries” clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE AC/22/2007 OR NEW GUIDANCE DOC).

TITLE:

Calculation of the effective parameters of magnetic piece parts

PROPOSED STABILITY DATE: 2030

NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

CALCULATION OF THE EFFECTIVE PARAMETERS OF MAGNETIC PIECE PARTS

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) IEC draws attention to the possibility that the implementation of this document may involve the use of a patent. IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of a patent, which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch and/or www.iso.org/patents. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60205 has been prepared by IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials.

This fifth edition cancels and replaces the fourth edition published in 2016. This edition constitutes a technical revision.

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

a) addition, in 5.2.3, of the drawing and the formulae of pair of URS-cores of rectangular-circular section;

b) using, in 5.9, 5.10, 5.11 and 5.13, of the conventional calculation formula that includes " B_1-D " is limited for the x-x cores (x is EL, ER, PQ or E) and addition new formulae for x-PLT cores that replaces " B_1-D " with "(B_1-D+B_2)/2";

c) addition, in 5.9, 5.10, 5.11 and 5.13, of formulae of l_1 and l_3 for x-PLT cores (x is EL, ER, PQ or E) which is different from the l_1 and l_3 of x-x cores;

d) addition of formula A_{min} in each subclause from 5.2.1 to 5.14.

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

FDIS	Report on voting
51/xxxx/FDIS	51/xxxx/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/publications.

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 July 2018 have been included in this copy.

CALCULATION OF THE EFFECTIVE PARAMETERS OF MAGNETIC PIECE PARTS

1 Scope

This document specifies uniform rules for the calculation of the effective parameters of closed circuits of ferromagnetic material.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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

4 Basic rules applicable to this standard

4.1 All results shall be expressed in units based on millimetres, shall be accurate to three significant figures, but to derive l_e, A_e and V_e the values of C_1 and C_2 shall be calculated to five significant figures. All angles are in radians.

NOTE The purpose of specifying this degree of accuracy is only to ensure that parameters calculated at different establishments are identical and it is not intended to imply that the parameters are capable of being determined to this accuracy.

4.2 A_{min} is the nominal value of the smallest cross-section. A_g is the geometrical cross-section of a ring core with rectangular shape. All the dimensions used to calculate A_{min} shall be the mean values between the tolerance limits quoted on the appropriate piece part drawing. All results shall be expressed in units based on millimetres and shall be accurate to three significant figures.

NOTE A_g to be used for the measurement of the saturation flux density B_{max} on ring cores with rectangular cross-section.

4.3 Calculations are only applicable to the component parts of a closed magnetic circuit.

4.4 All dimensions used for the purpose of calculations shall be the mean value within the tolerance limits quoted on the appropriate piece part drawing.

4.5 All irregularities in the outline of the core, such as small cut-outs, notches, chamfers, etc. shall be ignored unless otherwise described.

4.6 When the calculation involves the sharp corner of a piece part, then the mean length of flux path for that corner shall be taken as the mean circular path joining the centres of area of the two adjacent uniform sections, and the cross-sectional area associated with that length shall be taken as the average area of the two adjacent uniform sections.

Calculation of effective parameters l_e, A_e and V_e.

The effective parameters can be defined as

$$l_e = C_1^2/C_2 \quad A_e = C_1/C_2 \quad V_e = l_e A_e = C_1^3/C_2^2$$

where

l_e is the effective magnetic length of the core (mm);

A_e is the effective cross-sectional area (mm^2);

V_e is the effective volume (mm^3);

C_1 is the core constant (mm^{-1});

C_2 is the core constant (mm^{-3}).

5 Formulae for the various types of cores

5.1 Ring cores

5.1.1 Ring cores in general

Drawings of ring cores are shown in Figure 1.

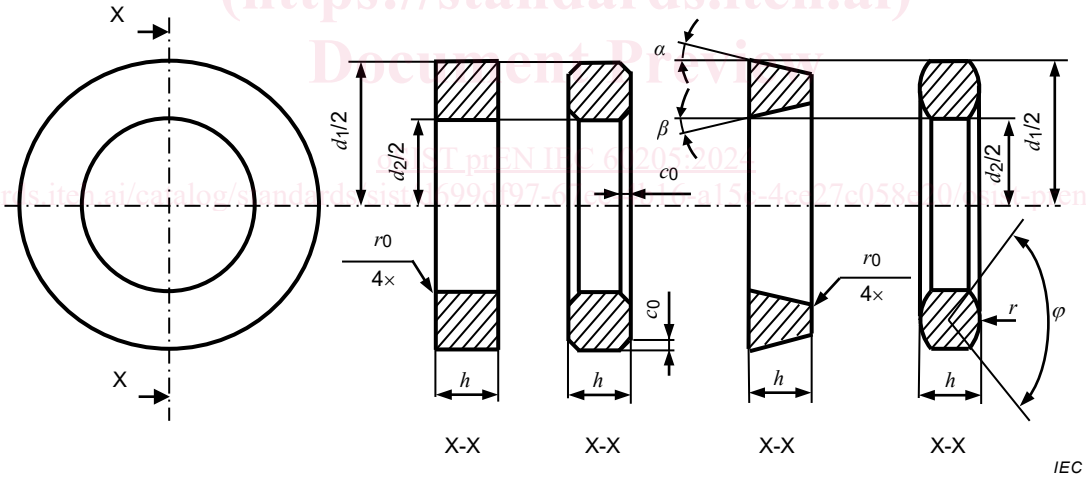

Figure 1 – Ring cores

$$C_1 = \frac{2\pi}{h_e \ln(d_1/d_2)}$$

$$C_2 = \frac{4\pi(1/d_2 - 1/d_1)}{h_e^2 \ln^3(d_1/d_2)}$$

5.1.2 For ring cores of rectangular cross-section with sharp corners

$$h_e = h$$

The geometrical cross-section of a ring core with rectangular shape A_g is given as:

$$A_g = h\frac{d_2 - d_1}{2}$$

5.1.3 For ring cores of rectangular cross-section with an appreciable average rounding radius r_0

$$h_e = h(1 - k_1) \qquad k_1 = \frac{1{,}716\ 8{r_0}^2}{h(d_1 - d_2)}$$

5.1.4 For ring cores of rectangular cross-section with appreciable chamfer c_0

$$h_e = h(1 - k_3) \qquad k_3 = \frac{4{c_0}^2}{h(d_1 - d_2)}$$

The geometrical cross-section of a ring core with appreciable chamfer shape A_g is given as:

$$A_g = h\frac{d_2 - d_1}{2} - 2{c_0}^2$$

5.1.5 For ring cores of trapezoidal cross-section with sharp corners

$$h_e = h(1 - k_2) \qquad k_2 = \frac{h(\tan\alpha + \tan\beta)}{d_1 - d_2}$$

5.1.6 For ring cores of trapezoidal cross-section with an appreciable average rounding radius r_0

$$h_e = h(1 - k_1 - k_2)$$

5.1.7 For ring cores of cross-section with circular arc frontal sides

$$h_e = h - \frac{d_1 - d_2}{4\sin^2(\varphi/2)}\left(2\sin\frac{\varphi}{2} - \frac{\sin\varphi}{2} - \frac{\varphi}{2}\right)$$

$$\varphi = 2\arcsin\frac{d_1 - d_2}{4r} \quad .$$

When the winding is uniformly distributed over a ring core, it may be expected that, at all points inside the ring core, the flux lines will be parallel to its surface.

No leakage flux will therefore leave or enter the ring core. This justifies the use of a theoretically more correct derivation of the effective parameters, which does not make use of the assumption that the flux is uniformly distributed over the cross-section.

5.2 Pair of U-cores

5.2.1 Pair of U-cores of rectangular section

Drawings of a pair of U-cores of the rectangular section are shown in Figure 2.

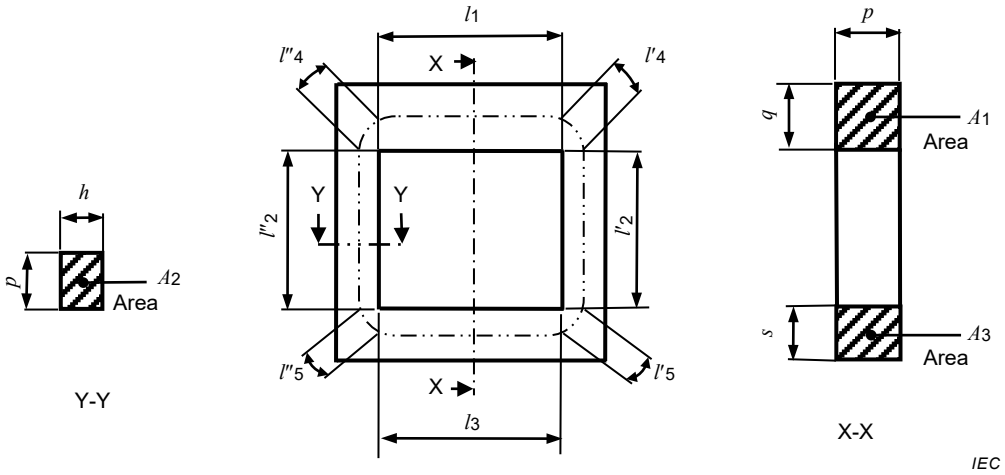

Figure 2 – Pair of U-cores of the rectangular section

5.2.2 Pair of UR-cores

Drawings of a pair of UR-cores with the rounded section are shown in Figure 3.

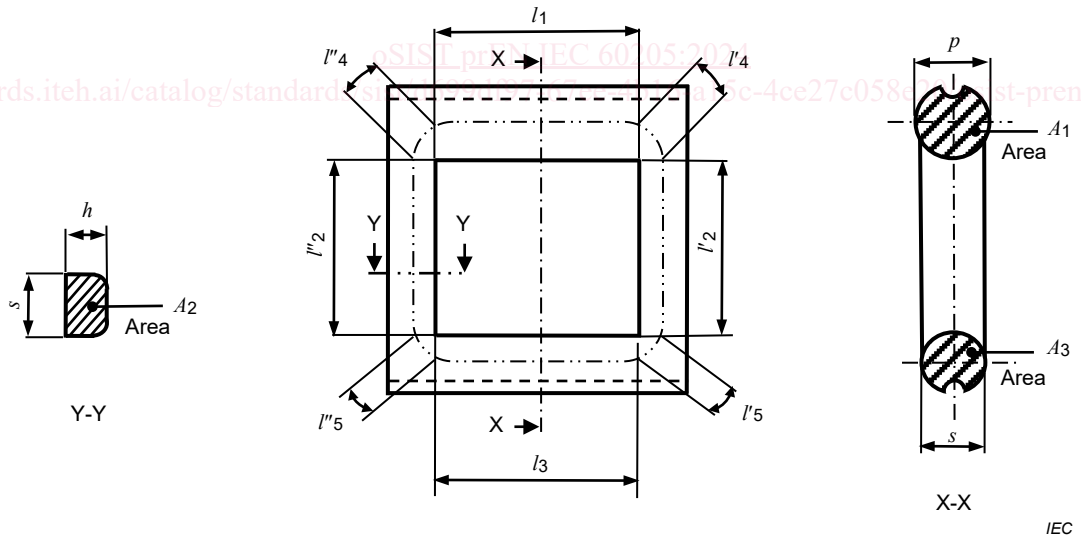

Figure 3 – Pair of UR-cores of rounded section

5.2.3 Pair of URS-cores of rectangular-circular sections

Drawings of a pair of URS-cores with the rectangular-circular sections are shown in Figure 4.

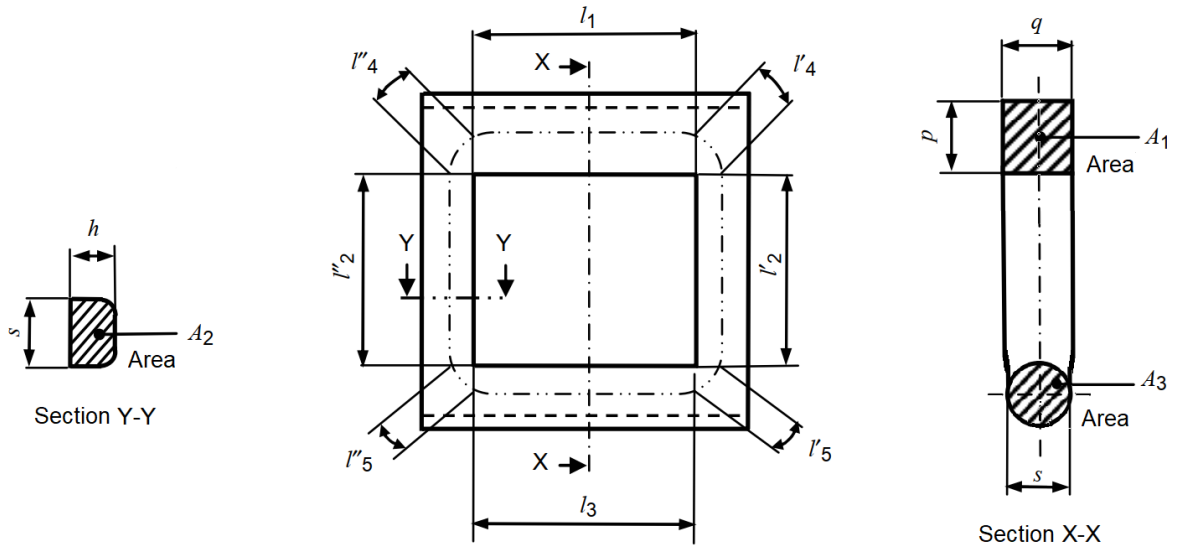

Figure 4 – Pair of URS-cores of rectangular-circular sections

Length of flux path associated with area A_2:

$$l_2 = l'_2 + l''_2$$

Mean length of flux path at corners:

$$l_4 = l'_4 + l''_4 = \frac{\pi}{4}(q + h)$$

$$l_5 = l'_5 + l''_5 = \frac{\pi}{4}(s + h)$$

In calculating A_2, any rounding of the interior back wall edges introduced for the purpose of facilitating manufacture is ignored.

$$A_1 = pq$$

$$A_2 = hs$$

$$A_3 = \frac{\pi}{4}s^2$$

Mean areas associated with l_4 and l_5: