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Edition 1.0 2020-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Magnetic powder cores – Guidelines on dimensions and the limits of surface irregularities –
Part 1: General specification**

**Noyaux en poudre magnétique – Lignes directrices concernant les dimensions et les limites des irrégularités de surface –
Partie 1: Spécification générale**

IEC 63182-1:2020-05(en-fr)

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MAGNETIC POWDER CORES – GUIDELINES ON DIMENSIONS AND THE LIMITS OF SURFACE IRREGULARITIES –

Part 1: General specification

FOREWORD

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International Standard IEC 63182-1 has been prepared by IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials.

The text of this International Standard is based on the following documents:

CDV	Report on voting
51/1324/CDV	51/1340/RVC

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

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

A list of all parts in the IEC 63182 series, published under the general title *Magnetic powder cores – Guidelines on dimensions and the limits of surface irregularities*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://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- withdrawn,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.

INTRODUCTION

Magnetic powder core materials are distinct from ferrite materials. Whereas ferrites are homogeneous ceramic oxides, powder cores are heterogeneous magnetic alloys. Alloys which can include iron, nickel and other additives are prepared in fine powder form. The powder particles are insulated with non-conductive materials, and the resulting heterogeneous structure is formed by compaction into a core shape, such as a ring.

Magnetic powder cores are suitable for use in inductors. They are characterized by low permeability, resistance to saturation under the influence of high currents, high flux densities, high Curie temperatures, as well as soft saturation, which is controlled, and gradual reduction in inductance with increasing DC bias field, even to very high levels of bias.

The commonly used magnetic powder core materials are pure iron (Fe), iron-silicon-aluminium (FeSiAl), iron-silicon (FeSi), iron-nickel (FeNi), iron-nickel-molybdenum (FeNiMo), iron-silicon-chromium (FeSiCr), iron-based amorphous powder (FeSiB) and iron-based nanocrystalline (FeCuNbSiB) powder.

Compliance with the requirements in the sectional specifications ensures basic mechanical interchangeability of complete assemblies and wound coils. The differences in loss, DC bias, and frequency response performance among materials, and among manufacturers, are significant, even though size and permeability can be identical for parts under comparison.

Due to the method of manufacture and the physical nature of the products, magnetic powder cores can be expected to exhibit some degree of physical irregularities such as chips and ragged edges, cracks, flash, scratch, rust and discoloration. For coated cores some coating layer defects such as peeling, pinholes, bubbles, coating tips and unevenness can occur.

The permissible extent of these surface irregularities will depend on the type, position and size of the irregularity and on the function of the core. Thus, in order to establish limits of surface irregularities for a given series of magnetic powder cores, for example ring-cores, block-cores, cylinder-cores, ellipse-cores, E-cores, EQ-cores, EER-cores, U-cores and pot-cores, a particular specification for each should be prepared, setting out in detail the permissible extent of the various types of irregularities. The irregularities are considered as being detectable without the use of any magnifying equipment. An area and length reference for visual inspection is shown in Annex A.

In each particular specification relevant to a standardized core series, general rules for the calculation of limits should be defined for every kind of irregularity and for all core parts and surfaces.

For guidance on the limits of irregularities, refer to the sectional specifications of the IEC 63182 series, where limits according to core size are given in suitable tables, along with identification of irregularity types on figures and drawings.

The anticipated sectional specifications in the IEC 63182 series are shown in Annex B.

MAGNETIC POWDER CORES – GUIDELINES ON DIMENSIONS AND THE LIMITS OF SURFACE IRREGULARITIES –

Part 1: General specification

1 Scope

This part of IEC 63182 specifies the dimensions of magnetic powder cores.

It is intended that this document will include magnetic powder cores which are widely used and referenced in industry, either because they are included in national standards, or because they are seen to have broad-based use in industry. Where applicable, it is intended that the existing industrial name for each powder core will appear with the part within the IEC 63182 series.

This document also gives guidelines on the allowable limits of surface irregularities of magnetic powder cores. It is considered as a general specification useful in the dialogue between magnetic powder core manufacturers and users about surface irregularities.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60401-1, *Terms and nomenclature for cores made of magnetically soft ferrites – Part 1: Terms used for physical irregularities and reference of dimensions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60401-1 and the following apply.

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

3.1
scratch
one or more scrapes caused by the handling process

3.2
rust
corrosion spots on the surface of an uncoated core caused by the action of oxygen and water in air

3.3
peeling
absence of some part of the coating layer resulting in the exposure of the bare core due to the failure of the coating to adhere to the substrate surface

3.4
pinhole
fine size hole (diameter less than 1,5 mm) on the coating layer

3.5
bubble
lifting of the coating from the core surface

3.6
coating tip
sharp point that develops in the surface during application or curing of the coating

3.7
unevenness
partial convexity or attached foreign matter on the coating layer

4 Locations and functions of core parts and surfaces

4.1 Mating surface

Some mating surfaces have been ground in order to reduce the residual air gap between the two core halves or between the adjacent assembled pieces. Others have not been ground, but should have sufficient flatness to maintain the specified electrical performance.

4.2 Centre leg or centre pole

The centre leg carries the total flux generated by the winding. It is called centre leg when rectangular as in Figure 1, and it is called centre pole (or centre post) when round as in a pot-core.

A centre leg (or centre pole) gap can be intentionally added either during the pressing of the magnetic powder core or as a secondary operation to provide two main functions. First, if no grinding of the mating surface is to be performed, the centre leg gap will eliminate any outer leg gap that could cause a pair of cores to mechanically rock. Second, the centre leg gap can be used to control electrical performance by tightly controlling inductance and the response of inductance to a DC bias field.

4.3 Outer walls or legs

The outer walls (e.g. pot-cores) or the outer legs (e.g. E-cores) guide the magnetic flux in a closed magnetic circuit.

4.4 Back wall, bottom and back surfaces

The back wall has the same magnetic function as the outer walls or legs. The back surface (ground or not) serves as a reference plane for grinding the mating surface in order to achieve the required electrical performance, parallelism, and flatness. The bottom surface is the interior plane of the back wall, facing the coil.

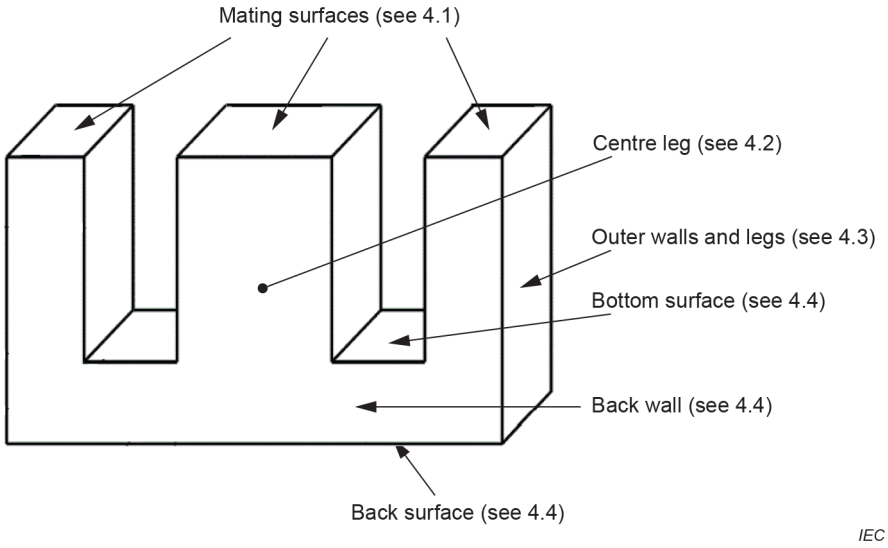

Figure 1 – Location of main core parts and surfaces – Example of E-core type

5 Dimensions descriptions

The alphabetic character assignments for the major dimensions of various core shapes are designated and illustrated in IEC 60401-1. For block-cores and ellipse-cores, the dimensions designations are described in Table 1 and Figure 2, for cylinder-cores, in Table 2 and Figure 3, and for EQ-cores, in Table 3 and Figure 4. All other minor core dimension designations are left to the discretion of the specifier.

Industry convention uses the term "ellipse-cores" even though the shape is not actually elliptical, but rather rectangular with semi-circular ends. Industry convention also uses the term "EQ-cores" for the same powder core geometry that is called "planar ER-cores" for ferrite cores in IEC 60401-1.

Table 1 – Block-core and ellipse-core dimensions designations

Letter	Dimension description
A	Length of block or ellipse
B	Width of block or ellipse
C	Height or thickness of block or ellipse
R	Radius of ellipse end

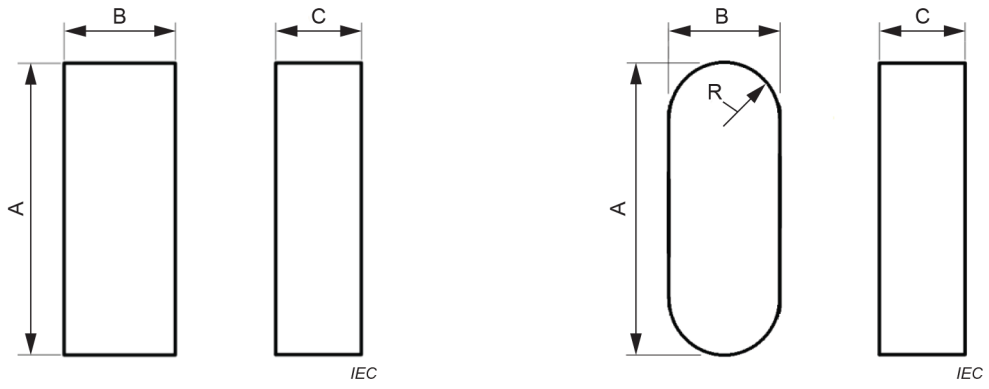

Figure 2 – Block-core and ellipse-core dimensions designations

Table 2 – Cylinder-core dimensions designations

Letter	Dimension description
A	Cylinder diameter
B	Cylinder height

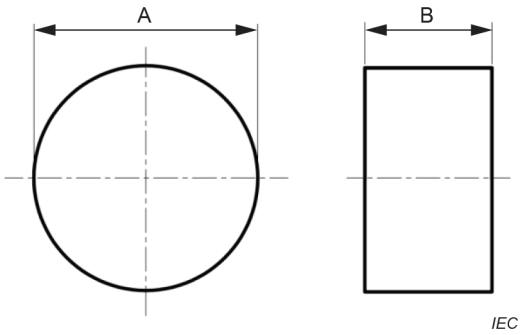

Figure 3 – Cylinder-core dimensions designations

Table 3 – EQ-core dimensions designations

Letter	Dimension description
A	Overall length of the core back
B	Core height
C	Core width
D	Available winding depth
E	Available winding diameter
F	Centre pole diameter
G	Wire-opening width

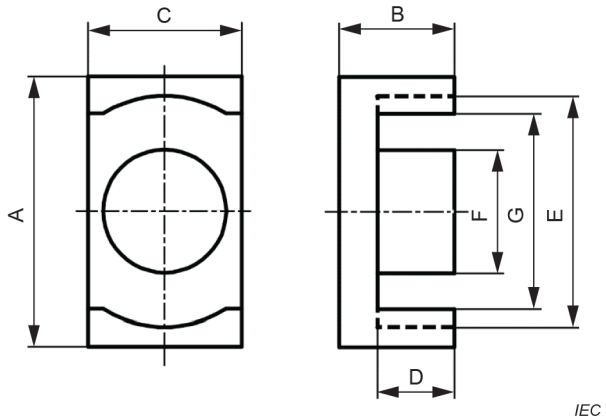

Figure 4 – EQ-core dimensions designations

6 Limits of surface irregularities

6.1 Surface irregularities of uncoated cores

6.1.1 Chips and ragged edges

The simplest way of performing inspection on these two types of irregularities is to compare a chip to a reference area limit and a ragged edge to a reference length limit.

The limits of chips are generally defined as a percentage of the related surface of the core.

The apparent area of a chip is considered to be the area of that chip.

The ragged edge length is generally limited to a percentage of the common perimeter of the respective two surfaces.

6.1.2 Cracks

The limits of cracks are generally defined as a percentage of the specified core section thickness.

The length of a crack is considered to be the actual length visible on the surface without magnification.

6.1.3 Flash

Generally, no limit is defined but the critical places where flash is not allowed should be listed.

6.1.4 Scratch

The limits of scratches are generally defined as a percentage of the respective surface area or a percentage of the reference size.

6.1.5 Rust

The limits of rust are generally defined as a percentage of the respective surface area.

6.1.6 Discoloration

Generally, no limit is defined.

6.2 Surface irregularities of coated cores

6.2.1 Peeling

Generally, peeling is not allowed.

6.2.2 Pinholes

The limits of pinholes are generally defined by the number of them.

6.2.3 Bubble

Any coating bubble is unacceptable.

6.2.4 Coating tip

Any coating tip is unacceptable.

6.2.5 Unevenness

The limit of unevenness is generally defined as a percentage of the respective surface area. The dimension after coating shall be within the published dimension limit.