

BS EN 60424-1:2016



BSI Standards Publication

Ferrite cores — Guidelines on the limits of surface irregularities

Part 1: General specification

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National foreword

This British Standard is the UK implementation of EN 60424-1:2016. It is identical to IEC 60424-1:2015. It supersedes BS EN 60424-1:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/51, Transformers, inductors, magnetic components and ferrite materials.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Date	Text affected
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English Version

**Ferrite cores - Guidelines on the limits of surface irregularities -
Part 1: General specification
(IEC 60424-1:2015)**

Noyaux ferrites - Lignes directrices relatives aux limites des
irrégularités de surface -
Partie 1: Spécification générale
(IEC 60424-1:2015)

Ferritkerne - Leitfaden für Grenzwerte von sichtbaren
Beschädigungen der Kernoberfläche -
Teil 1: Fachgrundspezifikation
(IEC 60424-1:2015)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

The text of document 51/1107/FDIS, future edition 2 of IEC 60424-1, prepared by IEC/TC 51 "Magnetic components and ferrite materials" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60424-1:2016.

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) 2016-10-08
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-01-08

This document supersedes EN 60424-1:1999.

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The text of the International Standard IEC 60424-1:2015 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60401-3	NOTE	Harmonized as EN 60401-3.
IEC 60424-2	NOTE	Harmonized as EN 60424-2.
IEC 60424-3	NOTE	Harmonized as EN 60424-3.
IEC 60424-4	NOTE	Harmonized as EN 60424-4.
IEC 60424-8	NOTE	Harmonized as EN 60424-8.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FERRITE CORES –
GUIDELINES ON THE LIMITS OF SURFACE IRREGULARITIES –****Part 1: General specification**

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International Standard IEC 60424-1 has been prepared IEC technical committee 51: Magnetic components and ferrite materials.

This second edition cancels and replaces the first edition published in 1999. This edition constitutes a technical revision.

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

- a) addition of pores in 3.5 and crystallites in 3.6.

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

FDIS	Report on voting
51/1107/FDIS	51/1123/RVD

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 in the IEC 60424 series, published under the general title *Ferrite cores – Guidelines on the limits of surface irregularities*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.

INTRODUCTION

Due to the method of manufacture and the physical nature of the products, ferrite cores can be expected to exhibit some degree of physical irregularities such as chips, ragged edges, cracks, flashing, and pull-out.

The permissible extent of these surface irregularities will depend on the type, position and size of the defect and on the function of the core. Thus, in order to establish limits of surface irregularities for a given series of ferrite cores, for example RM-cores, pot-cores, E-cores, U-cores and ring-cores, it is necessary to prepare a particular specification for each, setting out in detail the permissible extent of the various types of irregularities.

All surfaces of the core should be clean and free from loose ferrite particles or any other foreign matter. This is more critical for mating surfaces that should make good contact with one another. Stains, discolorations, surface crazing or crystallization are acceptable if they do not affect the normal performance of the core. The irregularities described below are considered as being detectable without the use of any magnifying equipment.

Surface irregularities limits are set for control of cosmetic appearance, and not for control of magnetic performance. Surface irregularities do not substantially affect core magnetic function, nor do they affect reliability. Reliability should be assessed for wound magnetics, rather than for cores alone. See IEC 60401-3 for more details concerning the reliability of ferrite cores and devices built with them.

FERRITE CORES – GUIDELINES ON THE LIMITS OF SURFACE IRREGULARITIES –

Part 1: General specification

1 Scope

This part of IEC 60424 gives guidelines on the allowable limits of surface irregularities of ferrite cores.

This standard should be considered as a general specification useful in the dialogue between ferrite core manufacturers and customers about surface irregularities.

2 Normative reference

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.

Void.

3 Terms and definitions

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

3.1

chips and ragged edges

areas with missing surface material that are generally caused by mechanical impact during handling

3.2

crack

surface irregularity which has a width much smaller than its length, and penetrates into the core

3.3

flash

sharp feather-edge wall extending beyond the intended contour surface of the core

3.4

pull-out

consequence of the removal of a surface layer of the core due to die “sticking”

3.5

pores

holes left on the surface of cores after sintering and surface finishing

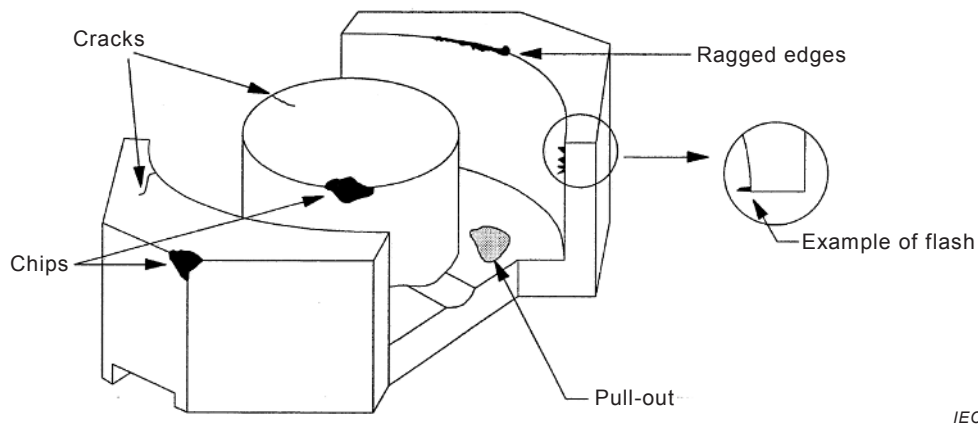
3.6

crystallites

grains of abnormal size distinguishable on the surface, often with sparkling facets

4 Examples of irregularities

Figure 1 shows different examples of surface irregularities on an RM-core.



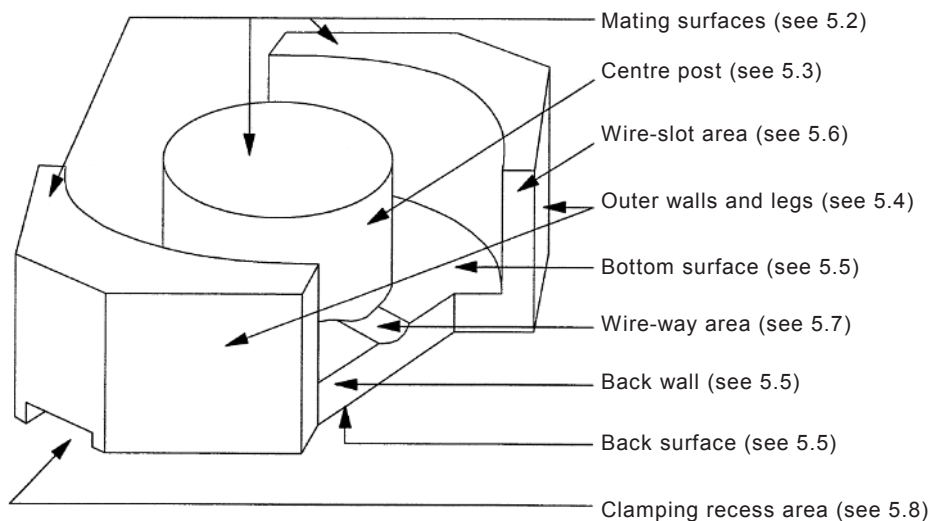
IEC

Figure 1 – Examples of surface irregularities

5 Locations and functions of core parts and surfaces

5.1 General

Figure 2 shows the location of main core parts and surfaces on an RM-core.



IEC

Figure 2 – Location of main core parts and surfaces – Example of RM-core type

5.2 Mating surfaces

These surfaces are generally ground in order to limit the residual air gap between the two core halves. Consequently, irregularities on these surfaces have to be considered as major ones, and carefully evaluated with regard to their influence on the magnetic properties of the complete circuit.

5.3 Centre post

This should be considered as the most important part of the core due to its function of carrying the total flux generated by the winding. The centre post of ferrite cores is generally circular (with or without a hole) or rectangular.

5.4 Outer walls or legs

The main function of the outer walls (for example pot-cores) or the outer legs (for example E-cores) is to guide the magnetic flux in a closed magnetic circuit.

5.5 Back wall, bottom and back surfaces

The back wall has the same magnetic function as the outer walls or legs; it may include wire-slots and wire-way areas (for example on RM-cores), the shapes and dimensions of which are dictated by the winding and isolation requirements.

Besides accommodating clamping, the back surface (ground or not) serves as a reference plane for grinding the mating surface to achieve its required parallelism, flatness and smoothness.

5.6 Wire-slot area

The wire-slot area is the lateral area of the outer walls, interfacing with the cut-out portion.

5.7 Wire-way area

The wire-way area is located on the bottom (inside) surface of the back wall, also called the floor. The wire-way runs radially from the centre post to the edge of the back wall, centred with respect to the wire-slot areas. The purpose of the wire-way is to provide a path for leads to reach from the inside of the coil to terminals on the outside.

5.8 Clamping recess area

The clamping recess areas on the back walls accommodate clamping clips, affording secure mounting, and preventing mechanical interference from the clip above the plane of the back wall.

6 Area and length reference for visual inspection

Irregularities such as chips, cracks and pull-out should be compared to five simple geometries which are shown in Table 1.

Such a table should be used as a reference for evaluation by operators either at the outgoing stage (core manufacturers) or at the incoming inspection (customers).

Other methods than visual inspection can be used, such as computerized optical detection.

NOTE The minimum area and length considered are respectively $0,5 \text{ mm}^2$ and 1 mm .

Recommended resolutions are as follows:

a) for area

- $0,5 \text{ mm}^2$ up to 5 mm^2
- 1 mm^2 from 5 mm^2 to 10 mm^2
- $2,5 \text{ mm}^2$ from 10 mm^2 to 20 mm^2
- 5 mm^2 from 20 mm^2 to 50 mm^2

b) for length

- 1 mm from 1 mm to 5 mm
- 2,5 mm from 5 mm to 10 mm

Table 1 – Area and length reference for visual inspection

Area	A	B	C	D	E	Area	A	B	C	D	E
0,5 mm ²						12,5 mm ²					
1,0 mm ²						15,0 mm ²					
1,5 mm ²						17,5 mm ²					
2,0 mm ²						20,0 mm ²					
2,5 mm ²						25,0 mm ²					
3,0 mm ²						30,0 mm ²					
3,5 mm ²						35,0 mm ²					
4,0 mm ²						40,0 mm ²					
4,5 mm ²						45,0 mm ²					
5,0 mm ²						50,0 mm ²					
6,0 mm ²											
7,0 mm ²											
8,0 mm ²											
9,0 mm ²											
10,0 mm ²											

Scale 1:1

1 mm 2 mm 3 mm 4 mm

5 mm 7,5 mm 10 mm

7 Limits of surface irregularities

7.1 General

In each particular specification relevant to a standardized core series, generic 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 IEC 60424-2 to IEC 60424-8, where limits per core size are given in suitable tables, along with identification of irregularity types on figures and drawings.

7.2 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.

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.

7.3 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.

7.4 Flash

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

7.5 Pull-outs

The limits of pull-outs are generally defined as a percentage of the respective surface area.

The apparent area of a pull-out, neglecting actual depth, is considered to be the area of that pull-out.

7.6 Pores

The limits of pores are generally defined as a percentage of the specified core.

7.7 Crystallites

The limits of crystallites are generally defined as a percentage of the specified core.

8 Sectional specifications

Table 2 shows the sectional specifications for the IEC 60424 family of standards for guidelines on the limits of surface irregularities.

Table 2 – IEC 60424 sectional specifications

Standard number	Title
IEC 60424-1	Ferrite cores – Guidelines on the limits of surface irregularities – Part 1: General specification
IEC 60424-2	Ferrite cores – Guidelines on the limits of surface irregularities – Part 2: RM-cores
IEC 60424-3	Ferrite cores – Guidelines on the limits of surface irregularities – Part 3: ETD-cores, EER-cores, EC-cores and E-cores
IEC 60424-4	Ferrite cores – Guidelines on the limits of surface irregularities – Part 4: Ring-cores
IEC 60424-5 (future)	Ferrite cores – Guidelines on the limits of surface irregularities – Part 5: Planar-cores
IEC 60424-6 (future)	Ferrite cores – Guidelines on the limits of surface irregularities – Part 6: Pot-cores
IEC 60424-7 (future)	Ferrite cores – Guidelines on the limits of surface irregularities – Part 7: EP-cores
IEC 60424-8	Ferrite cores – Guidelines on the limits of surface irregularities – Part 8: PQ-cores

Bibliography

- [1] IEC 60401-3, *Terms and nomenclature for cores made of magnetically soft ferrites – Part 3: Guidelines on the format of data appearing in manufacturers' catalogues of transformer and inductor cores*
 - [2] IEC 60424-2, *Ferrite cores – Guidelines on the limits of surface irregularities of ferrite cores – Part 2: RM-cores*
 - [3] IEC 60424-3, *Ferrite cores – Guidelines on the limits of surface irregularities – Part 3: ETD-cores, EER-cores, EC-cores and E-cores*
 - [4] IEC 60424-4, *Ferrite cores – Guidelines on the limits of surface irregularities – Part 4: Ring-cores*
 - [5] IEC 60424-8, *Ferrite cores – Guidelines on the limits of surface irregularities – Part 8: PQ-cores*
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