

INTERNATIONAL STANDARD



Terms and nomenclature for cores made of magnetically soft ferrites – Part 1: Terms used for physical irregularities and reference of dimensions



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Terms and nomenclature for cores made of magnetically soft ferrites – Part 1: Terms used for physical irregularities and reference of dimensions

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.100.10

ISBN 978-2-8322-8218-2

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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International Standard IEC 60401-1 has been prepared by IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials.

This second edition cancels and replaces the first edition of IEC 60401-1 published in 2002 and the second edition of IEC 60401-2 published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous editions of IEC 60401-1 and IEC 60401-2:

- a) added the surface irregularity term “pores” in 4.3.1.6;
- b) added the surface irregularity term “scratch” in 4.3.6.3;
- c) removed the surface irregularity term “crater” in 4.1.5 of IEC 60401-1: 2002;
- d) removed the bulk irregularity terms “superpores” in 5.1, “inclusions” in 5.2, “internal stratification” in 5.3 and “internal crack” in 5.4 of IEC 60401-1: 2002;
- e) removed the contents related to “yoke ring cores” in 7.1.3 and 7.4 of IEC 60401-1:2002;
- f) replaced the surface irregularity term “stratification” with “lamination” in 4.3.4.7;
- g) replaced the location related terms “upper surface of back” with “bottom surface” and “lower surface of back” with “back surface” in Figure A.1;
- h) changed Clause 7 of IEC 60401-1:2002 into Annex A.

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

CDV	Report on voting
51/1313/CDV	51/1332/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 60401 series, published under the general title *Terms and nomenclature for cores made of magnetically soft ferrites* 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.

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TERMS AND NOMENCLATURE FOR CORES MADE OF MAGNETICALLY SOFT FERRITES –

Part 1: Terms used for physical irregularities and reference of dimensions

1 Scope

This part of IEC 60401 provides a nomenclature of the most frequent surface, bulk and shape irregularities relevant to cores made of soft ferrites (magnetic oxides). Most irregularities are graphically exemplified as visual aids. A general recommendation is also given in Annex A for a consistent scheme for specifying the exact location of the irregularity, combining a general name for the location with more detailed qualifiers of the specified location. This document can also be useful as a terminology reference when preparing technical documentation, irregularity inspection specifications, etc.

This document also presents a method for defining the designation nomenclature for the major physical attributes of soft ferrite core shapes. The purpose of this document is to facilitate uniform usage of dimensional characters by manufacturers, specifiers, and users when describing core dimensions on drawings, in tables, and on catalogue specification sheets.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in 4.2, 4.3, 4.5 and Annex A 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>

4 Physical irregularities

4.1 General overview

Physical irregularities mean here the surface irregularities, bulk irregularities and shape irregularities. The irregularity here stands for inconsistency of the state or quality of the part's surface, bulk or shape with its intended regularity. These irregularities are considered here in the macroscopic scale, i.e. within the range of linear dimensions of irregularities from one micrometre to tens of millimetres.

There is a great variety of surface, bulk and shape irregularities degrading the quality of parts made of ferrites. Different types of these irregularities ~~may~~ can often occur together and overlap one another.

Each type of irregularity is, in general, produced by one or more of the following: ~~an incorrectly or inaccurately performed process~~ variability in a manufacturing step, ~~or improper~~ handling, grinding, packing or transportation.

The extent of the quality degradation is dependent on the type, scale, and combination of irregularities being present as well as on their locations on the part. There are locations particularly sensitive to the degrading effect of the specific types of irregularities.

The irregularities ~~may~~ can in extreme cases ~~give~~ have a detrimental or critical effect ~~to~~ on magnetic, electric and mechanical performances of the part. Operations performed on the part, such as marking, winding, assembling and mounting, can also be adversely affected by the irregularities.

An ongoing tendency to upgrade the overall quality of the parts results in more stringent restrictions being imposed on the quantity of irregularities in these parts.

This brings about a need for a set of definitions, or nomenclature, which would be a primary basis for approaches to irregularities and their location issues.

Therefore, this nomenclature is intended to be used as a uniform reference when formulating more detailed descriptions of irregularities at specified locations, requirements and procedures related to the inspection and assessment of irregularities. This nomenclature can also be useful with regard to methods and tools used for detection, recognition and classification of irregularities.

4.2 General terms for physical irregularities

4.2.1

surface irregularity

unintentional state or appearance of the surfaces, edges and corners of the part

Note 1 to entry: Some surface irregularities, if excessive, can so deform contours and surfaces of the part, that they may also be classified as shape irregularities.

4.2.2

interior irregularity

unintentional inhomogeneity inside the part

4.2.3

shape irregularity

unintentional deformation of the contour lines or surfaces delimiting the shape of the part

Note 1 to entry: In some cases, shape irregularities smaller than quoted tolerances ~~may~~ can still disqualify the part.

~~3.3~~

~~bulk irregularity~~

~~unintentional inhomogeneity inside the part~~

4.2.4

tolerance

<dimensional> allowable difference between the nominal and permissible limit dimensions of the contour lines defining the part's shape

4.2.5

location

<of the irregularity> position on or within the part where the irregularity is present

4.3 Surface irregularities

4.3.1 Chip irregularities

4.3.1.1

chip

lack of surface material generally caused by mechanical impact during handling or ~~grinding~~ transportation

Note 1 to entry: In almost all cases, chips are located on the edges of surfaces.

~~According to specific locations, the chips are sub-classified:~~

4.3.1.2

surface chip

chip located only on the core surface

SEE: Figure 1.



Figure 1 – Surface chip

4.3.1.3

edge chip

chip located only on the core edge

SEE: Figure 2.

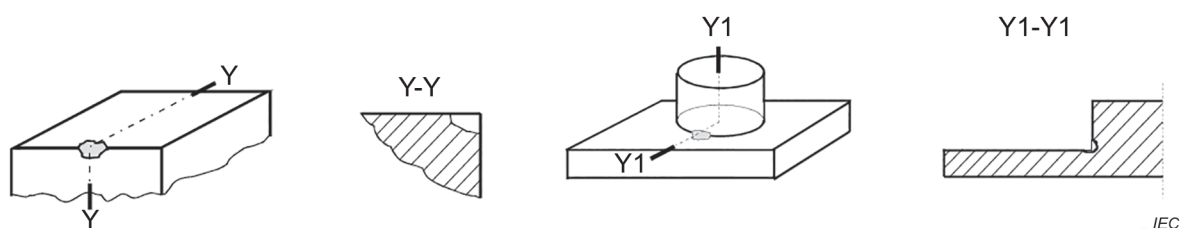


Figure 2 – Edge chip

4.3.1.4

corner chip

chip located only in a corner

SEE: Figure 3.

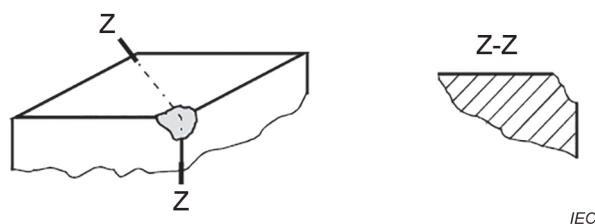


Figure 3 – Corner chip

4.3.1.5

pull-out

consequence of the removal of the surface layer of the core due to die “sticking”, which occurs on surfaces perpendicular to the direction of the pressing action

Note 1 to entry: A pull-out with a depth greater than 1 mm should be considered as a chip.

SEE: Figure 4.

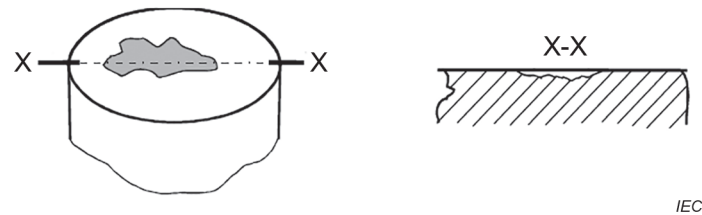
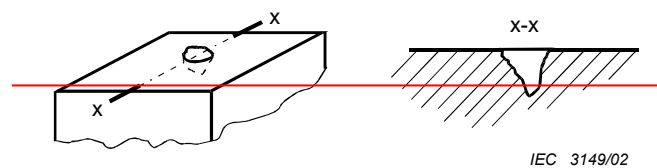


Figure 4 – Pull-out

4.1.5

crater

~~blind hole with depth comparable to or greater than its diameter~~



4.3.1.6

pore

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

SEE: Figure 5.

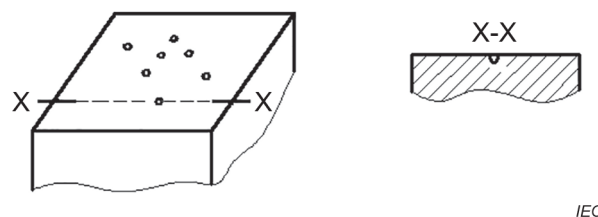


Figure 5 – Pores

4.3.2 Protruding (convex) irregularities

4.3.2.1

hump

elevation of a rounded contour on the relevant surface

SEE: Figure 6.

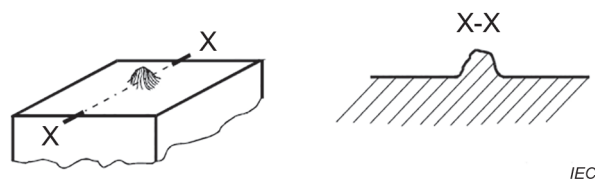


Figure 6 – Hump

4.3.2.2**attached particle**

any particle on the surface which cannot be removed by compressed-air, cleaning, washing or wiping

SEE: Figure 7.



Figure 7 – Attached particle

4.3.2.3**inclusion**

millimetre or sub-millimetre-sized foreign body located in the surface of the part ~~(refer to 5.2)~~

4.3.3 Edge irregularities**4.3.3.1****ragged edge**

edge affected by a series of small chips

SEE: Figure 8.

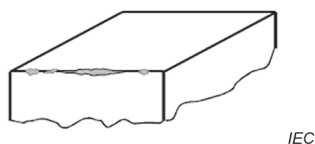


Figure 8 – Ragged edge

4.3.3.2**flash**

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

SEE: Figure 9.

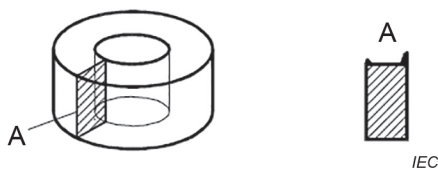


Figure 9 – Flash

4.3.4 Crack irregularities

4.3.4.1

crack

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

~~Specific types of 'cracks' can be sub-classified:~~

4.3.4.2

single-surface narrow crack

crack located on a single surface, not going beyond its edges, and with a width not exceeding a specified limit (e.g. 0,1 mm) anywhere along the crack path on the surface

SEE. Figure 10.

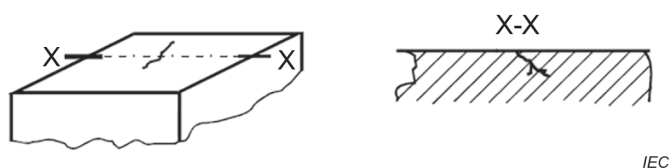


Figure 10 – Single-surface narrow crack

4.3.4.3

single-surface broad crack

crack located on a single surface, not going beyond its edges, and with a width equal to or exceeding the limit specified for the narrow crack anywhere along the crack path on the surface

SEE. Figure 11.



Figure 11 – Single-surface broad crack

4.3.4.4

edge narrow crack

crack located on two adjacent surfaces and crossing their common edge, with a width not exceeding a specified limit (e.g. 0,1 mm) anywhere along the crack path on these surfaces

SEE: Figure 12.

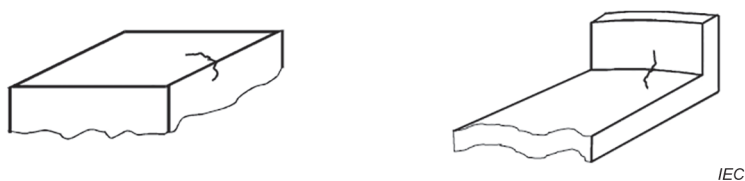


Figure 12 – Edge narrow crack

4.3.4.5**edge broad crack**

crack located on two adjacent surfaces and crossing their common edge, with a width equal to or exceeding the limit specified for the narrow crack anywhere along the crack path on these surfaces

SEE: Figure 13.

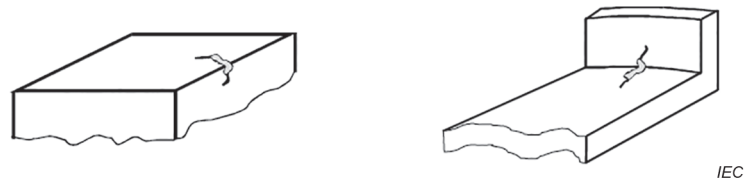


Figure 13 – Edge broad crack

4.3.4.6**inner channel crack**

narrow or broad crack along an inner edge of the core

SEE: Figure 14.

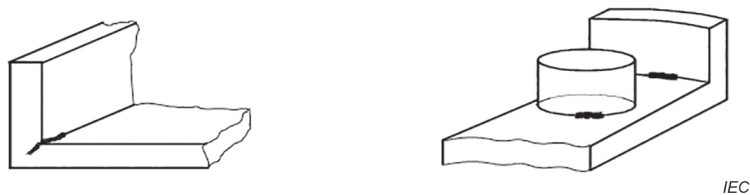


Figure 14 – Inner channel crack

4.3.4.7**stratification lamination**

series of cracks located side by side which are more or less parallel, or single crack, which runs along a significant portion (e.g. 20 %) of the periphery of the part

Note 1 to entry: **Stratification Lamination** is usually positioned transversely to the direction of the pressing of the core.

SEE: Figure 15.

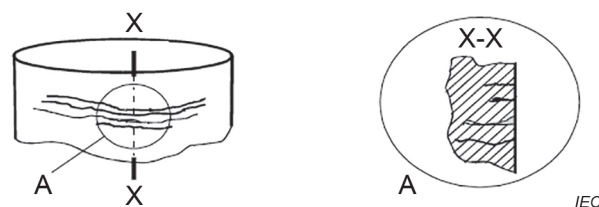


Figure 15 – Lamination

4.3.4.8**crazing**

grid-like pattern of superficial cracks of a depth not exceeding a specified limit (e.g. 0,3 mm)

SEE: Figure 16.

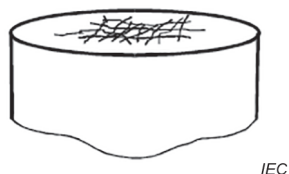


Figure 16 – Crazing

4.3.5 Colour irregularities

4.3.5.1

difference in colour tone

slight but visible local change(s) in the tint of the natural colour or shading of an area of a surface from the surrounding background

SEE: Figure 17.

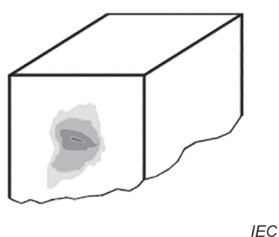


Figure 17 – Difference in colour tones

4.3.5.2

discoloration

visible difference in the colours of an area of a surface from the normal uniform colour background

SEE: Figure 18.

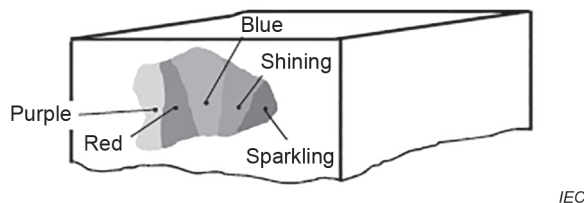


Figure 18 – Discoloration

4.3.5.3

stain

smear of oil, grease, or other substance ~~etc.~~ or deposit (e.g. whitish or water marks) on the surface

SEE: Figure 19.

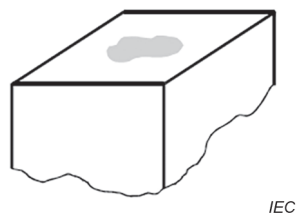


Figure 19 – Stain

4.3.5.4

crystallite

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

SEE: Figure 20.

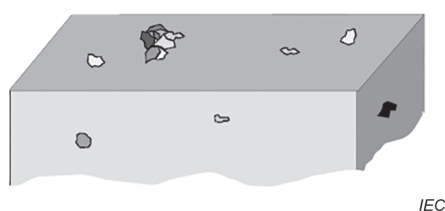
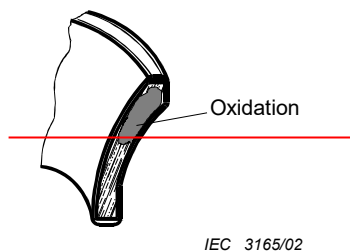


Figure 20 – Crystallite

4.5.5

oxidation of split surfaces

~~part of split (detached, crashed, etc.) surface which is oxidized~~



4.3.6 Machining-related irregularities

4.3.6.1

roughness

uneven, ~~not smooth~~ rough surface ~~including~~ which includes traces from grinding, abrasives, etc.

SEE: Figure 21.

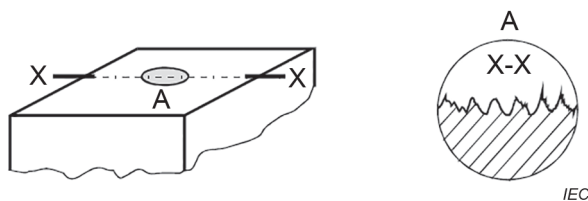


Figure 21 – Roughness

4.3.6.2

short-ground surface

part of surface which unintentionally remains un-ground after grinding, with no steplike surface irregularities

Note 1 to entry: See 4.5.3.1.

SEE: Figure 22.

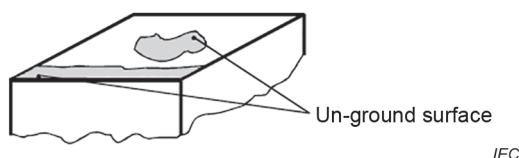


Figure 22 – Short-ground surface

4.3.6.3

scratch

one or more scrapes caused by the handling process

SEE: Figure 23.

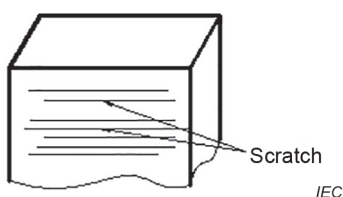


Figure 23 – Scratch

4.4 Interior irregularities

Since inclusions, cracks or lamination that is confined to the inside of a part cannot be detected by direct inspection except with destructive or expensive procedures, control of bulk irregularities is maintained through break strength testing. Small sample sizes from production batches are destructively broken with M testing, W testing, or tensile pull testing. The yield strength is recorded and compared with specification limits or control limits. Further, internal irregularities that cause electrical performance to be impaired are detected by means of testing against the electrical specifications.

5 Bulk irregularities

5.1

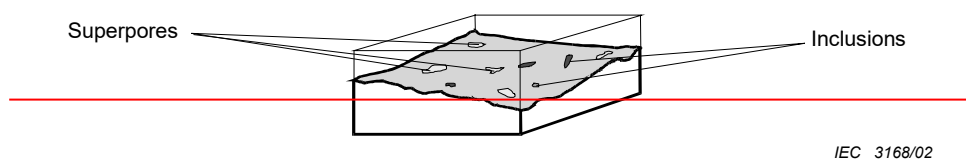
superpores

~~pores being millimetre-sized voids~~

5.2

inclusions

~~millimetre or sub-millimetre-sized foreign bodies located inside cores~~



NOTE—An inclusion, if it appears on the surface of the part, is also considered as the surface irregularity (see 4.2.3).

5.3

internal stratification

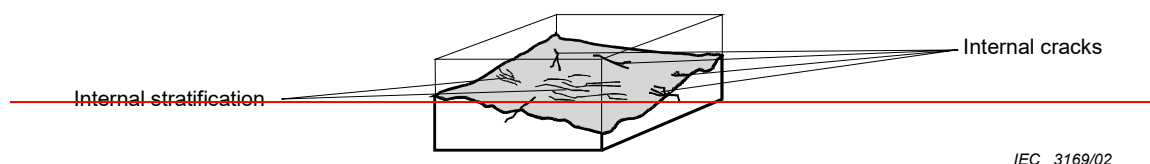
~~stratum shaped material discontinuity located inside the core and not always extending to the surface; usually narrow but sometimes of an extensive area~~

NOTE—The internal stratification caused by the improper press of the material is usually positioned transversely to the direction of pressing.

5.4

internal crack

~~crack shaped material discontinuity inside the core not always extending to the surface; usually narrow but sometimes of an extensive length~~



4.5 Shape irregularities (deformations)

4.5.1 Non-flat irregularities

4.5.1.1

convexity

~~outwards~~ outwardly curved outline or surface

SEE: Figure 24.

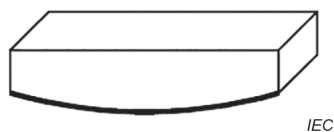


Figure 24 – Convexity

4.5.1.2

concavity

~~inwards~~ inwardly curved outline or surface

SEE: Figure 25.



Figure 25 – Concavity

4.5.1.3

warping

state of a shape with twisted surface(s)

SEE: Figure 26.

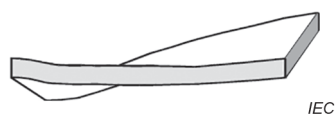


Figure 26 – Warping

4.5.1.4

bending

deflection, curved or angular, from any direction that is regarded as the intended ~~one~~ deflection

~~Three different kind of deflections as follows:~~

4.5.1.4.1

deflection-out

state of being more or less inclined to the outside from the perpendicular or from another intended inclination

Note 1 to entry: This is also called "toe-out".

SEE: Figure 27.

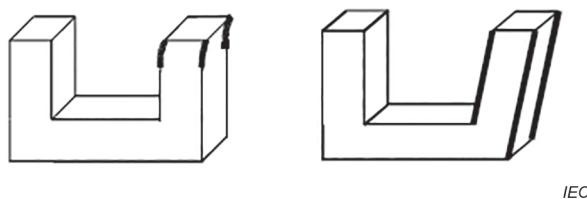


Figure 27 – Deflection-out

4.5.1.4.2

deflection-in

state of being more or less inclined to the inside from the perpendicular or from another intended inclination

Note 1 to entry: This is also called "toe-in".

SEE: Figure 28.