BS EN 61332:2017

BSI Standards Publication

Soft ferrite material classification

National foreword

This British Standard is the UK implementation of EN 61332:2017. It is identical to IEC 61332:2016. It supersedes BS EN 61332:2005 which is withdrawn.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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EN 61332

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English Version

Soft ferrite material classification (IEC 61332:2016)

Classification des matériaux ferrites doux
(IEC 61332:2016)

Werkstoffeigenschaften von Ferritmaterialien
(IEC 61332:2016)

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Europäisches Komitee für Elektrotechnische Normung

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European foreword

The text of document 51/1146/FDIS, future edition 3 of IEC 61332, prepared by IEC/TC 51 "Magnetic components, ferrite and magnetic powder materials" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61332:2017.

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) 2017-09-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-12-23

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In the official version, for Bibliography, the following note has to be added for the standard indicated :

IEC 60401-3:2015	NOTE	Harmonized as EN 60401-3:2016 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60050-221	-	International Electrotechnical Vocabulary (IEV) - Chapter 221: Magnetic materials and components	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SOFT FERRITE MATERIAL CLASSIFICATION

FOREWORD

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International Standard IEC 61332 has been prepared IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials.

This third edition cancels and replaces the second edition published in 2005. This edition constitutes a technical revision.

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

a) deleted "c" rank from subclass from Table 3, because of too large power loss density;
b) added "a-wide" rank in subclasses PW3, PW4 and PW5 in Table 3;
c) changed "B" of PW3 class from 100 mT to 200 mT; "$B \times f$" and "power loss density" have also been changed;
d) changed "B" of PW4 class from 50 mT to 100 mT; "$B \times f$" and "power loss density" have also been changed.

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

FDIS	Report on voting
51/1146/FDIS	51/1155/RVD

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.

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.

A bilingual version of this publication may be issued at a later date.

SOFT FERRITE MATERIAL CLASSIFICATION

1 Scope

This document specifies classification rules for soft ferrite materials used in inductive components (inductors and transformers) fulfilling the requirements of the electronic industries.

This document addresses the following issues for ferrite suppliers and users:

- cross-reference between materials from multiple suppliers;
- assistance to customers in understanding the published technical data in catalogues when comparing multiple suppliers;
- guidance to customers in selecting the most applicable material for each application;
- setting of nomenclature for IEC standards relating to ferrite;
- establishing uniform benchmarks for suppliers for performance in new development of materials.

The numerical values given in this document are typical values of the parameters (properties) of the related materials. Direct translation from the material specification into the core specification is not always easy or possible.

Every detailed material and core specification should be agreed upon between the user and the manufacturer.

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 60050-221, *International Electrotechnical Vocabulary – Chapter 221: Magnetic materials and components*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-221 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 Classification

4.1 Material classification

Soft ferrite materials may be classified according to the following basic parameters:

- initial permeability and relevant operation frequency and/or applicable maximum frequency;
- initial permeability as a function of the temperature;
- applicable maximum flux density and/or amplitude permeability;
- power loss at a given frequency, temperature and flux density;
- normalized impedance at a given frequency.

4.2 Main classes

Soft ferrite materials may be divided into three main classes identified by two letters as follows:

- class IS materials are for use at AC low flux density as impedances in interference suppression (EMI) applications;
- class SP materials are for use at low flux density in signal processing applications;
- class PW materials are for use at high flux density (power application).

4.3 Subclasses

Each main class is divided into subclasses identified by two letters and a serial number.

Ferrite manufacturers' catalogues may indicate more than one class into which a material grade can fall, where desired.

5 Soft ferrite material classes

5.1 Materials used as impedances in interference suppression applications (IS class)

These materials are mainly used in the shape of rods, tubes, beads, wide band chokes, bobbin cores and rings. The relevant subclasses are given in Table 1.

Table 1 – IS class ferrite materials

Subclasses	Frequency[a] MHz	Normalized impedance[b] Z_N Ω/mm	Initial permeability[c] μ_i	Curie temperature T_C °C
IS1	300	≥ 50	< 100	> 300
IS2a IS2b	300	≥ 50 ≥ 40	100 to 2 000	200 to 300
IS3a IS3b	100	≥ 40 ≥ 30	100 to 2 000	100 to 250
IS4a IS4b	30	≥ 30 ≥ 20	100 to 2 000	100 to 250
IS5a IS5b	10	≥ 30 ≥ 20	2 000 to 6 000	100 to 250
IS6a IS6b	3	≥ 30 ≥ 20	2 000 to 6 000	100 to 150
IS7a IS7b	1	≥ 20 ≥ 10	2 000 to 6 000	100 to 150
IS8a IS8b	1	≥ 20 ≥ 10	6 000 to 10 000	100 to 150
IS9a IS9b	0,5	≥ 10 ≥ 5	10 000 to 15 000	> 100

[a] The frequency is the measuring frequency of the normalized impedance.

[b] Measured on a bead ϕ5 mm × ϕ2 mm × 10 mm and at a temperature of 25 °C.

[c] μ_i is measured at ≤ 10 kHz, ≤ 0,5 mT. μ_i is for reference only, indicating typical values seen. μ_i is not a fundamental parameter for class IS materials.

5.2 Materials used mainly in low flux density applications (B ≤ 5 mT) (SP class)

These materials are mainly used in the shape of ring-cores, pot-cores, EP-cores, RM-cores and E-cores. The relevant subclasses are given in Table 2.

Table 2 – SP class ferrite materials

Subclasses	Initial permeability[a]	Relative loss factor[a]	Frequency[b]	Curie temperature
		$\tan\delta/\mu_i$		T_C
	μ_i	$\times 10^{-6}$	MHz	°C
SP1	< 100	50 to 150	10	> 300
SP2	100 to 400	20 to 30	1	> 250
SP3	400 to 800	15 to 50	0,1	> 150
SP4	800 to 1 200	1 to 10	0,1	> 120
SP5	1 200 to 2 000	1 to 10	0,1	> 120
SP6	1 200 to 2 500	2 to 7	0,1	> 150
SP7	1 500 to 2 500	3 to 5	0,1	> 150
SP8	2 500 to 3 500	2 to 10	0,1	> 130
SP9	3 500 to 6 000	≤ 15	0,1	> 120
SP10a SP10b	6 000 to 8 000 6 000 to 8 000	≤ 3 ≤ 10	0,01 0,01	> 120 > 120
SP11a SP11b	8 000 to 12 000 8 000 to 12 000	≤ 3 ≤ 10	0,01 0,01	> 100 > 100
SP12a SP12b	12 000 to 16 000 12 000 to 16 000	≤ 6 ≤ 20	0,01 0,01	> 100 > 100
SP13	16 000 to 20 000	≤ 20	0,01	> 100

NOTE The size of the test core is ϕ10 mm × ϕ6 mm × 4 mm.

[a] μ_i and $\tan\delta/\mu_i$ are measured at 25 °C.

[b] The frequency is the measuring frequency for $\tan\delta/\mu_i$.

5.3 Materials used mainly in high flux density applications (PW class)

These materials are mainly used in the shape of RM-cores, EFD-cores, ER-cores, ETD-cores, EER-cores, E-cores, PQ-cores, ring-cores and cores for planar applications. The relevant subclasses are given in Table 3.

Table 3 – PW class ferrite materials

Subclasses	f_{max} [a]	f [c,d]	B [b]	μ_a [c]	T	Performance factor ($B \times f$)	Power loss (volume) Density [d,e,f]	μ_i [g]
	kHz	kHz	mT		°C	mT×kHz	kW/m^3	
PW1a PW1b	100	15	300	2 500	100	4 500 (300 × 15)	≤ 100 ≤ 200	3 500 to 2 000
PW2a PW2b	200	25	200	2 500	100	5 000 (200 × 25)	≤ 60 ≤ 150	3 500 to 2 000
PW3a PW3b PW3a-wide	300	100	200	3 000	100 100 80 to 140	20 000 (200 × 100)	≤ 350 ≤ 700 ≤ 450	3 500 to 2 000
PW4a PW4b PW4a-wide	500	300	100	3 000	100 100 60 to 120	30 000 (100 × 300)	≤ 350 ≤ 700 ≤ 350	3 000 to 1 400
PW5a PW5b PW5a-wide	1 000	500	50	2 000	100 100 60 to 120	25 000 (50 × 500)	≤ 100 ≤ 150 ≤ 150	2 000 to 1 400
PW6a PW6b	2 000	1 000	25	1 000	100	25 000 (25 × 1 000)	≤ 100 ≤ 150	1 400 to 800
PW7a PW7b	3 000	2 000	15	1 000	100	30 000 (15 × 2 000)	≤ 100 ≤ 150	1 400 to 800
PW8a PW8b	5 000	3 000	10	400	100	30 000 (10 × 3 000)	≤ 100 ≤ 200	800 to 400
PW9a PW9b	10 000	5 000	10	40	100	50 000 (10 × 5 000)	≤ 200 ≤ 300	400 to 40

NOTE The size of the test core is ϕ25 mm × ϕ15 mm × 10 mm or smaller.

[a] f_{max} is the guide of applicable maximum frequency relevant to a given material subclass.

[b] B is the applicable AC peak flux density relevant to a given material subclass. These levels of B normally result in power losses in the ranges ≤ 300 kW/m^3. In these ranges, a wide variety of sizes in the common shapes can be used in open air conditions without forced cooling. The use of higher flux densities in these subclasses will result in higher power losses which may often require additional cooling, or will be limited in open air with no forced cooling to the use of only smaller sizes from the common core shapes.

[c] μ_a is the amplitude permeability at the conditions of T, B and f in Table 3. μ_a is for reference only.

[d] Power loss should be measured at the conditions of T, B and f in Table 3. These combinations of B and f are different than the preferred combinations according IEC 60401-3:2015, Table 2, where higher power losses than 300 kW/m^3 are assumed as well (see also footnote b above).

[e] Power loss is only referring to B as AC peak flux density and does not apply to situations where there is a combination of AC and DC flux density applicable in which power losses may be different. In these cases, it is usual that a critical parameter used for core selection is either

1) a saturation flux density at the intended maximum operating temperature (typically 100 °C to 120 °C); or
2) a maximum decrease in inductance with a specified DC flux density, AC flux density, temperature, and air gap in the core structure (the gap is defined by the dimension or by the inductance factor).

[f] Power loss only refers to the temperature of 100 °C, although there are some power ferrites available which are optimised for lower or higher operating temperatures than about 100 °C.

[g] μ_i is measured at ≤ 10 kHz, ≤ 0,5 mT. μ_i is for reference only, indicating typical values seen. μ_i is not a fundamental parameter for class PW materials.

Bibliography

IEC 60401-3: 2015, *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*

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