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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Ferrite cores – Guidelines on dimensions and the limits of surface irregularities – Part 12: Ring-cores

Noyaux ferrites – Lignes directrices relatives aux dimensions et aux limites des irrégularités de surface – Partie 12: Noyaux toriques

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FERRITE CORES – GUIDELINES ON DIMENSIONS AND THE LIMITS OF SURFACE IRREGULARITIES –

Part 12: Ring-cores

FOREWORD

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International Standard IEC 63093-12 has been prepared by IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials.

This first edition cancels and replaces the first edition of IEC 62317-12 published in 2016 and the second edition of IEC 60424-4 published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 62317-12:2016 and IEC 60424-4:2015:

a) IEC 63093-12 integrates the contents of IEC 62317-12:2016 and IEC 60424-4:2015.

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

FDIS	Report on voting
51/1271/FDIS	51/1284/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.

A list of all parts in the IEC 63093 series, published under the general title *Ferrite 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- withdrawn,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
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FERRITE CORES – GUIDELINES ON DIMENSIONS AND THE LIMITS OF SURFACE IRREGULARITIES –

Part 12: Ring-cores

1 Scope

This part of IEC 63093 specifies the dimensions that are of importance for mechanical interchangeability for a preferred range of ring-cores, also called toroid cores, and the effective parameter values to be used in calculations involving them. It also gives guidelines on allowable limits of surface irregularities applicable to ring-cores.

This document is a specification useful in the negotiations between ferrite 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 60205, *Calculation of the effective parameters of magnetic piece parts*

IEC 60401-1, *Terms and nomenclature for cores made of magnetically soft ferrites – Part 1: Terms used for physical irregularities*

IEC 60424-1, *Ferrite cores – Guidelines on the limits of surface irregularities – Part 1: General specification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60401-1 and IEC 60424-1 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 Primary dimensions

4.1 General

Compliance with the following requirements ensures mechanical interchangeability of complete assemblies and wound coils.

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4.2 Dimensions of ring-cores

4.2.1 Designation of dimensions

Figure 1 and Table 1 describe the alphabetic character assignments for the dimensions of ferrite ring-cores.

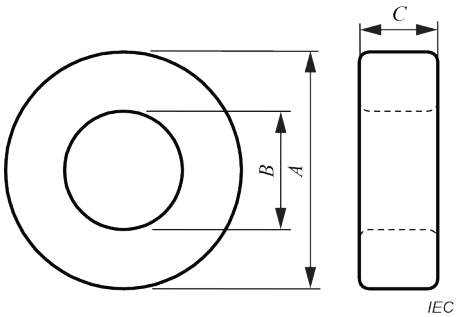

Figure 1 – Dimensions of ring-cores

Table 1 – Ring-core dimension designations

Letter	Dimension description
A	Outside diameter
B	Inside diameter
C	Height

4.2.2 Identification of standard sizes

Table 2 shows the nominal dimensions for the range of standard ring-cores. Table 2 also shows, where applicable, the origin and regional name of each standard size, whether from historical European sizes, historical Japanese sizes, or historical USA sizes. The previous IEC TR 61604 (now withdrawn) detailed the different ring sizes that were tooled and commonly used in the three distinct geographic regions. IEC TR 61604 laid the groundwork for the present document, which reflects the more global nature of the industry, compared to the time when ferrite standards were evolving in different parts of the world. Manufacturers tend to have more globally complete offerings of ring sizes than before, leading to a profusion of different sizes.

The number of different ring sizes used in total is quite large, far in excess of the 82 commonly known standard sizes shown here, for a couple of reasons: ring-cores are relatively inexpensive to build tooling for, nor does a new ring-core require an expensive new coil former to be assembled, meaning that custom ring-cores are often commercially practical. Ferrite rings, which lack a residual air gap, that E-cores and other shapes have at their mating surfaces, exhibit directly the full magnetic performance possible in the ferrite material, meaning that assembling precisely optimal new dimensions can give a significant advantage to a designer that is optimizing for best possible performance.

4.2.3 Effective parameter values

The effective parameter values for the standard ring-cores are given in Table 3. For global practicality and simplicity the effective parameters in this document are calculated from the nominal dimensions, assuming cores of a rectangular cross section, and are useful for reference and comparison of cores. For cores having a cross section with an appreciable average rounding radius, more precise values shall be calculated from the method given in IEC 60205, if required.

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4.2.4 Dimensional limits for standard sizes

The standard tolerance limits for uncoated ring-cores are given in Table 4. Manufacturers can choose to offer looser standard limits for ferrite materials that exhibit greater process variability, or tighter limits for applications that justify higher processing and yield costs to achieve a narrower dimensional range.

The limits take account of shrinkage variation and warping during firing. The specification for the out-of-round condition of the inner or outer circumference is that the inside diameter (B) and outside diameter (A) shall stay within the indicated limits, measured at any point. Similarly, the specification for the non-flat condition of the sides of a ring is that the height minimum and maximum shall be achieved at all points.

Table 2 – Standard ring-cores

Nominal uncoated dimensions				Size reference
A (mm)	B (mm)	C (mm)		
2,5	1,3	1,3		
2,5	1,5	0,8		
2,5	1,5	1,0		Europe R2,5
3,1	1,3	1,3		
3,1	1,8	2,0		
3,5	1,8	1,3		
3,9	1,8	1,8		
3,94	2,24	1,27		USA T3,9
4,0	2,0	2,0		
4,0	2,2	1,6		Europe R4
4,83	2,29	1,27		USA T4,8
5,84	3,05	1,52		USA T5,8
6,0	3,0	2,0		
6,0	4,0	2,0		
6,3	3,8	2,5		Europe R6,3
7,62	3,18	4,78		USA T7,6
8,0	4,0	2,0		
8,2	3,7	4,0		
9,0	6,0	3,0		
9,53	4,75	3,18		USA T9,5
10,0	5,0	4,0		
10,0	5,0	5,0		Japan FOR 10
10,0	6,0	4,0		Europe R10
12,0	6,0	4,0		Japan FOR12
12,7	7,1	5,1		
12,7	7,92	6,35		USA T12,7
13,2	7,4	4,0		
13,6	7,0	3,5		
14,0	8,0	7,0		
14,0	9,0	5,0		
15,88	8,89	4,7		USA T15,9
16,0	9,0	5,0		

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Nominal uncoated dimensions				Size reference
A (mm)	*B* (mm)	*C* (mm)		
16,0	9,6	6,3		Europe R16
16,0	12,0	8,0		
18,0	10,0	10,0		Japan FOR 18
18,5	9,8	10,3		Japan FOR 19
20,0	10,0	7,0		Europe R20
20,0	12,0	10,0		Japan FOR 20
22,0	14,0	10,0		Japan FOR 22
22,1	13,72	6,35		USA T22,1
25,0	15,0	10,0		Europe R25
25,0	15,0	12,0		Japan FOR 25
25,4	15,49	9,53		USA T25,4
26,9	14,2	12,2		
28,0	16,0	13,0		Japan FOR 28
29,0	19,0	7,49		USA T29,0
30,8	19,1	12,7		
31,0	19,0	13,0		Japan FOR 31
32,0	19,0	13,0		
36,0	23,0	10,0		USA T36.0
36,0	23,0	15,0		Europe R36
38,0	19,0	13,0		Japan FOR 38
38,0	22,0	13,0		
38,1	19,0	6,35		USA T38,1
40,0	24,0	16,0		Europe R40
40,0	24,0	20,0		
41,8	26,2	18,0		
44,5	30,0	13,0		Japan FOR 45
47,0	27,0	15,0		Japan FOR 47
49,1	31,8	15,9		
49,1	33,8	15,9		
50,0	30,0	20,0		Europe R50
51,0	32,0	19,0		
55,0	32,0	19,0		
58,0	41,0	18,0		
61,0	35,6	12,7		
63,0	38,0	25,0		Europe R63
68,0	48,0	13,0		
72,0	48,0	20,0		
73,7	38,9	12,7		USA T73,7
80,0	40,0	15,0		
80,0	50,0	20,0		
85,7	55,5	12,7		
96,0	70,0	20,0		
102,0	65,0	15,0		

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Nominal uncoated dimensions				Size reference
A (mm)	*B* (mm)	*C* (mm)		
104,0	80,0	20,0		
107,0	65,0	18,0		
127,0	89,0	20,0		
140,0	106,0	25,0		
152,0	104,0	19,0		
202,0	153,0	25,0		
305,0	207,0	30,0		

Table 3 – Effective parameters of ring-cores

A mm	*B* mm	*C* mm		C_1 mm^{-1}	C_2 mm^{-3}	A_e mm^2	l_e mm	V_e mm^3
2,5	1,3	1,3		7,391 1	9,818 3	0,753	5,56	4,19
2,5	1,5	0,8		15,375	39,281	0,391	6,02	2,36
2,5	1,5	1,0		12,300	25,140	0,489	6,02	2,94
3,1	1,3	1,3		5,561 6	5,060 3	1,10	6,11	6,72
3,1	1,8	2,0		5,779 1	4,556 0	1,27	7,33	9,30
3,5	1,8	1,3		7,268 3	6,823 6	1,07	7,74	8,25
3,9	1,8	1,8		4,514 6	2,510 1	1,80	8,12	14,6
3,94	2,24	1,27		8,761 0	8,333 8	1,05	9,21	9,68
4,0	2,0	2,0		4,532 4	2,358 4	1,92	8,71	16,7
4,0	2,2	1,6		6,568 7	4,699 1	1,40	9,18	12,8
4,83	2,29	1,27		6,629 3	4,304 5	1,54	10,2	15,7
5,84	3,05	1,52		6,363 5	3,108 1	2,05	13,0	26,7
6,0	3,0	2,0		4,532 4	1,572 3	2,88	13,1	37,7
6,0	4,0	2,0		7,748 1	3,927 4	1,97	15,3	30,2
6,3	3,8	2,5		4,971 4	1,625 0	3,06	15,2	46,5
7,62	3,18	4,78		1,504 2	0,151 00	9,96	15,0	149
8,0	4,0	2,0		4,532 4	1,179 2	3,84	17,4	67,0
8,2	3,7	4,0		1,973 9	0,231 14	8,54	16,9	144
9,0	6,0	3,0		5,165 4	1,163 7	4,44	22,9	102
9,53	4,75	3,18		2,837 6	0,388 69	7,30	20,7	151
10,0	5,0	4,0		2,266 2	0,235 84	9,61	21,8	209
10,0	5,0	5,0		1,812 9	0,150 94	12,0	21,8	262
10,0	6,0	4,0		3,075 0	0,392 81	7,83	24,1	188
12,0	6,0	4,0		2,266 2	0,196 53	11,5	26,1	301
12,7	7,1	5,1		2,118 6	0,152 59	13,9	29,4	408
12,7	7,92	6,35		2,095 4	0,140 65	14,9	31,2	465
13,2	7,4	4,0		2,714 2	0,240 59	11,3	30,6	345
13,6	7,0	3,5		2,703 0	0,242 75	11,1	30,1	335
14,0	8,0	7,0		1,604 0	0,078 393	20,5	32,8	671
14,0	9,0	5,0		2,844 1	0,231 26	12,3	35,0	430
15,88	8,89	4,7		2,304 4	0,144 26	16,0	36,8	588

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A mm	B mm	C mm		C_1 mm^{-1}	C_2 mm^{-3}	A_e mm^2	l_e mm	V_e mm^3
16,0	9,0	5,0		2,184 1	0,128 29	17,0	37,2	633
16,0	9,6	6,3		1,952 4	0,098 969	19,7	38,5	760
16,0	12,0	8,0		2,730 1	0,171 81	15,9	43,4	689
18,0	10,0	10,0		1,069 0	0,027 502	38,9	41,5	1 610
18,5	9,8	10,3		0,960 07	0,022 158	43,3	41,6	1 800
20,0	10,0	7,0		1,295 0	0,038 504	33,6	43,6	1 460
20,0	12,0	10,0		1,230 0	0,031 425	39,1	48,1	1 880
22,0	14,0	10,0		1,390 1	0,035 349	39,3	54,7	2 150
22,1	13,72	6,35		2,075 6	0,079 499	26,1	54,2	1 410
25,0	15,0	10,0		1,230 0	0,025 140	48,9	60,2	2 940
25,0	15,0	12,0		1,025 0	0,017 458	58,7	60,2	3 530
25,4	15,49	9,53		1,333 1	0,028 812	46,3	61,7	2 850
26,9	14,2	12,2		0,806 12	0,010 764	74,9	60,4	4 520
28,0	16,0	13,0		0,863 67	0,011 365	76,0	65,6	4 990
29,0	19,0	7,49		1,983 8	0,053 767	36,9	73,2	2 700
30,8	19,1	12,7		1,035 4	0,014 203	72,9	75,5	5 500
31,0	19,0	13,0		0,987 28	0,012 912	76,5	75,5	5 770
32,0	19,0	13,0		0,927 15	0,011 223	82,6	76,6	6 330
36,0	23,0	10,0		1,402 4	0,021 939	63,9	89,6	5 730
36,0	23,0	15,0		0,934 95	0,009 750 7	95,9	89,6	8 600
38,0	19,0	13,0		0,697 29	0,005 875 7	119	82,7	9 820
38,0	22,0	13,0		0,884 32	0,008 716 9	101	89,7	9 100
38,1	19,0	6,35		1.422 1	0,024 412	58,3	8,8	4 830
40,0	24,0	16,0		0,768 75	0,006 137 6	125	96,.3	12 100
40,0	24,0	20,0		0,615 00	0,003 928 1	157	96,3	15 100
41,8	26,2	18,0		0,747 25	0,005 419 8	138	103	14 200
44,5	30,0	13,0		1,225 8	0,013 175	93,0	114	10 600
47,0	27,0	15,0		0,755 68	0,005 168 2	146	110	16 200
49,1	31,8	15,9		0,909 70	0,006 719 0	135	123	16 700
49,1	33,8	15,9		1,058 3	0,008 802 2	120	127	15 300
50,0	30,0	20,0		0,615 00	0,003 142 5	196	120	23 600
51,0	32,0	19,0		0,709 51	0,004 002 5	177	126	22 300
55,0	32,0	19,0		0,610 59	0,002 863 4	213	130	27 800
58,0	41,0	18,0		1,006 3	0,006 643 5	151	152	23 100
61,0	35,6	12,7		0,918 69	0,005 834 9	157	145	22 800
63,0	38,0	25,0		0,497 14	0,001 625 0	306	152	46 500
68,0	48,0	13,0		1,387 6	0,010 782	129	179	23 000
72,0	48,0	20,0		0,774 81	0,003 272 9	237	183	43 400
73,7	38,9	12,7		0,774 23	0,003 624 5	214	165	35 300
80,0	40,0	15,0		0,604 31	0,002 096 3	288	174	50 200
80,0	50,0	20,0		0,668 42	0,002 269 4	295	197	58 000
85,7	55,5	12,7		1,138 7	0,006 031 9	189	215	40 600
96,0	70,0	20,0		0,994 64	0,003 857 4	258	256	66 100

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A mm	B mm	C mm		C_1 mm^{-1}	C_2 mm^{-3}	A_e mm^2	l_e mm	V_e mm^3
102,0	65,0	15,0		0,929 63	0,003 407 1	273	254	69 200
104,0	80,0	20,0		1,197 4	0,005 017 9	239	286	68 200
107,0	65,0	18,0		0,700 31	0,001 891 4	370	259	96 000
127,0	89,0	20,0		0,883 58	0,002 349 8	376	332	125 000
140,0	106,0	25,0		0,903 39	0,002 139 4	422	381	161 000
152,0	104,0	19,0		0,871 42	0,001 934 0	451	393	177 000
202,0	153,0	25,0		0,904 61	0,001 486 4	609	551	335 000
305,0	207,0	30,0		0,540 36	0,000 372 22	1450	784	1 140 000

Table 4 – Recommended dimensional limits for uncoated ring-cores

A mm	**Min.** mm	**Max.** mm	B mm	**Min.** mm	**Max.** mm	C mm	**Min.** mm	**Max.** mm
2,5	2,35	2,65	1,3	1,15	1,45	1,3	1,15	1,45
2,5	2,35	2,65	1,5	1,35	1,65	0,8	0,65	0,95
2,5	2,35	2,65	1,5	1,35	1,65	1,0	0,85	1,15
3,1	2,95	3,25	1,3	1,15	1,45	1,3	1,15	1,45
3,1	2,95	3,25	1,8	1,65	1,95	2,0	1,85	2,15
3,5	3,35	3,65	1,8	1,65	1,95	1,3	1,15	1,45
3,9	3,75	4,05	1,8	1,65	1,95	1,8	1,65	1,95
3,94	3,79	4,09	2,24	2,09	2,39	1,27	1,12	1,42
4,0	3,80	4,20	2,0	1,85	2,15	2,0	1,85	2,15
4,0	3,80	4,20	2,2	2,05	2,35	1,6	1,45	1,75
4,83	4,63	5,03	2,29	2,14	2,44	1,27	1,12	1,42
5,84	5,64	6,04	3,05	2,90	3,20	1,52	1,37	1,67
6,0	5,80	6,20	3,0	2,85	3,15	2,0	1,85	2,15
6,0	5,80	6,20	4,0	3,85	4,15	2,0	1,85	2,15
6,3	6,10	6,50	3,8	3,65	3,95	2,5	2,35	2,65
7,62	7,42	7,82	3,18	3,03	3,33	4,78	4,48	5,08
8,0	7,80	8,20	4,0	3,85	4,15	2,0	1,85	2,15
8,2	8,00	8,40	3,7	3,55	3,85	4,0	3,75	4,25
9,0	8,70	9,30	6,0	5,80	6,20	3,0	2,80	3,20
9,53	9,23	9,83	4,75	4,55	4,95	3,18	3,03	3,33
10,0	9,70	10,30	5,0	4,80	5,20	4,0	3,85	4,15
10,0	9,70	10,30	5,0	4,80	5,20	5,0	4,85	5,15
10,0	9,70	10,30	6,0	5,80	6,20	4,0	3,85	4,15
12,0	11,60	12,40	6,0	5,75	6,25	4,0	3,85	4,15
12,7	12,30	13,10	7,1	6,85	7,35	5,1	4,90	5,30
12,7	12,30	13,10	7,92	7,67	8,17	6,35	6,15	6,55
13,2	12,80	13,60	7,4	7,15	7,65	4,0	3,85	4,15
13,6	13,20	14,00	7,0	6,75	7,25	3,5	3,35	3,65
14,0	13,50	14,50	8,0	7,70	8,30	7,0	6,80	7,20
14,0	13,50	14,50	9,0	8,70	9,30	5,0	4,80	5,20

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