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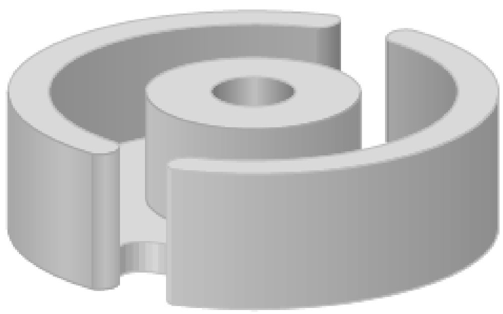

Standard Specifications for

Ferrite Pot Style Cores

The International Magnetics Association

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FOREWORD

This standard on ferrite pot cores was developed by the engineering committee of the Soft Ferrite Division of the Magnetic Materials Producers Association. Several International Electrotechnical Commission documented recommendations have been included in this standard. The specific IEC publications that have been used in total or in part are:

IEC 133	Dimensions for pot cores of ferromagnetic oxides and associated parts.
IEC 133A	First supplement to Publication 133.
IEC 133B	Second supplement to Publication 133, Amendment #1
IEC 205	Calculation of effective parameters of magnetic piece parts.

ISO Recommendations R370 was used in the conversion of toleranced dimensions from inches into millimeters and vice versa.

This pot core standard is only an advisory document and its use or adaptation is entirely voluntary.

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Standard Specifications for
FERRITE POT CORES

1.0 SCOPE

This standard defines a series of ferrite pot cores, and their dimensions and tolerances. This range of ferrite pot cores is in accordance with the international standard, IEC Publication 133, “Dimensions for pot cores made of ferromagnetic oxides,” and supplements IEC 133A and 133B.

To further enhance the use of standard ferrite pot cores, bobbin design information and a visual inspection specification are included in this standa

2.0 POT CORE DIMENSIONS AND TOLERANCES

The physical dimensions of the standard series of pot cores shall be in accordance with Table 1. For dimensional details see Figure 1.

SIZE	TOL	D1		D2		D3		D4		H1		H2		B (2 SLOT)		B (4 SLOT)		A		R	
(mm)		mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in			mm	in
9x5	MIN.	9	0.354	7.5	0.295	3.7	0.1457	2	0.0787	5.1	0.201	3.6	0.1417	1.6	0.063	—	—	6	0.24	—	—
	MAX.	9.3	0.366	7.75	0.305	3.9	0.1535	2.2	0.0866	5.4	0.213	3.9	0.1535	2.4	0.094	—	—	7.2	0.28	0.3	0.01
11X7	MIN.	10.9	0.429	9	0.354	4.5	0.1772	2	0.0787	6.3	0.248	4.4	0.173	1.6	0.063	—	—	6.5	0.26	—	—
	MAX.	11.3	0.445	9.4	0.37	4.7	0.185	2.2	0.0866	6.6	0.26	4.7	0.185	2.6	0.102	—	—	8	0.32	0.3	0.01
14X8	MIN.	13.8	0.543	11.6	0.457	5.8	0.2283	3	0.118	8.2	0.323	5.6	0.2205	2	0.079	1.6	0.063	8.7	0.34	—	—
	MAX.	14.3	0.563	12	0.472	6	0.2362	3.2	0.126	8.5	0.335	6	2362	4.1	0.161	2	0.079	10	0.41	0.3	0.01
18X11	MIN.	17.6	0.693	14.9	0.587	7.3	0.2874	3	0.118	10.4	0.409	7.2	0.2835	2	0.079	2	0.079	11	0.45	—	—
	MAX.	18.4	0.724	15.4	0.606	7.6	0.2992	3.2	0.126	10.7	0.421	7.6	0.2992	4.4	0.173	3	0.118	14	0.55	0.3	0.01
22X1	MIN.	21.2	0.835	17.9	0.705	9.1	0.3583	4.4	0.173	13.2	0.52	9.2	0.362	2.5	0.098	2.5	0.098	13	0.52	—	—
	MAX.	22	0.866	18.5	0.728	9.4	0.3701	4.7	0.185	13.6	0.535	9.6	0.378	4.4	0.173	3.5	0.138	17	0.65	0.4	0.014
26X16	NIH.	25	0.984	21.2	0.835	11.1	0.437	5.4	0.2126	15.9	0.626	11	0.433	2.5	0.098	2.5	0.098	17	0.67	—	—
	MAX.	26	1.024	22	0.866	11.5	0.453	5.7	0.2244	16.3	0.642	11.4	0.449	4.4	0.173	3.5	0.138	20	0.79	0.4	0.014
30X19	NIH.	29.5	1.161	25	0.984	13.1	0.5157	5.4	0.2126	18.6	0.732	13	0.5118	3	0.118	3	0.118	20	0.79	—	—
	MAX.	30.5	1.201	25.8	1.016	13.5	0.5315	5.7	0.2244	19	0.748	13.4	0.5276	5.3	0.209	4	0.157	23	0.91	0.4	0.014
36X22	MIN.	35	1.378	29.9	1.177	15.6	0.614	5.4	0.2126	21.4	0.843	14.6	0.5748	3.5	0.138	3.5	0.138	24	0.95	—	—
	MAX.	36.2	1.425	30.9	1.217	16.2	0.638	5.7	0.2244	22	0.866	15	0.5906	5.6	0.22	4.5	0.177	27	1.07	0.4	0.014
42X29	MIN.	41.7	1.642	35.6	1.402	17.1	0.673	5.4	0.2126	29.3	1.154	20.3	0.799	4	0.16	-	-	-	-	-	-
	MAX.	43.1	1.697	37	1.457	17.7	0.697	5.7	0.2244	29.9	1.177	20.7	0.815	-	-	-	-	-	-	0.4	0.016

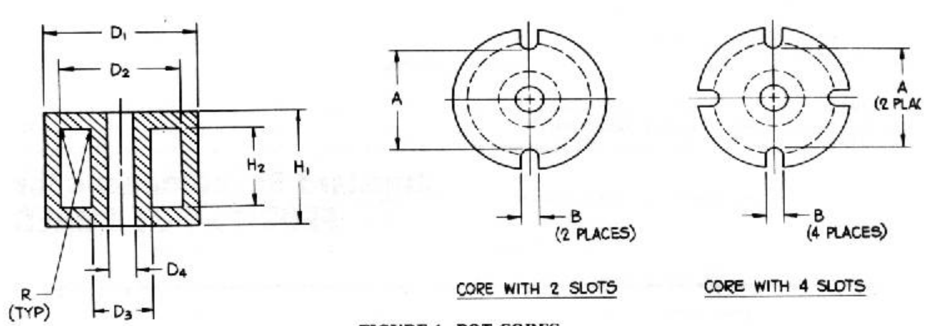

FIGURE 1 POT CORES

3.0 BOBBIN DIMENSIONS

3.1 After the bobbin has been wound, the wound bobbin shall be within the outline dimensions shown in Table 2 and Figure 2.

SIZE	TOL.	d_2		d_3		h_2		R_1	
		mm	in	mm	in	mm	in	mm	in
9x5	MIN.	—	—	4	0.157	—	—	0.25	0.01
	MAX.	7.4	0.291	—	—	3.6	0.142	—	—
11x7	MIN.	—	—	4.8	0.189	—	—	0.25	0.01
	MAX.	8.9	0.35	—	—	4.4	0.173	—	—
14x8	MIN.	—	—	6.1	0.24	—	—	0.25	0.01
	MAX.	11.5	0.453	—	—	5.6	0.22	—	—
18x11	MIN.	—	—	7.7	0.303	—	—	0.25	0.01
	MAX.	14.8	0.583	—	—	7.2	0.283	—	—
22x13	MIN.	—	—	9.5	0.374	—	—	0.35	0.014
	MAX.	17.8	0.701	—	—	9.2	0.362	—	—
26x16	MIN.	—	—	11.6	0.457	—	—	0.35	0.014
	MAX.	21.1	0.831	—	—	11	0.433	—	—
30x19	MIN.	—	—	13.6	0.535	—	—	0.35	0.014
	MAX.	24.9	0.98	—	—	13	0.512	—	—
36x22	MIN.	—	—	16.3	0.642	—	—	0.35	0.014
	MAX.	29.8	1.173	—	—	14.6	0.575	—	—
42x29	MIN.	—	—	17.8	0.701	—	—	0.4	0.016
	MAX.	35.5	1.398	—	—	20.3	0.799	—	—

3.2 The dimensions of the bobbins that will fit the standard range of pot cores are shown in Figure 3 and Table 3. Printed circuit version of some of these bobbins are listed n Table 4 and detailed in Figures 4 and 5.

											EXAMPLE OF STANDARD							
SIZE (mm)	No. of Sect.	TOL.	A1		A2		A3		B		D1		D2		D3		H	
			mm^2	in^2	mm^2	in^2	mm^2	in^2	mm	in	mm	in	mm	in	mm	in	mm	in
9x5	1	MIN.	3.17	0.00492					1.6	0.060	7.23	0.285	4.67	0.184	4.01	0.158	3.40	0.134
		MAX	4.78	-					-	-	7.34	0.289	4.78	0.188	4.11	0.162	3.50	1.38
11x7	1	MIN.	4.78	0.00742					1.6	0.060	8.69	0.342	5.59	0.220	4.81	0.189	4.09	0.161
		MAX	-	-					-	-	8.89	0.350	5.69	0.224	4.91	0.193	4.19	0.165
	2	MIN.			2.16	0.0335												
		MAX			-	-												
	3	MIN.					1.26	0.00195										
		MAX					-	-										

14x8	1	MIN. MAX	8.81 -	0.0136 -					1.6 -	0.060 -	11.3 11.5	0.444 0.454	6.98 7.24	0.275 0.285	5.97 6.10	0.235 0.240	5.28 5.49	0.208 0.216
	2	MIN. MAX			3.92 -	0.00608 -												
	3	MIN. MAX					2.35 -	0.00365 -										
18x11	1	MIN. MAX	17.1 -	0.0265 -					1.8 -	0.070 -	14.6 14.8	0.574 0.584	8.59 8.84	0.338 0.348	7.700 7.82	0.303 0.308	6.88 7.09	0.271 0.279
	2	MIN. MAX			7.61 -	0.0118 -												
	3	MIN. MAX					4.66 -	0.00722 -										
22x13	1	MIN. MAX	26.2 -	0.0406 -					1.8 -	0.070 -	17.6 17.8	0.694 0.702	10.3 10.6	0.407 0.417	9.5 9.75	0.374 0.384	8.89 9.09	0.350 0.358
	2	MIN. MAX			12.5 -	0.0194 -												
	3	MIN. MAX					7.87 -	0.0122 -										
26x16	1	MIN. MAX	37.5 -	0.0582 -					1.8 -	0.070 -	20.9 21.1	0.824 0.832	12.4 12.7	0.489 0.499	11.6 11.7	0.457 0.462	10.7 10.9	0.421 0.429
	2	MIN. MAX			17.3 -	0.0269 -												
	3	MIN. MAX					10.8 -	0.0168 -										
30x19	1	MIN. MAX	53.7 -	0.0834 -					1.8 -	0.070 -	24.7 24.9	0.972 0.980	14.6 14.9	0.575 0.585	13.6 13.7	0.535 0.540	12.7 12.9	0.500 0.508
	2	MIN. MAX			25.1 -	0.0389 -												
	3	MIN. MAX					15.9 -	0.0246 -										
36x22	1	MIN. MAX	71.3 -	0.110 -					2.8 -	0.110 -	29.5 29.8	1.160 1.172	17.9 18.2	0.705 0.715	16.4 16.6	0.645 0.653	14.2 14.4	0.560 0.568
	2	MIN. MAX			31.9 -	0.0494 -												
	3	MIN. MAX					20.0 -	0.0310 -										
42x48	1	MIN. MAX	136 -	0.211 -					2.8 -	0.110 -	35.2 35.4	1.386 1.394	19.5 19.7	0.768 0.776	18.0 18.2	0.709 0.717	19.6 19.8	0.772 0.780
	2	MIN. MAX			55.6 -	0.0862 -												

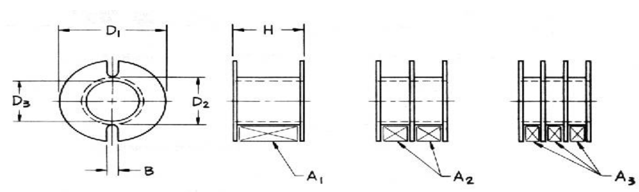

FIGURE 3 BOBBIN

PRINTED CIRCUIT BOBBINS

SIZE (mm)	TOL	P		S_1		S_2		FIG.
		mm		mm	in	mm	in	
14x8	MIN. MAX.	4.62 4.88	.182 .192	3.45 3.66	.136 .144	16.13 16.38	.635 .645	5
18x11	MIN. MAX.	4.57 4.95	.180 .195	3.43 3.68	.135 .145	21.21 21.72	.835 .855	4

22x13	MIN. MAX.	4.44 4.95	.175 .195	3.43 3.68	.135 .145	24.54 25.42	.966 1.001	4
26x16	MIN. MAX.	4.62 4.82	.182 .192	3.45 3.71	.136 .146	28.07 28.88	1.105 1.137	4

For minimum winding areas for the different bobbin sizes and design configurations see Table 3.

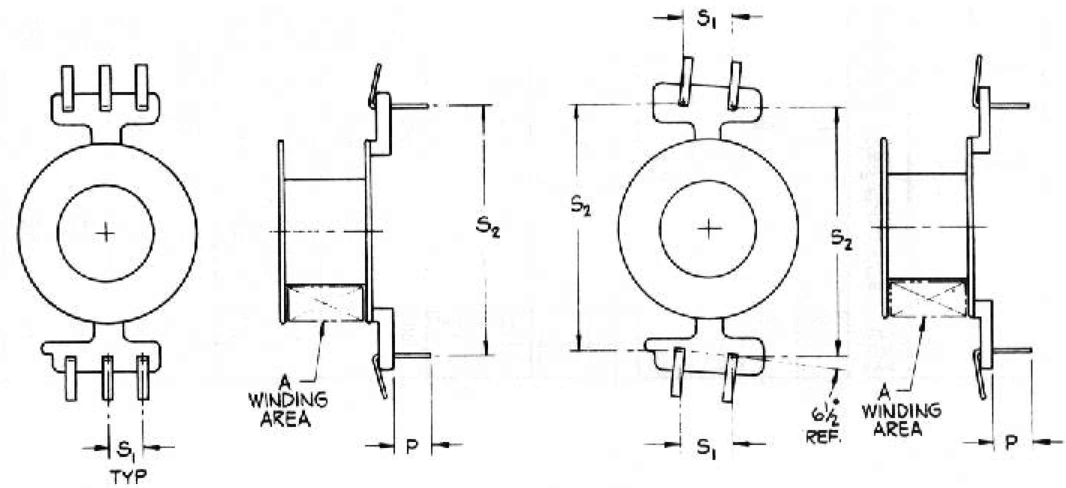

FIGURE 4 PRINTED CIRCUIT BOBBINS FIGURE 5

4.0 CALCULATION OF DIMENSIONAL PARAMETERS OF POT CORES

The method used here is recommended for the calculation of the dimensional parameters of pot cores and is in accordance with IEC Publication 205, "Calculation of Effective Parameters of Magnetic Piece Parts."

4.1 For this method of calculating the dimensional parameters of pot cores, the pot core set is substituted by an ideal toroidal core such that a coil wound on that toroid would give exactly the same electrical performance as a coil with same number of turns placed on the pot core set.

4.2 The dimensional parameters of that substitute toroid. are called effective parameters. These are indicated by the suffix "e" added to the symbol.

Magnetic path length ℓ_e mm

Cross-sectional area A_e mm^2

Core volume V_e mm^3

4.3 For the purpose of the calculation of the dimensional parameters, the closed magnetic circuit of a pot core set is divi into five sections. For each section the area, flux path length and the core constants C1 and C_2 are determined. See I 6.

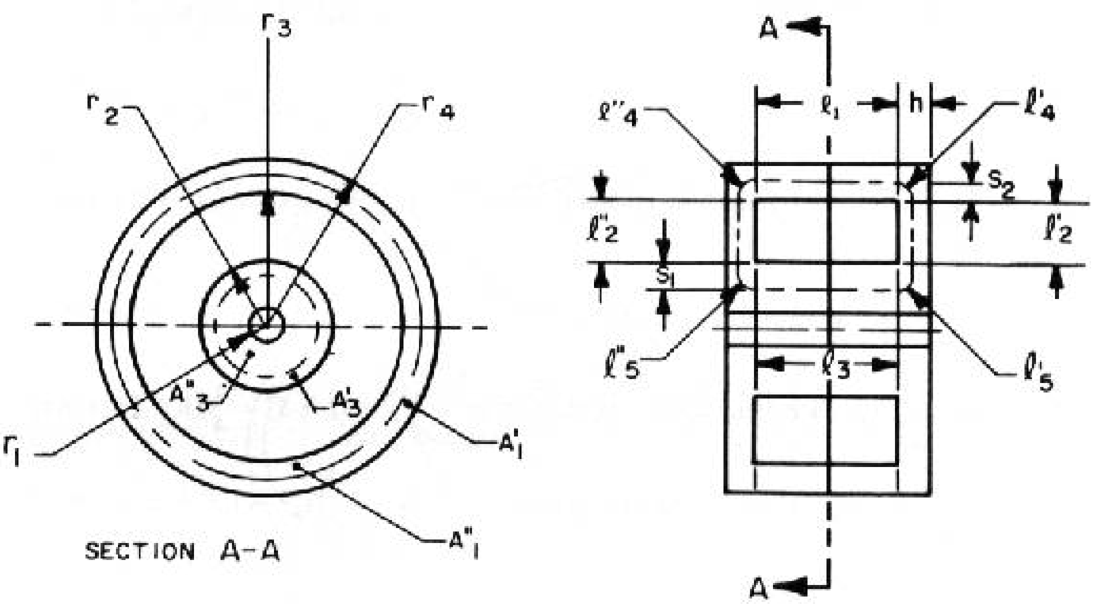

FIGURE 6 POT CORE SET DIVIDED INTO 5 SECTIONS

$$\mathbf{C_1} = \ell/A \ mm^{-1} \text{ and} C_2 = \ell/A^2 \ mm\text{-}1 \ mm^{-3}$$

The core constants for the total magnetic circuit of the pot core set are:

$$\mathbf{C_1} = \Sigma\ \ell/A \ mm^{-1} \text{ and } C_2 = \Sigma\ \ \ell/A^2 \ mm\text{-}1 \ mm^{-3}$$

From these core constants the effective dimensional pot core parameters can be calculated.

Magnetic path length $\ell_e = \mathbf{C_1}^2 / C_2$ mm

Cross-sectional area $A_e = \mathbf{C_1} / C_2$ mm^2

Core volume $V_e = \ell_e A_e = \mathbf{C_1}^3 / C_2^2$ mm^3

4.4 For each of the five sections of the magnetic circuit of a pot core set, the magnetic path length and cross-sectional area has to be determined:

Area of centerpost, $A_3 = A'_3 + A''_3$

The condition to obtain A'3 A"3 is: $S_1 = r_2 - \sqrt{\dfrac{r_2^2 + r_1^2}{2}}$

Area of outer ring. $A_1 = A'_1 + A''_1$

The condition to obtain A'1 A"1 is: $S_2 = \sqrt{\ r_2^2 + r_1^2}$

Cross sectional area of centerpost. $A_1 = \Pi (r_2 - r_1)(r_2+r_1)\ mm^2$

Cross sectional area for outer ring, $A_1 = \Pi (r_4 - r_3)(r_4+r_3)\ mm^2$

ℓ/A for two plates. $\ell_2/A_2 = 1/\Pi h\ 1n\ r_3/r_2 = .733/h \log r_3/r_2\ mm^{-1}\ \ell_2/A_2$

for two plates, $\ell_2/A_2^2 = 1/2\Pi^2 h^2\ x\ r_3 - r_2/r_3 r_2 = .733/mm^{-3}$

Mean flux path length at corners. $\ell_4 = \ell'_4 + \ell''_4 = \Pi/4\ (h + 2S_2)\ mm$

Cross sectional area associated with ℓ_4 $A_4 = \Pi/4^2\ (r_4^2 - r_3^2 + 2\ r_3 h)$

Mean flux path length at corners, $\ell_5 = \ell'_5 + \ell''_5 = \Pi/4\ (h + 2S_1)\ mm$

Cross sectional area associated with ℓ_5, $A_4 = \Pi/2\ (r_2^2 - r_1^2 + 2\ r_2 h)\ mm^2$

4.5 The above calculations ignore the effects of wire slots corrections:

From A_1 subtract: $ng\ (r_4 - r_3)$

Multiply ℓ_2/A_2 by: $[\ 1/\ 1- ng/2\ \Pi\ r_3\ ]$

Multiply ℓ_2/A_2^2 by: $[\ 1/\ (1- ng/2\ \Pi\ r_3)^2]$

Multiply A_4 by: $[\ 1- ng/\ \Pi\ (r_4 - r_3)$

n = number of wire slots

g = slot width

5.0 SURFACE CONDITIONS AND APPEARANCE OF POT CORES

5.1 **Cleanliness**

All surfaces of the pot core should be free of dirt or any other foreign matter. (Any stains, discolorations or surface crazings are allowed if they do not interfere with the performance of the pot core.)

5.2 **Visual Appearance of Pot Cores**

5.2.1 Mating Surfaces (See Figure 7)

For the purpose of this visual specification the mating surfaces do not include the areas adjacent to the wire slots nor the centerpost if it is gapped. These areas will be considered separately in 5.2.2 and 5.2.4.

5.2. 1. I Chips (See Figure 7)

Chips penetrating from the edges onto the mating surface area shall not exceed 50% of the width of the surface containing the defect. The total number of chips acceptable for the size stated above and located on the outer wall (OW) surfaces shall not exceed:

4 – Core size 1811 and smaller, and

6 – Core size 2213 and larger.

The total number of chips acceptable for the size stated above on the centerpost surface(l W) shall not exceed 2 for all pot core sizes.

A ragged edge or a series of small chips, less than 25% of the width, clustered or strung out together on edges is allowable for 20% of the circumference of the centerpost. One series of chips on each half outer wall and one series of chips on the centerpost is allowed.

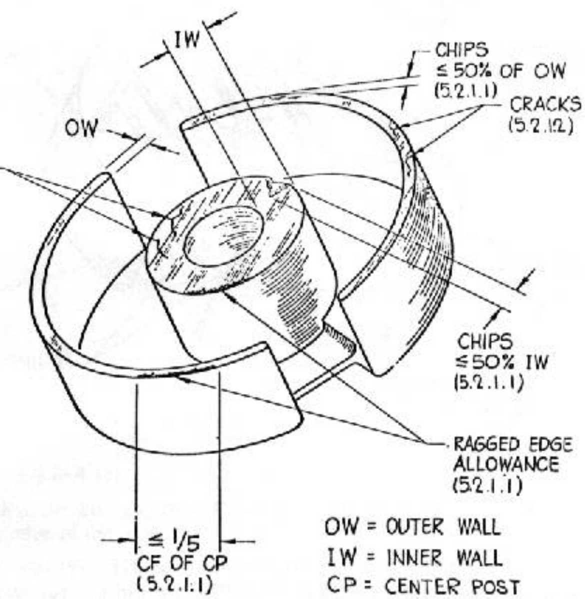

FIGURE 7

5.2.1.2 Cracks (See Figure 7)

Cracks on the outer wall surface that are less than 50% of the width of the outer wall are allowed. Sum total of crack lengths is not to exceed the width of the outer wall.

Cracks on the centerpost surface that are less than 50% of the width of the inner wall are allowed. Sum total of crack lengths is not to exceed the width of the inner wall.

5.2.2 Wire Slot and Wire Way Areas (See Figures 8, 9 and II)

5.2.2.1 Flashings (See Figure 8)

There shall be no flashings extending from the core into the wire slot.

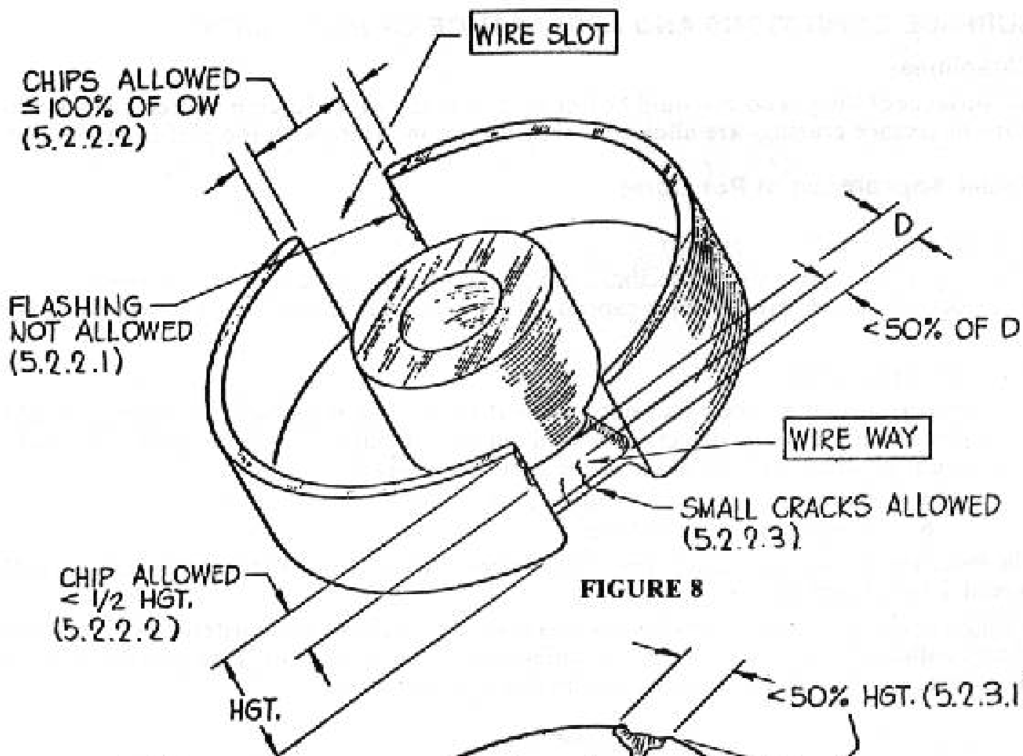

FIGURE 8

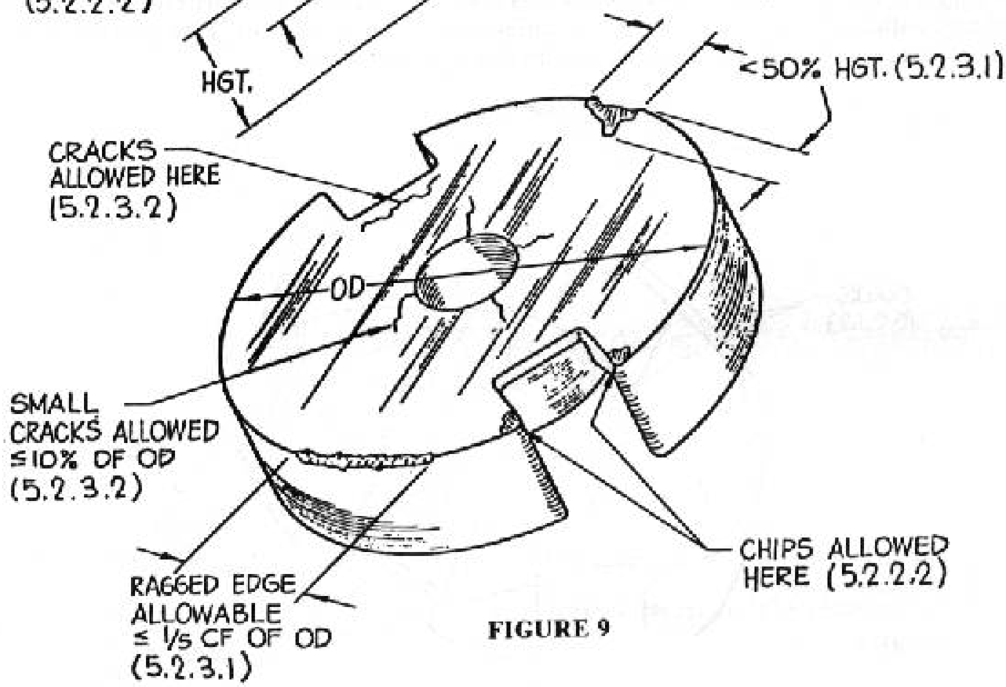

FIGURE 9

5.2.2.2 Chips (See Figures 8 and 9)

From the mating surface side (Fig. 8), chips 100% across width of outer wall and same in length along the mating surface are acceptable.

From the back surface (Fig. 9), chips 100% across width of the outer wall and same in length along the back surface are acceptable.

Chips from the mating surface down the edge of the wire slot and from the back surface down the edge of the wire slot with a length of less than 50% of the core height are acceptable. (Fig. 8)

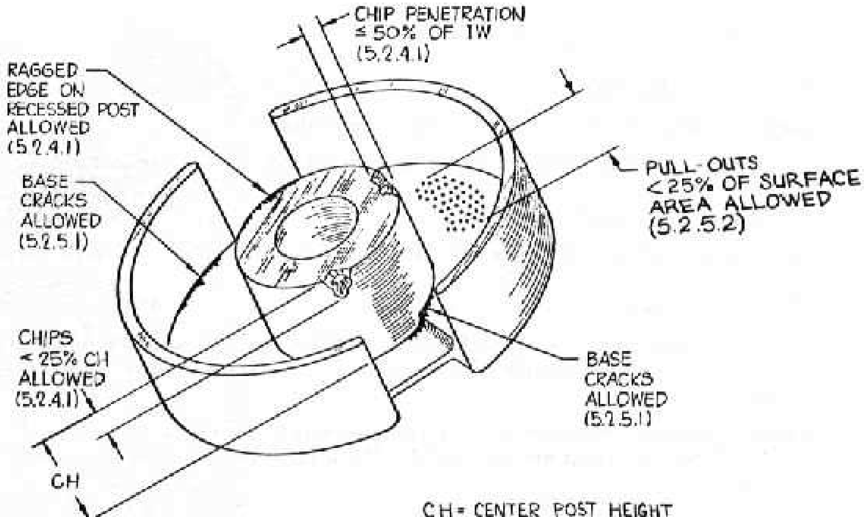

FIGURE 10

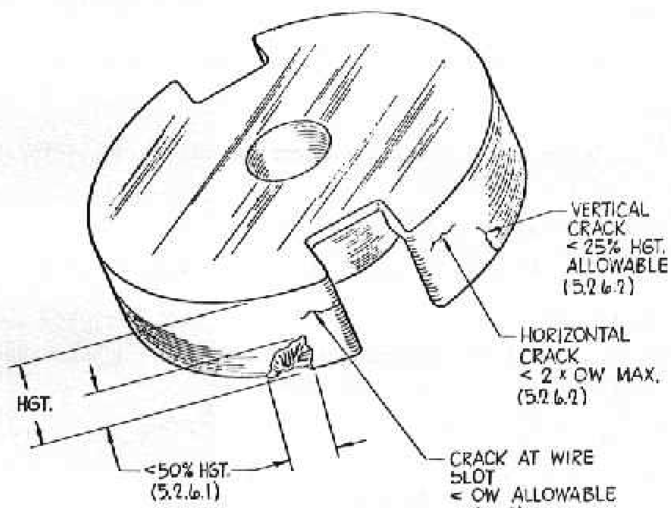

FIGURE 11

5.2.2.3 Cracks (See Figures 8 and 11)

Cracks at the edge of the wire way (Fig. 8) going into the back wall, with a length less than half the distance from the edge of the wire way to the centerpost, are acceptable.

Cracks at the wire slot (Fig. 11) less in length than the width of the outer wall are allowed. Total number of cracks acceptable per above shall not exceed 4 per core.

5.2.3 *Back Surface* (See Figure 9)

5.2.3.1 Chips (See Figure 9)

The maximum dimension of a chip on the back surface of a core should be less than 50% of the height of the core. The total number of chips, acceptable to the above, shall not exceed 4.

A ragged edge or a series of small chips, less than 25% of the width of the outer wall, clustered or strung out together on the edge is allowable for 20% of the circumference of the pot core outer wall.

5.2.3.2 Cracks (See Figure 9)

Surface cracks parallel to the wire way are permissible.

Surface radial cracks from the center hole, up to 10% of the core diameter in length, are allowed.

5.2.4 Centerpost (See Figure 10)

The following applies for those pot cores that have a recessed centerpost

5.2.4.1 Chips (See Figure 10)

A series of small chips, less than 25% of the width of the inner wall, resulting in a ragged edge around the centerpost edge, is permissible. No chip on the surface shall be greater than 50% of the width of the wall.

Chips on the outer diameter of the centerpost with a maximum dimension of less than 25% of the height of the centerpost are permissible. The total number of chips acceptable for the size stated above is 3.

5.2.5 Coil Space (See Figure 10)

5.2.5.1 Cracks (See Figure 10)

Cracks at the base of the centerpost and the base of the outer wall are permissible.

5.2.5.2 Pull-outs (See Figure 10)

Pull-outs in the bottom surface of the pot core that are less than 25% of the bottom area are acceptable.

5.2.6 Exterior Outer Wall Surfaces (See Figure 11)

The areas adjacent to the wire slot are not included and are covered in 5.2.2.

5.2.6.1 Chips (See Figure 11)

Chips with a maximum dimension of less than 50% of the core height are allowed. The total number of chips acceptable to the above shall not exceed 5.

5.2.6.2 Cracks (See Figure 11)

Vertical cracks that are less than 25% of the core height in length are acceptable. The total number of vertical cracks acceptable to the above shall not exceed 2.

Horizontal cracks that are less than twice the outer wall thickness in length are acceptable. The total number of horizontal cracks acceptable to the above shall not exceed 2.