Chapter 3

Magnetic Cores

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Introduction

The key ingredient in a magnetic device is the magnetic field (flux) created when current is passed through a coiled wire. The ability to control (channel, predict, conduct), the magnetic field (flux) is critical to controlling the operation of the magnetic device.

The ability of a material to conduct magnetic flux is defined as permeability. A vacuum is defined as having a permeability of 1.0 and the permeability of all other materials is measured against this baseline. Most materials such as air, paper, and wood are poor conductors of magnetic flux, in that they have low permeability. If wire is wound on a dowel, it exhibits a magnetic field exactly, as shown in Figure 3-1. There are a few materials, such as iron, nickel, cobalt, and their alloys that have high permeabilities, sometimes ranging into the hundreds of thousands. These materials and their alloys are used as the base materials for all core materials.

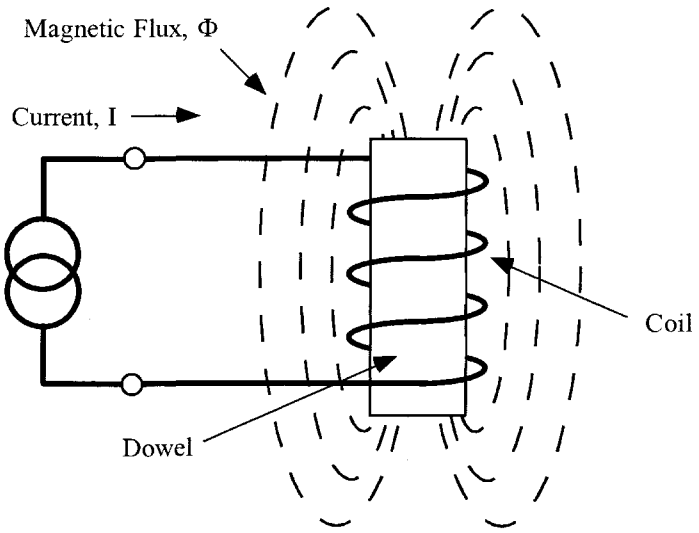


Figure 3-1. Air Core with an Intensified Magnetic Field.

The main purpose of the core is to contain the magnetic flux and create a well-defined, predictable path for the flux. This flux path, and the mean distance covered by the flux within the magnetic material, is defined as the Magnetic Path Length (MPL) (see Figure 3-2). The Magnetic Path Length and permeability are vital keys in predicting the operation characteristic of a magnetic device. Selection of a core material and geometry are usually based on a compromise between conflicting requirements, such as size, weight, temperature rise, flux density, core loss, and operating frequency.

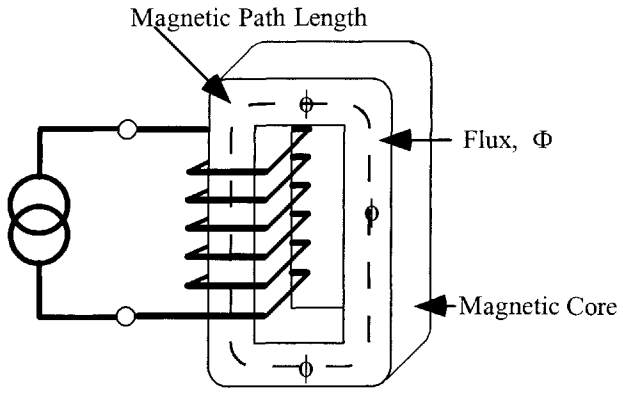


Figure 3-2. Magnetic Core Confines the Magnetic Field.

Core Type and Shell Type Construction

There are two types of construction for magnetic cores, core type and shell type. The shell type construction is shown in Figure 3-3, and the core type construction is shown in Figure 3-4. In the shell type, shown in Figure 3-3, the core surrounds the coil. Here the magnetic fields are around the outside of the coil. The advantage of this configuration is that it requires only one coil. In the core type of construction, shown in Figure 3-4, the coils are outside of the core. A good example of this is a toroid, where the coil is wound on the outside of a core.

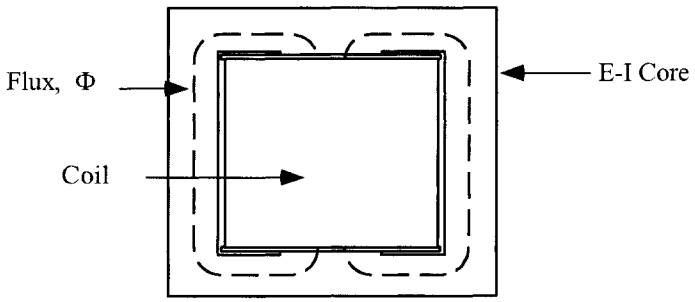


Figure 3-3. Shell Type Construction: the Core Surrounds the Coil.

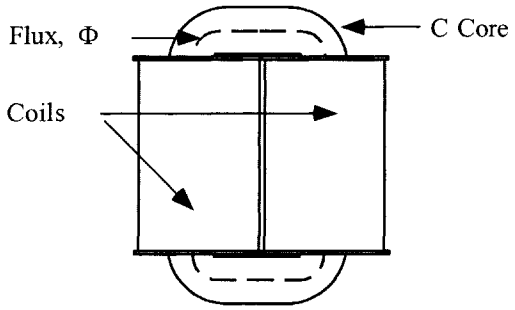


Figure 3-4. Core Type Construction the Coil Surrounds the Core.

Types of Core Materials

Magnetic cores are made of three basic materials. The first is bulk metal, the second is powdered materials, and the third is ferrite material.

The bulk metals are processed from the furnace into ingots. Then, the material is put into a process of hot and cold rolling. The rolling process produces a sheet of material with a thickness ranging from 0.004 to 0.031 inches that can be punched into laminations. It can be further rolled to thicknesses ranging from 0.002 to 0.000125 inches, then slit and wound into tape cores, such as C cores, E cores and toroids.

The powder cores, such as powder molypermalloy and powdered iron materials, are die-pressed into toroids, EE cores and slugs. Powder core processing starts at the ingot, then goes through various steps of grinding until the powder is the right consistency for the required performance. Normally, powder cores are not machined after processing.

Ferrites are ceramic materials of iron oxide, alloyed with oxides or carbonate of manganese, zinc, nickel, magnesium, or cobalt. Alloys are selected and mixed, based on the required permeability of the core. Then, these mixtures are molded into the desired shape with pressure of approximately 150-200 tons per square inch and fired at temperatures above 2000 degrees F. After the parts are made, they are usually tumbled to remove burrs and sharp edges, which are characteristic of this process. Ferrites can be machined to almost any shape to meet the engineer's needs.

Eddy Currents and Insulation

Transformers, operating at moderate frequency, require the reduction of eddy current losses in the magnetic material. To reduce the eddy current losses to a reasonable value requires electrical steel to have adequate resistivity. Also, it needs to be rolled to a specific thickness, and it needs effective electrical insulation or coating of the magnetic material.

If an alternating voltage is applied to the primary winding, as shown in Figure 3-5, it will induce an alternating flux in the core. The alternating flux will, in turn, induce a voltage on the secondary winding. This alternating flux also induces a small alternating voltage in the core material. These voltages produce currents called eddy currents, which are proportional to the voltage. The magnitude of these eddy currents is also limited by the resistivity of the material. The alternating flux is proportional to the applied voltage. Doubling the applied voltage will double the eddy currents. This will raise the core loss by a factor of four. Eddy currents not only flow in the lamination itself, but could flow within the core as a unit, if the lamination is not properly stamped, and if the lamination is not adequately insulated, as shown in Figure 3-6.

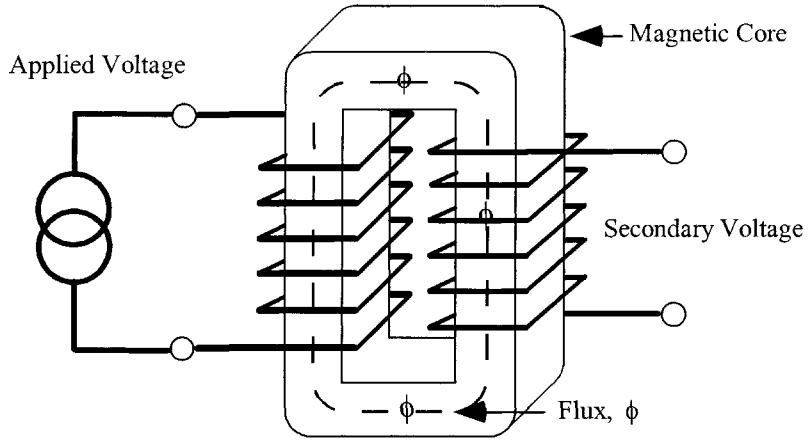


Figure 3-5. Applied Alternating Voltage Induces an Alternating Flux.

There are two eddy currents, as shown in Figure 3-6, i_a and i_b. The intralaminar eddy current, i_a, is governed by flux, per lamination and resistance of the lamination. It is, therefore, dependent on lamination width, thickness, and volume resistivity.

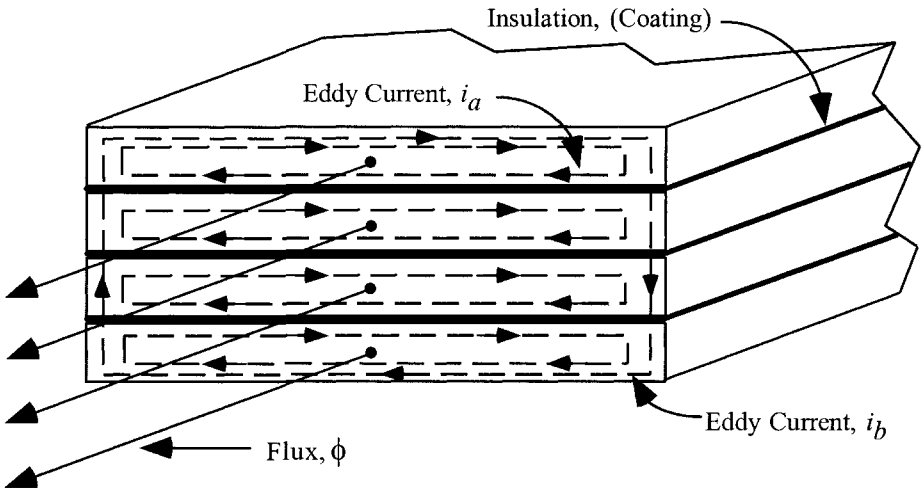


Figure 3-6. Insulation is Required Between Laminations to Reduce Eddy Currents.

The interlaminar eddy current, i_b, is governed by total flux and resistance of the core stack. It is primarily dependent upon stack width and height, the number of laminations, and the surface insulation resistance, per lamination.

The magnetic materials used for tape cores and laminations are coated with an insulating material. The insulating coating is applied to reduce eddy currents. The American Iron and Steel Institute (AISI) has set up insulation standards for transformer steels used in different applications. High permeability, nickel-iron cores are very strain sensitive. Manufacturers of these cores normally have their own proprietary, insulating material.

Laminations

Laminations are available in scores of different shapes and sizes. The punch press technology for fabricating laminations has been well-developed. Most lamination sizes have been around forever. The most commonly used laminations are the EI, EE, FF, UI, LL, and the DU, as shown in Figure 3-7. The laminations differ from each other by the location of the cut in the magnetic path length. This cut introduces an air gap, which results in the loss of permeability. To minimize the resulting air gap, the laminations are generally stacked in such a way the air gaps in each layer are staggered.

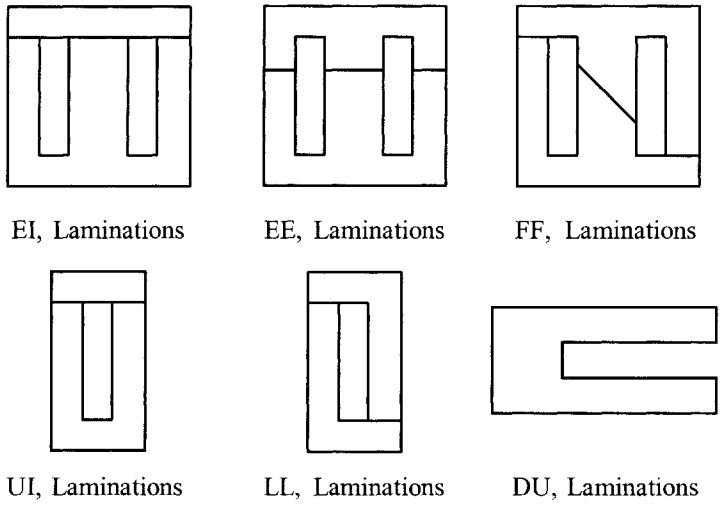


Figure 3-7. Commonly Used, Lamination Shapes.

There are bobbins and brackets for almost all standard stacking dimensions. Most of the EI lamination is the scrapless. The name, scrapless, is derived from shapes that are punched with minimum waste, as shown in Figure 3-8.

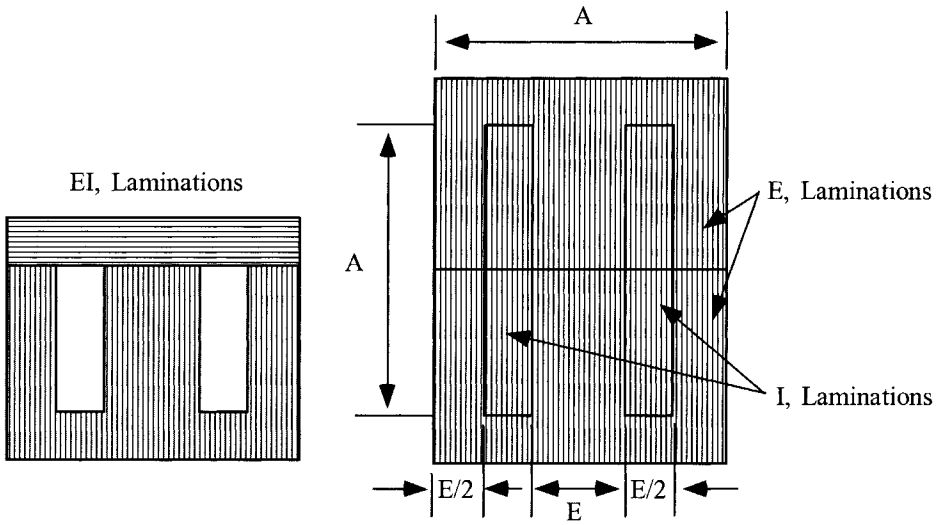


Figure 3-8. Typical, Scrapless EI Lamination.

Annealing and Stress-Relief

One of the most important parameters in transformer steels is permeability. Any stress or strain of the magnetic materials will have an impact on the permeability. The resulting stress could cause higher magnetizing current, or a lower inductance. When the transformer is being assembled (in the stacking process), and a lamination is bent (does not return to its original shape), that lamination has been stressed and should be replaced.

Some of the important magnetic properties are lost due to stress and strain after stamping, shearing and slitting. These properties that have been lost or seriously reduced can be restored to the magnetic materials by annealing. Basically, stress relief is accomplished by heating (annealing) the magnetic material to prescribed temperature, (depending on the material), followed by cooling to room temperature. The entire annealing process is a delicate operation. The annealing must be done under controlled conditions of time, temperature and the ambient atmosphere that will avoid, even minute, adverse changes in the chemistry of the steel.

Stacking Laminations and Polarity

The edges of the magnetic material that have been stamped, sheared, or slit, will have a burr, as shown in Figure 3-9. The quality of the equipment will keep the burr to a minimum. This burr now gives the lamination a polarity. When a transformer is being stacked, the lamination build is normally sized by dimensions, or it just fills the bobbin.

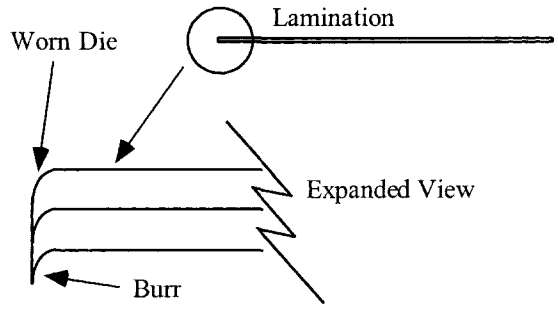


Figure 3-9. Expanded View, Showing Lamination Burr.

If the laminations are stacked correctly, all of the burred ends will be aligned. If the laminations are stacked randomly, such as the burr ends facing each other, then, the stacking factor would be affected. The stacking factor has a direct impact on the cross-section of the core. The end result would be less iron. This could lead to premature saturation, as an increase in the magnetizing current, or a loss of inductance.

There are several methods used in stacking transformer laminations. The most common technique used in stacking laminations is the alternate method. The alternate method is where one set of laminations, such as an E and an I, are assembled. Then, the laminations are reversed, as shown in Figure 3-10. This technique, used in stacking, provides the lowest air gap and the highest permeability. Another method for stacking

laminations is to interleave two-by-two, also shown in Figure 3-10. The second method of stacking would be in groups of two or more. This is done to cut assembly time. The loss in performance in stacking, other than one by one, is the increase in magnetizing current and a loss of permeability.

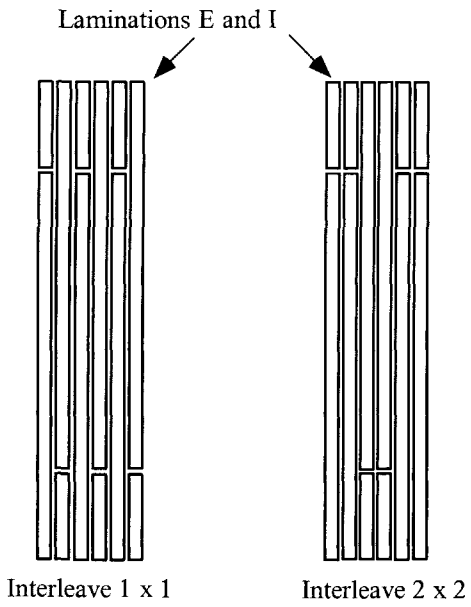


Figure 3-10. Methods for Stacking Laminations.

Flux Crowding

When laminations are stacked, as shown in Figure 3-11, there is flux crowding. This flux crowding is caused by the difference in spacing between the E, I, and the adjacent lamination. The adjacent lamination has a minimum air gap, which translates into a higher permeability.

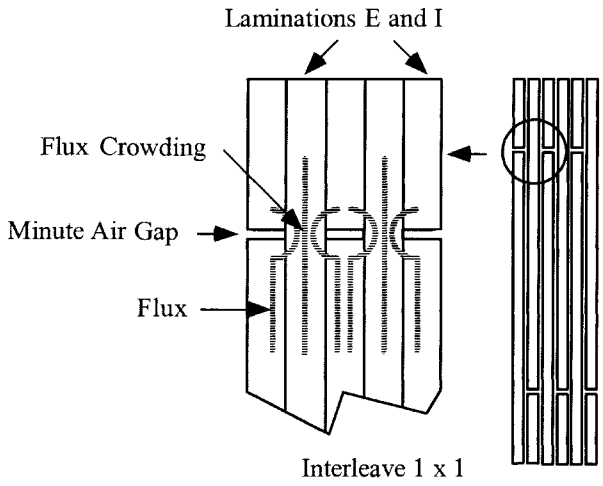


Figure 3-11. Flux Crowding, when Laminations are Interleaved.

Exciting Current

The flux will skirt the low permeability air gap and migrate into the adjacent lamination, causing flux crowding in that lamination. Eventually, this crowding will cause saturation in that portion of the lamination, and the excitation current will rise. After that portion of the lamination has saturated, the flux will migrate back to the lower permeability segment of the lamination from where it left. This effect can be easily viewed by observing the B-H loops at low and high flux densities, and comparing them with a toroidal core of the same material, with a minimum air gap, as shown in Figure 3-12. The B-H loop, along with the magnetizing current, I_m, of a toroidal core, is shown in Figure 3-12A. The toroidal core, with its inherit minimum air gap, will have almost a square of current. Using the same material in lamination form will exhibit a B-H loop, and a magnetizing current, I_m, similar to Figure 3-12B operating at low flux densities. Increasing the excitation will cause premature saturation of the lamination, as seen by the non-linear, exciting current, as shown in Figure 3-12C

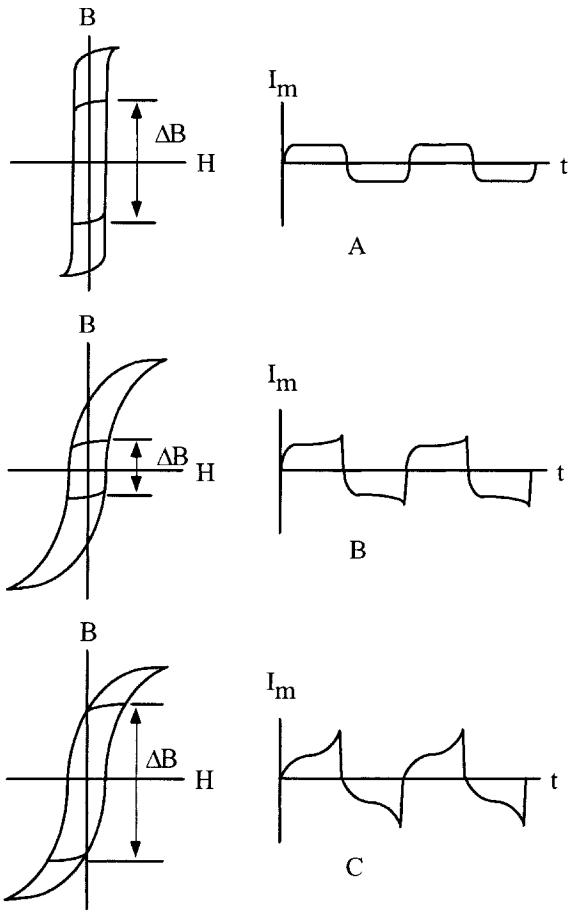


Figure 3-12. Comparing the Exciting Currents and Three B-H Loops.

Most finished transformers or inductors will have some sort of bracket, such as an L bracket, end bells, a channel bracket or maybe a bolt through the mounting holes to the chassis. When transformers are being assembled, there is a certain amount of attention that has to be used to get proper performance. The insulation material used to coat the lamination is normally very durable, but it can be scratched off and degrade the performance. When brackets are used in the transformer assembly, as shown in Figure 3-13, care must be taken on how the bolts and brackets are put together. The transformer assembly bolts, shown in Figure 3-13, should be the recommended size for the mounting hole and use all of the required hardware. This hardware should include the correct bolt size and length, and correct surface washer, lock washer and nut. Also, included in this hardware, should be fiber shoulder washers and proper sleeving to cover the bolt threads. If insulating hardware is not used, there is a good chance of a partial, shorted turn. The continuity for this partial turn can be created through the bolts and bracket, or the bolts, bracket, and the chassis. This partial shorted turn will downgrade the performance of the transformer.

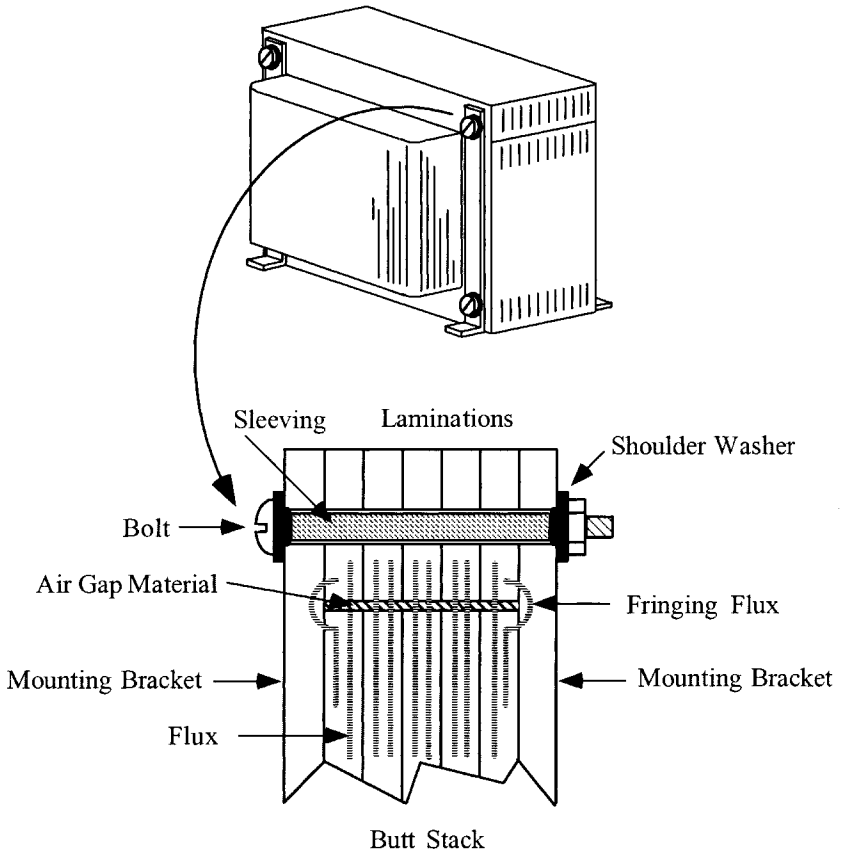


Figure 3-13. Lamination Mounting Hardware.

Tape Wound C, EE, and Toroidal Cores

Tape wound cores are constructed by winding around a mandrel, a magnetic material in the form of a preslit tape, as shown in Figure 3-14. This tape material comes in all of the iron alloys, plus the amorphous materials. The tape thickness varies from 0.0005 inch (0.0127 mm) to 0.012 inch (0.305 mm). The advantage of this type of construction is that the flux is parallel with the direction of rolling of the magnetic material. This provides the maximum utilization of flux with the minimum of magnetizing force. There are two disadvantages in this type of construction. When the core is cut in half, as shown in Figure 3-15, the mating surface has to be ground, lapped, and then, acid-etched. This is done to provide a smooth mating surface with the minimum of air gap and the maximum of permeability. The other disadvantage is when the cores are reassembled, the method used is normally done with a band and buckle, and this procedure requires a little skill to provide the right alignment and correct tension, as shown in Figure 3-16. The C cores are impregnated for strength, prior to being cut. The cut C core can be used in many configurations in the design of a magnetic component, as shown in Figure 3-17. The EE cores are constructed in the same way as C cores, but they have an additional overwind, as shown in Figure 3-18. The assembled three-phase transformer is shown in Figure 3-19.

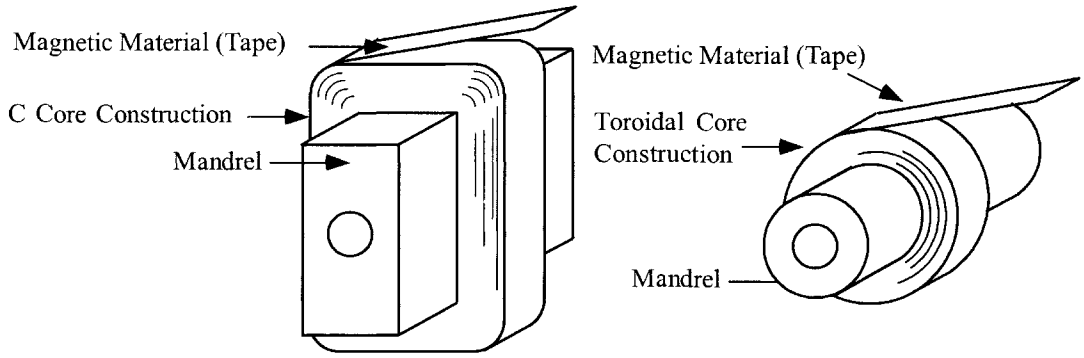


Figure 3-14. Tape Cores Being Wound on a Mandrel.

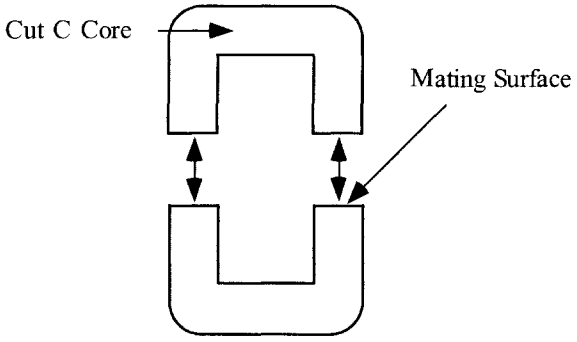


Figure 3-15. Two Halves of a Cut C Core.

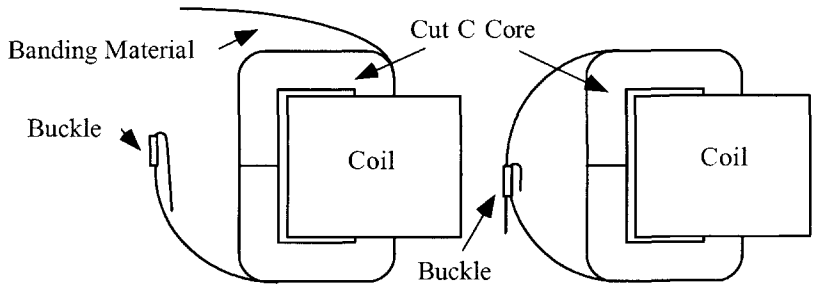


Figure 3-16. Banding the Cut C Core.

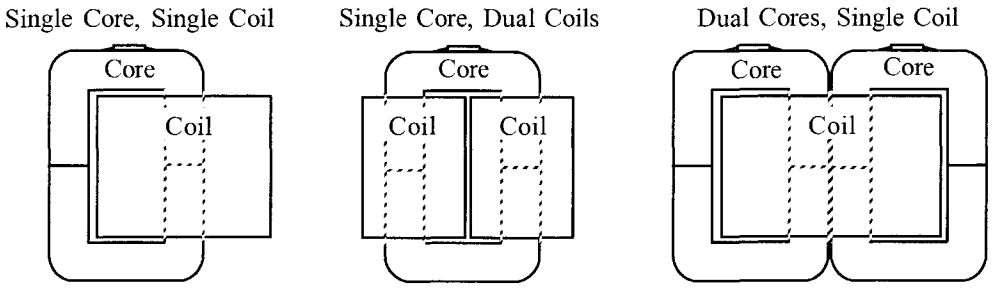


Figure 3-17. Three Different C Core Configurations.

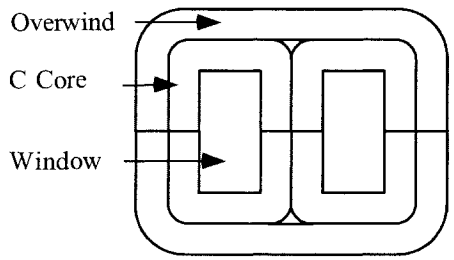


Figure 3-18. Three-Phase, Cut EE Core.

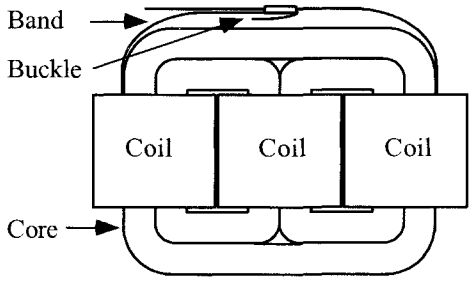


Figure 3-19. Typical, Assembled EE Cut Core.

Tape Toroidal Cores

Tape toroidal cores are constructed in the same way as tape C cores, by winding the magnetic material around a mandrel, in the form of a preslit tape. This tape material comes in all of the iron alloys, plus the amorphous materials. The tape thickness varies from 0.000125 inch (0.00318 mm) to 0.012 inch (0.305 mm). The tape toroid is normally offered in two configurations, cased and encapsulated, as shown in Figure 3-20. The cased toroid offers superior electrical properties and stress protection against winding. The encapsulated cores are used when not all of the fine magnetic properties are important to the design, such as in power transformers.

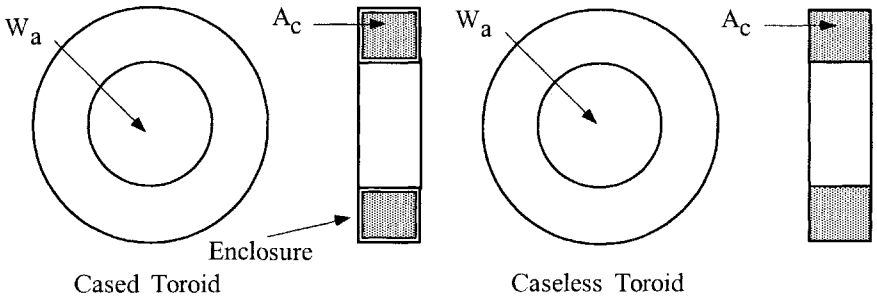


Figure 3-20. Outline of a Cased and a Caseless Toroidal Core.

Toroidal, Powder Core

Powder cores, as shown in Figure 3-21, are very unique. They give the engineer another tool to speed the initial design. Powder cores have a built-in air gap. They come in a variety of materials and are very stable with time and temperature. The cores are manufactured with good engineering aids. Manufacturers provide catalogs for their cores, listing not only the size, but also permeability and Millihenrys per 1000 turns. The data is presented to the engineer in such a way that it takes the minimum amount of time to have a design that will function.

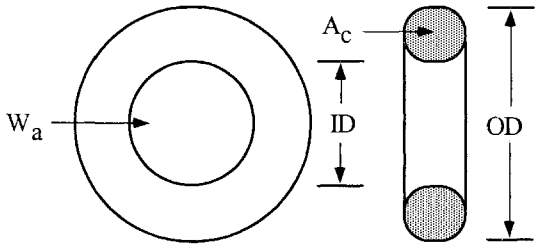


Figure 3-21. Outline of a Powder Toroidal Core.

Stacking Factors

The standard stacking factors for tape cores, wound cut cotes and laminations are shown in Table 3-1.

Table 3-1. Standard Stacking Factors.

Thickness	Tape Cores	Wound Cut Cores	Laminations		$(S.F.)^2$
mils			Butt Stack	Interleave 1x1	
0.125	0.250				0.062
0.250	0.375				0.141
0.500	0.500				0.250
1.000	0.750	0.830			0.562
2.000	0.850	0.890			0.722
4.000	0.900	0.900	0.900	0.800	0.810
6.000		0.900	0.900	0.850	0.810
12.000	0.940	0.950			0.884
14.000	0.940	0.950	0.950	0.900	0.902
18.000			0.950	0.900	0.810
25.000			0.950	0.920	0.846

Design and Dimensional Data for EI Laminations

Laminations are still one of the most widely-used cores in power conversion. The dimensional outline for EI laminations and an assembled transformer is shown in Figure 3-22. Dimensional data for EI laminations is given in Table 3-2; design data is given in Table 3-3.

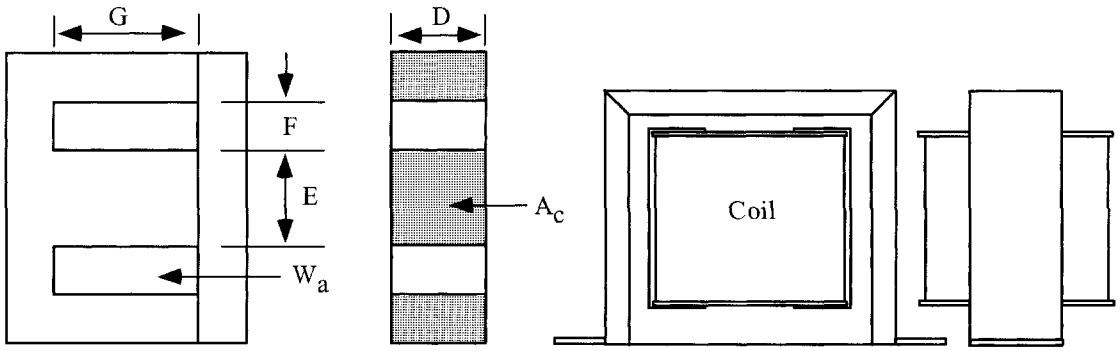


Figure 3-22. EI Lamination Outline.

Table 3-2. Dimensional Data for EI Laminations.

EI, Laminations, (Tempel) 14 mil									
Part No.	D cm	E cm	F cm	G cm	Part No.	D cm	E cm	F cm	G cm
EI-375	0.953	0.953	0.794	1.905	EI-112	2.857	2.857	1.429	4.286
EI-021	1.270	1.270	0.794	2.064	EI-125	3.175	3.175	1.588	4.763
EI-625	1.588	1.588	0.794	2.381	EI-138	3.493	3.493	1.746	5.239
EI-750	1.905	1.905	0.953	2.857	EI-150	3.810	3.810	1.905	5.715
EI-875	2.223	2.223	1.111	3.333	EI-175	4.445	4.445	2.223	6.668
EI-100	2.540	2.540	1.270	3.810	EI-225	5.715	5.715	2.858	8.573

Table 3-3. Design Data for 14 mil EI Laminations.

EI, Laminations, (Tempel) 14 mil										
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	$W_a A_c$	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2
EI-375	36.1	47.2	6.7	7.3	1.754	0.862	1.512	1.303	0.067	46.2
EI-021	47.6	94.3	8.2	8.3	1.075	1.523	1.638	2.510	0.188	62.1
EI-625	63.5	170.0	9.5	9.5	0.418	2.394	1.890	4.525	0.459	83.2
EI-750	108.8	296.0	11.2	11.4	0.790	3.448	2.723	9.384	1.153	120.0
EI-875	171.0	457.0	13.0	13.3	0.789	4.693	3.705	17.384	2.513	163.0
EI-100	254.0	676.0	14.8	15.2	0.790	6.129	4.839	29.656	4.927	212.9
EI-112	360.0	976.0	16.5	17.2	0.789	7.757	6.124	47.504	8.920	269.4
EI-125	492.0	1343.0	18.3	19.1	0.789	9.577	7.560	72.404	15.162	333.0
EI-138	653.0	1786.0	20.1	21.0	0.789	11.588	9.148	106.006	24.492	403.0
EI-150	853.0	2334.0	22.0	22.9	0.789	13.790	10.887	150.136	37.579	479.0
EI-175	1348.0	3711.0	25.6	26.7	0.789	18.770	14.818	278.145	81.656	652.0
EI-225	2844.0	7976.0	32.7	34.3	0.789	31.028	24.496	760.064	288.936	1078.0

Design and Dimensional Data for UI Laminations

The dimensional outline for UI laminations and an assembled transformer is shown in Figure 3-23. Dimensional data for UI laminations is given in Table 3-4; design data is given in Table 3-5.

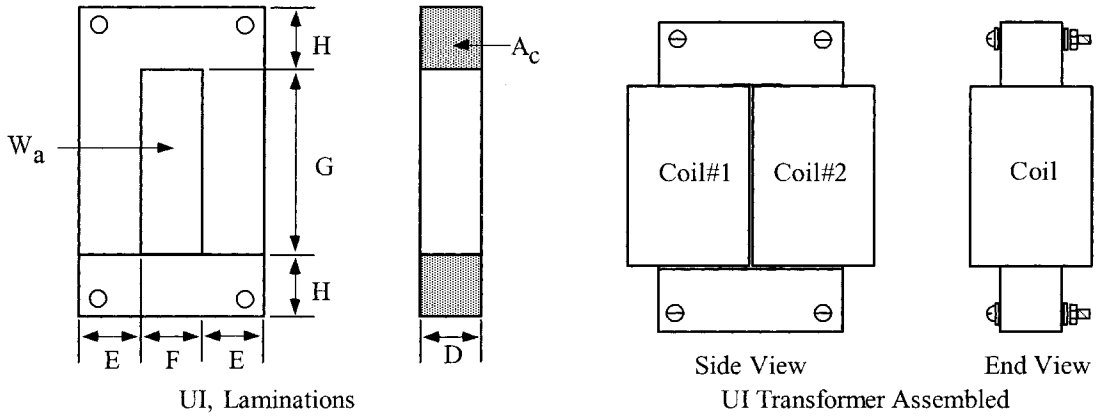


Figure 3-23. UI Lamination Outline.

Table 3-4. Dimensional Data for UI Laminations.

UI, Standard Laminations 14 mil											
Part No.	D cm	E cm	F cm	G cm	H cm	Part No.	D cm	E cm	F cm	G cm	H cm
50UI	1.270	1.270	1.270	3.810	1.270	125UI	3.175	3.175	3.175	9.525	3.175
60UI	1.429	1.429	2.223	5.398	1.429	150UI	3.810	3.810	3.810	11.430	3.810
75UI	1.905	1.905	1.905	5.715	1.905	180UI	4.572	4.572	4.572	11.430	4.572
100UI	2.540	2.540	2.540	7.620	2.540	240UI	6.096	6.096	6.096	15.240	6.096

Table 3-5. Design Data for 14 mil UI Laminations.

UI, Standard Laminations 14 mil										
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	$W_a A_c$	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2
50UI	132	173	7.68	15.24	3.159	1.532	4.839	7.414	0.592	110
60UI	418	300	9.81	18.10	6.187	1.939	11.996	23.263	1.839	209
75UI	434	585	11.22	22.86	3.157	3.448	10.887	37.534	4.614	247
100UI	1016	1384	14.76	30.48	3.158	6.129	19.355	118.626	19.709	439
125UI	1967	2725	18.29	38.10	3.158	9.577	30.242	289.614	60.647	685
150UI	3413	4702	22.04	45.72	3.158	13.790	43.548	600.544	150.318	987
180UI	4884	7491	26.28	50.29	2.632	19.858	52.258	1037.740	313.636	1296
240UI	11487	17692	34.77	67.06	2.632	35.303	92.903	3279.770	1331.997	2304

Design and Dimensional Data for LL Laminations

The dimensional outline for LL laminations and an assembled transformer is shown in Figure 3-24. Dimensional data for LL laminations is given in Table 3-6; design data is given in Table 3-7.

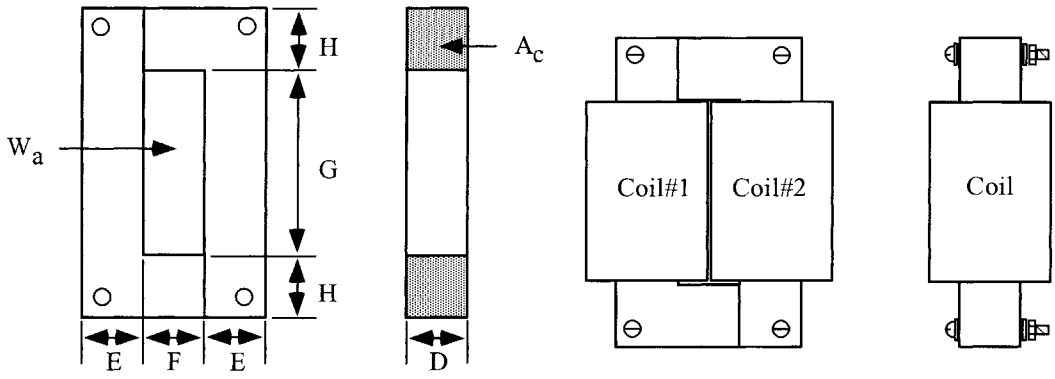


Figure 3-24. LL Lamination Outline.

Table 3-6. Dimensional Data for 14 mil LL Laminations.

LL, Standard Laminations 14 mil											
Part No.	D cm	E cm	F cm	G cm	H cm	Part Number	D cm	E cm	F cm	G cm	H cm
141L	0.635	0.635	1.270	2.858	0.635	104L	1.270	1.270	1.984	5.555	1.270
108L	1.031	1.031	0.874	3.334	1.111	105L	1.270	1.270	1.905	6.826	1.270
250L	1.031	1.031	0.874	5.239	1.111	102L	1.429	1.429	1.588	5.398	1.429
101L	1.111	1.111	1.588	2.858	1.111	106L	1.429	1.429	2.223	5.398	1.429
7L	1.270	1.270	1.270	3.810	1.270	107L	1.588	1.588	2.064	6.350	1.588
4L	1.270	1.270	1.905	3.810	1.270						

Table 3-7. Design Data for 14 mil LL Laminations.

LL, Standard Laminations 14 mil										
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	$W_a A_c$	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2
141L	63.8	31.3	4.9	10.8	9.473	0.383	3.629	1.390	0.043	55.2
108L	61.2	97.9	5.9	12.7	2.884	1.010	2.913	2.943	0.201	70.3
250L	96.1	127.1	5.9	16.5	4.532	1.010	4.577	4.624	0.316	92.0
101L	118.5	115.9	7.3	13.3	3.867	1.173	4.536	5.322	0.340	97.3
7L	132.2	173.9	7.7	15.2	3.159	1.532	4.839	7.414	0.592	109.7
4L	224.0	185.2	8.7	16.5	4.737	1.532	7.258	11.121	0.785	141.9
104L	344.9	228.0	8.8	20.2	7.193	1.532	11.020	16.885	1.176	180.2
105L	401.3	256.5	8.7	22.5	8.488	1.532	13.004	19.925	1.407	199.4
102L	268.6	284.1	8.8	19.7	4.419	1.939	8.569	16.617	1.462	167.6
106L	418.6	302.1	9.8	21.0	6.187	1.939	11.996	23.263	1.839	208.8
107L	475.2	409.5	10.2	23.2	5.474	2.394	13.105	31.375	2.946	235.8

Design and Dimensional Data for DU Laminations

The dimensional outline for DU laminations and an assembled transformer is shown in Figure 3-25. Dimensional data for DU laminations is given in Table 3-8; design data is given in Table 3-9.

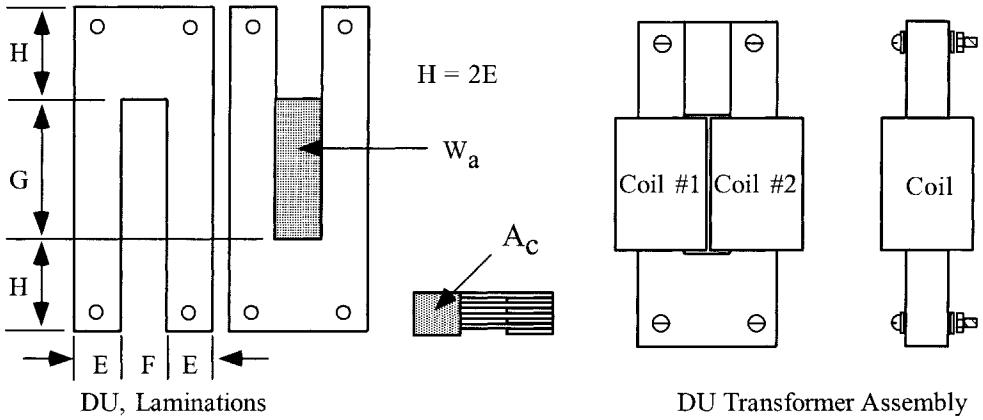


Figure 3-25. DU Lamination Outline.

Table 3-8. Dimensional Data for 14 mil DU Laminations.

DU, Standard Laminations 14 mil											
Part No.	D cm	E cm	F cm	G cm	H cm	Part No.	D cm	E cm	F cm	G cm	H cm
DU-63	0.159	0.159	0.318	0.794	0.318	DU-39	0.953	0.953	0.953	2.858	1.905
DU-124	0.318	0.318	0.476	1.191	0.635	DU-37	0.953	0.953	1.905	3.810	1.905
DU-18	0.476	0.476	0.635	1.588	0.953	DU-50	1.270	1.270	2.540	5.080	2.540
DU-26	0.635	0.635	0.635	1.905	1.270	DU-75	1.905	1.905	3.810	7.620	3.810
DU-25	0.635	0.635	0.953	2.064	1.270	DU-1125	2.858	2.858	5.715	11.430	5.715
DU-1	0.635	0.635	0.953	3.810	1.270	DU-125	3.175	3.175	5.080	10.160	6.350

Table 3-9. Design Data for 14 mil DU Laminations.

DU, Standard Laminations 14 mil										
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	$\frac{W_a}{A_c}$	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2
DU-63	1.4	0.6	1.5	3.2	10.500	0.024	0.252	0.006	0.00003	4.2
DU-124	4.9	4.3	2.4	5.2	5.906	0.096	0.567	0.054	0.0009	11.8
DU-18	11.9	13.5	3.3	7.3	4.688	0.215	1.008	0.217	0.0057	23.4
DU-26	17.0	28.9	3.9	8.9	3.159	0.383	1.210	0.463	0.0180	33.9
DU-25	31.1	30.4	4.4	9.9	5.133	0.383	1.966	0.753	0.0260	44.3
DU-1	57.3	42.4	4.4	13.3	9.634	0.383	3.630	1.390	0.0479	60.9
DU-39	55.3	104.5	5.7	13.3	3.158	0.862	2.722	2.346	0.1416	76.2
DU-37	186.0	124.5	7.2	17.2	8.420	0.862	7.258	6.256	0.2992	134.3
DU-50	443.9	287.8	9.7	22.8	8.422	1.532	12.903	19.771	1.2524	238.0
DU-75	1467.0	985.2	14.2	34.3	8.420	3.448	29.032	100.091	9.7136	537.1
DU-1125	4880.0	3246.0	21.0	51.4	8.421	7.757	65.322	506.709	74.8302	1208.0
DU-125	3906.0	3966.0	21.3	41.4	5.389	9.577	51.610	494.275	88.9599	1147.0

Design and Dimensional Data for Three Phase Laminations

The dimensional outline for 3Phase EI laminations and an assembled transformer is shown in Figure 3-26. Dimensional data for 3Phase EI laminations is given in Table 3-10; design data is given in Table 3-11.

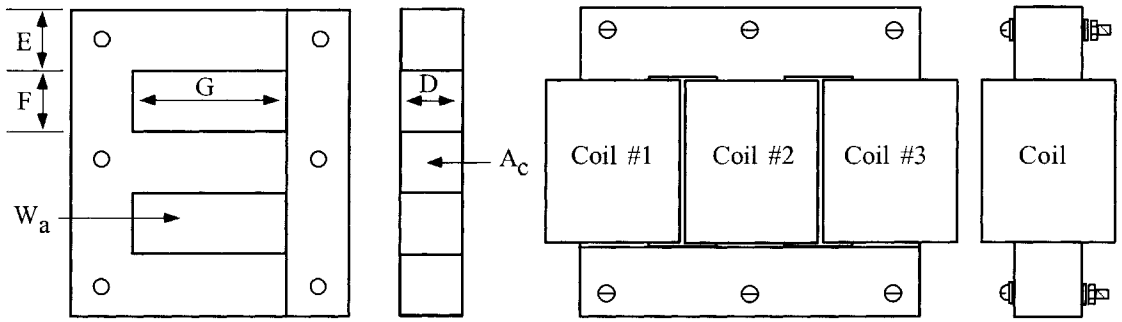


Figure 3-26. EI Three Phase Laminations Outline.

Table 3-10. Dimensional Data for 14 mil EI Three Phase Laminations.

3Phase, Standard Laminations, Thomas & Skinner 14 mil									
Part No.	D cm	E cm	F cm	G cm	Part No.	D cm	E cm	F cm	G cm
0.250EI	0.635	0.635	0.871	2.858	1.000EI	2.540	2.540	3.810	7.620
0.375EI	0.953	0.953	1.270	3.175	1.200EI	3.048	3.048	3.048	7.620
0.500EI	1.270	1.270	1.588	3.493	1.500EI	3.810	3.810	3.810	9.525
0.562EI	1.427	1.427	1.588	5.398	1.800EI	4.572	4.572	4.572	11.430
0.625EI	1.588	1.588	1.984	5.634	2.400EI	6.096	6.096	6.096	15.240
0.875EI	2.223	2.223	2.779	6.111	3.600EI	9.144	9.144	9.144	22.860

Table 3-11. Design Data for 14 mil EI Three Phase Laminations.

3Phase, Standard Laminations, Thomas & Skinner 14 mil									
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	W_a / $2A_c$	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2
0.250EI	57	54	4.3	3.251	0.383	2.49	1.43	0.051	53
0.375EI	134	154	6.2	2.339	0.862	4.03	5.21	0.289	102
0.500EI	242	324	8.2	1.810	1.532	5.54	12.74	0.955	159
0.562EI	403	421	8.8	2.213	1.936	8.57	24.88	2.187	207
0.625EI	600	706	10.1	2.334	2.394	11.18	40.13	3.816	275
0.875EI	1255	1743	13.9	1.809	4.693	16.98	119.53	16.187	487
1.000EI	2594	2751	16.7	2.368	6.129	29.03	266.91	39.067	730
1.200EI	2178	3546	17.6	1.316	8.826	23.23	307.48	61.727	725
1.500EI	4266	6957	22.0	1.316	13.790	36.29	750.68	187.898	1132
1.800EI	7326	12017	26.3	1.316	19.858	52.26	1556.61	470.453	1630
2.400EI	17230	28634	34.8	1.316	35.303	92.90	4919.66	1997.995	2899
3.600EI	58144	96805	52.2	1.316	79.432	209.03	24905.75	15174.600	6522

Design and Dimensional Data for Tape Wound C Cores

The dimensional outline for C cores is shown in Figure 3-27. Dimensional data for C cores is given in Table 3-12; design data is given in Table 3-13.

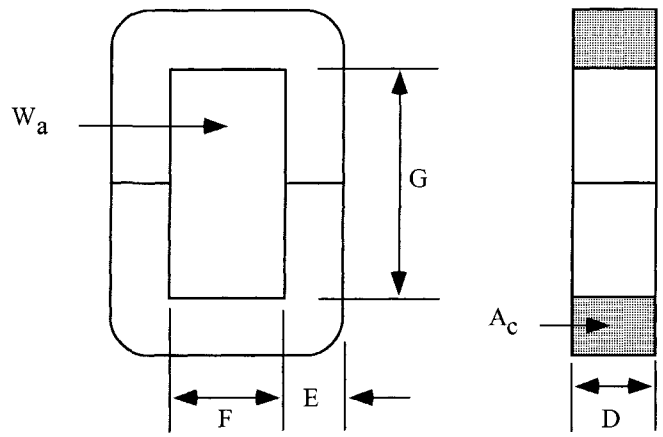


Figure 3-27. Tape C Core Dimensional Outline.

Table 3-12. Dimensional Data for Tape C Cores.

C Cores, Magnetic Metals, 2 mil									
Part No.	D cm	E cm	F cm	G cm	Part No.	D cm	E cm	F cm	G cm
ML-002	0.635	0.476	0.635	1.588	ML-014	1.270	1.270	1.270	3.969
ML-004	0.635	0.635	0.635	2.223	ML-016	1.905	1.270	1.270	3.969
ML-006	1.270	0.635	0.635	2.223	ML-018	1.270	1.111	1.588	3.969
ML-008	0.953	0.953	0.953	3.016	ML-020	2.540	1.588	1.588	3.969
ML-010	1.588	0.953	0.953	3.016	ML-022	2.540	1.588	1.588	4.921
ML-012	1.270	1.111	1.270	2.858	ML-024	2.450	1.588	1.905	5.874

Table 3-13. Design Data for Tape C Cores.

C Cores, Magnetic Metals, 2 mil										
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	$\frac{W_a}{A_c}$	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2
ML-002	13.0	13.0	3.6	6.4	3.747	0.269	1.008	0.271	0.0080	21.0
ML-004	19.8	22.6	3.9	8.3	3.933	0.359	1.412	0.507	0.0184	29.8
ML-006	27.2	45.2	5.4	8.3	1.967	0.718	1.412	1.013	0.0537	37.5
ML-008	58.4	72.5	5.7	11.8	3.556	0.808	2.874	2.323	0.1314	63.6
ML-010	73.5	120.8	7.2	11.8	2.134	1.347	2.874	3.871	0.2902	74.7
ML-012	95.1	121.7	7.4	12.7	2.891	1.256	3.630	4.558	0.3109	87.1
ML-014	137.7	170.4	7.7	15.6	3.513	1.435	5.041	7.236	0.5408	112.1
ML-016	160.5	255.6	9.0	15.6	2.341	2.153	5.041	10.854	1.0443	126.8
ML-018	176.2	149.1	7.9	15.6	5.019	1.256	6.303	7.915	0.5056	118.9
ML-020	254.5	478.4	11.4	17.5	1.756	3.590	6.303	22.626	2.8607	182.0
ML-022	315.6	530.5	11.4	19.4	2.177	3.590	7.815	28.053	3.5469	202.0
ML-024	471.7	600.1	11.9	21.9	3.117	3.590	11.190	40.170	4.8656	244.8

Dimensional Outline for Tape Wound EE Cores

The dimensional outline for EE cores is shown in Figure 3-28. Dimensional data for EE cores is given in Table 3-14; design data is given in Table 3-15.

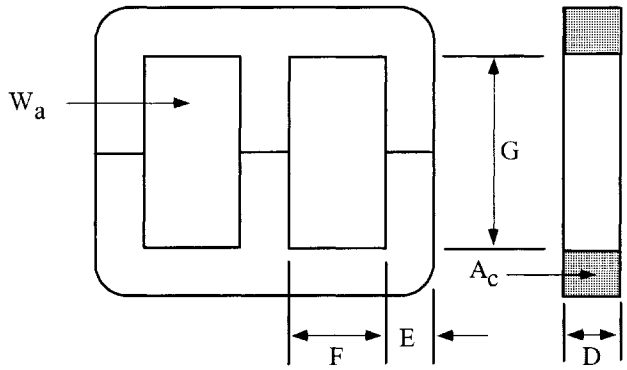


Figure 3-28. Tape EE Core Dimensional Outline.

Table 3-14. Dimensional Data for Tape EE Cores.

3Phase E Cores, National-Arnold Magnetics, 14 mil									
Part No.	D cm	E cm	F cm	G cm	Part No.	D cm	E cm	F cm	G cm
CTA-25	1.905	1.905	1.905	2.858	CTA-12	3.810	2.540	2.381	6.350
CTA-22	3.175	1.429	1.905	5.239	CTA-20	5.715	2.540	2.540	6.350
CTA-17	3.175	1.746	1.905	6.350	CTA-03	4.445	2.540	3.493	9.843
CTA-14	3.175	2.223	2.381	4.763	CTA-15	5.080	3.493	2.540	7.620

Table 3-15. Design Data for Tape EE Cores.

3Phase E Cores, National-Arnold Magnetics, 14 mil									
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	W_a / $2A_c$	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2
CTA-25	326	686	11.2	0.789	3.448	5.44	28.16	3.461	261
CTA-22	682	1073	12.8	1.158	4.310	9.98	64.53	8.686	324
CTA-17	867	1422	13.4	1.148	5.266	12.10	95.56	14.977	400
CTA-14	916	1803	15.1	0.846	6.705	11.34	114.06	20.203	468
CTA-12	1391	2899	17.3	0.822	9.194	15.12	208.50	44..438	613
CTA-20	1834	4420	21.3	0.585	13.790	16.13	333.64	86.347	737
CTA-03	3717	4597	20.3	1.602	10.730	34.38	553.15	117.079	993
CTA-15	2266	6544	22.0	0.574	16.860	19.35	489.40	150.340	956

Design and Dimensional Data for Tape Wound Toroidal Cores

The dimensional outline for tape wound Toroidal cores is shown in Figure 3-29. Dimensional data for cased tape wound Toroidal cores is given in Table 3-16; design data is given in Table 3-17.

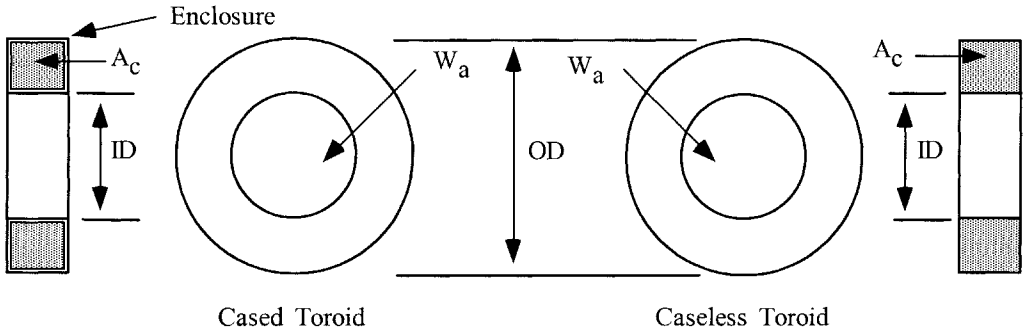


Figure 3-29. Tape Toroidal Core Dimensional Outline.

Table 3-16. Dimensional Data for Tape Toroidal Cores.

Toroidal Tape Cores, Magnetics 2 mil Iron Alloy (cased and coated)											
Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm
52402	1.346	0.724	0.610	52057	2.134	1.359	0.610	52061	2.781	1.664	0.927
52107	1.651	1.041	0.610	52000	2.134	1.041	0.610	52004	3.429	2.286	0.927
52153	1.499	0.724	0.610	52155	1.659	0.884	0.927	52076	2.794	1.334	0.762
52056	1.816	1.041	0.610	52176	2.134	1.041	0.927	52007	2.794	1.334	0.927

Table 3-17. Design Data for Tape Toroidal Cores.

Toroidal Tape Cores, Magnetics 2 mil Iron Alloy (cased)										
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2
52402	2.84	0.50	2.16	3.25	18.727	0.022	0.412	0.00906	0.0000388	9.80
52107	6.76	0.70	2.30	4.24	38.682	0.022	0.851	0.01872	0.0000717	15.50
52153	3.20	1.10	2.20	3.49	9.581	0.043	0.412	0.01770	0.0001400	11.20
52056	7.40	1.50	2.40	4.49	19.791	0.043	0.851	0.03660	0.0002592	16.80
52057	13.80	1.80	2.70	5.48	33.744	0.043	1.451	0.06237	0.0003998	23.70
52000	8.10	3.30	2.70	4.99	9.895	0.086	0.851	0.07320	0.0009384	20.60
52155	6.10	2.60	2.80	3.99	7.140	0.086	0.614	0.05278	0.0006461	16.00
52176	9.70	6.50	3.20	4.99	4.977	0.171	0.851	0.14554	0.0031203	23.30
52061	28.70	9.10	3.70	6.98	12.719	0.171	2.175	0.37187	0.0068597	40.30
52004	61.70	11.70	4.20	8.97	24.000	0.171	4.104	0.70184	0.0113585	62.20
52076	17.20	9.50	3.50	6.48	7.244	0.193	1.398	0.26975	0.0060284	34.60
52007	18.50	12.70	3.70	6.48	5.440	0.257	1.398	0.35920	0.0099305	36.40

Design and Dimensional Data for EE Ferrite Cores

The dimensional outline for EE ferrite cores is shown in Figure 3-30. Dimensional data for EE ferrite cores is given in Table 3-18; design data is given in Table 3-19.

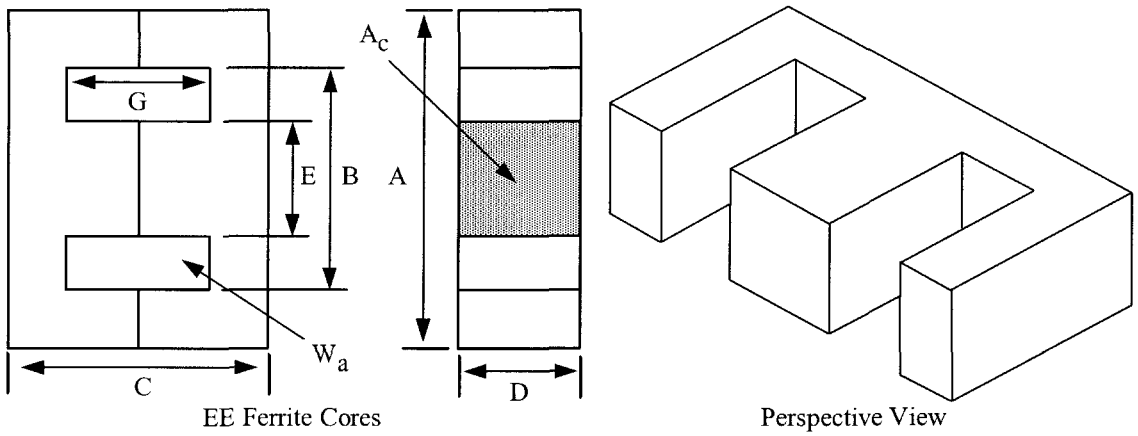


Figure 3-30. Dimension Outline for EE Ferrite Cores.

Table 3-18. Dimensional Data for EE Ferrite Cores.

EE, Ferrite Cores (Magnetics)													
Part No.	A cm	B cm	C cm	D cm	E cm	G cm	Part No.	A cm	B cm	C cm	D cm	E cm	G cm
EE-187	1.930	1.392	1.620	0.478	0.478	1.108	EE-21	4.087	2.832	3.300	1.252	1.252	2.080
EE-2425	2.515	1.880	1.906	0.653	0.610	1.250	EE-625	4.712	3.162	3.940	1.567	1.567	2.420
EE-375	3.454	2.527	2.820	0.935	0.932	1.930	EE-75	5.657	3.810	4.720	1.880	1.880	2.900

Table 3-19. Design Data for EE Ferrite Cores.

EE, Ferrite Cores (Magnetics)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a / A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
EE-187	6.8	4.4	3.8	4.01	2.219	0.228	0.506	0.116	0.0028	14.4	500
EE-2425	13.9	9.5	4.9	4.85	2.068	0.384	0.794	0.305	0.0095	23.5	767
EE-375	36.4	33.0	6.6	6.94	1.875	0.821	1.539	1.264	0.0624	45.3	1167
EE-21	47.3	57.0	8.1	7.75	1.103	1.490	1.643	2.448	0.1802	60.9	1967
EE-625	64.4	103.0	9.4	8.90	0.808	2.390	1.930	4.616	0.4700	81.8	2767
EE-75	111.1	179.0	11.2	10.70	0.826	3.390	2.799	9.487	1.1527	118.0	3467

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for EE and EI Planar, Ferrite Cores

The dimensional outline for EE and EI planar ferrite cores is shown in Figure 3-31. Dimensional data for EE and EI planar ferrite cores is given in Table 3-20; design data is given in Table 3-21.

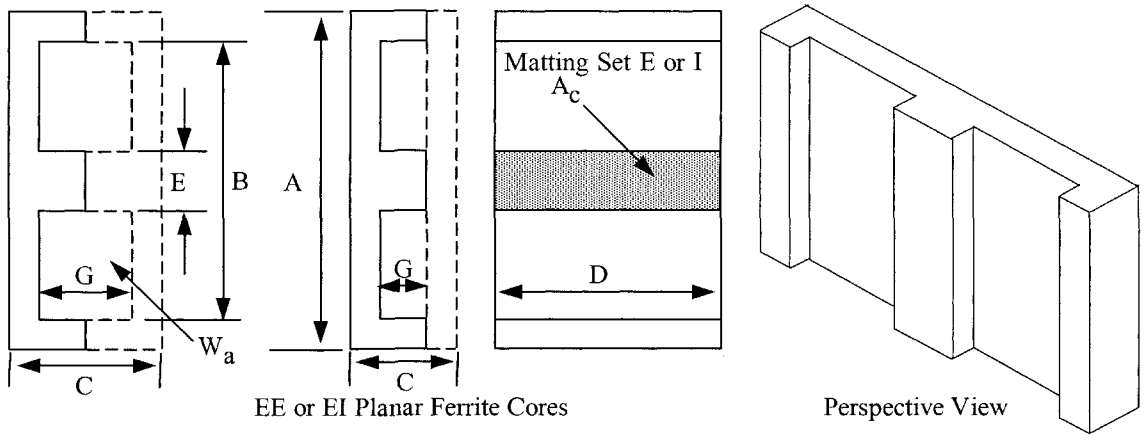


Figure 3-31. Dimension Outline for EE, EI Planar Ferrite Cores.

Table 3-20. Dimensional Data for EE, EI Planar Ferrite Cores.

EE&EI/LP, Ferrite Cores (Magnetics)													
Part No.	A cm	B cm	C cm	D cm	E cm	G cm	Part No.	A cm	B cm	C cm	D cm	E cm	G cm
EI-41805	1.800	1.370	0.638	1.000	0.398	0.188	EI-43208	3.175	2.490	0.953	2.032	0.635	0.305
EE-41805	1.800	1.370	0.796	1.000	0.398	0.376	EE-43208	3.175	2.490	1.270	2.032	0.635	0.610
EI-42216	2.160	1.610	0.867	1.590	0.508	0.297	EI-44310	4.318	3.440	1.395	2.790	0.813	0.533
EE-42216	2.160	1.610	1.144	1.590	0.508	0.610	EE-44310	4.318	3.440	1.906	2.790	0.813	1.066

Table 3-21. Design Data for EE, EI Planar Ferrite Cores.

EE&EI/LP, Ferrite Cores (Magnetics)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
EI-41805	1.5	4.1	4.7	2.03	0.2269	0.401	0.091	0.0366	0.00124	10.4	1737
EE-41805	3.1	4.9	4.7	2.42	0.4564	0.401	0.183	0.0715	0.00248	11.6	1460
EI-42216	3.8	10.4	6.5	2.58	0.2035	0.806	0.164	0.1319	0.00651	17.8	2592
EE-42216	7.8	13.0	6.5	3.21	0.4169	0.806	0.336	0.2709	0.01337	20.5	2083
EI-43208	8.9	22.0	8.9	3.54	0.224	1.290	0.289	0.3649	0.02126	33.4	3438
EE-43208	17.8	26.0	8.9	4.17	0.4388	1.290	0.566	0.7299	0.04253	37.9	2915
EI-44310	29.7	58.0	11.9	5.06	0.3084	2.270	0.700	1.5892	0.12085	65.4	4267
EE-44310	59.4	70.8	11.9	6.15	0.6167	2.270	1.400	3.1784	0.24170	75.3	3483

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for EC, Ferrite Cores

The dimensional outline for EC ferrite cores is shown in Figure 3-32. Dimensional data for EC ferrite cores is given in Table 3-22; design data is given in Table 3-23.

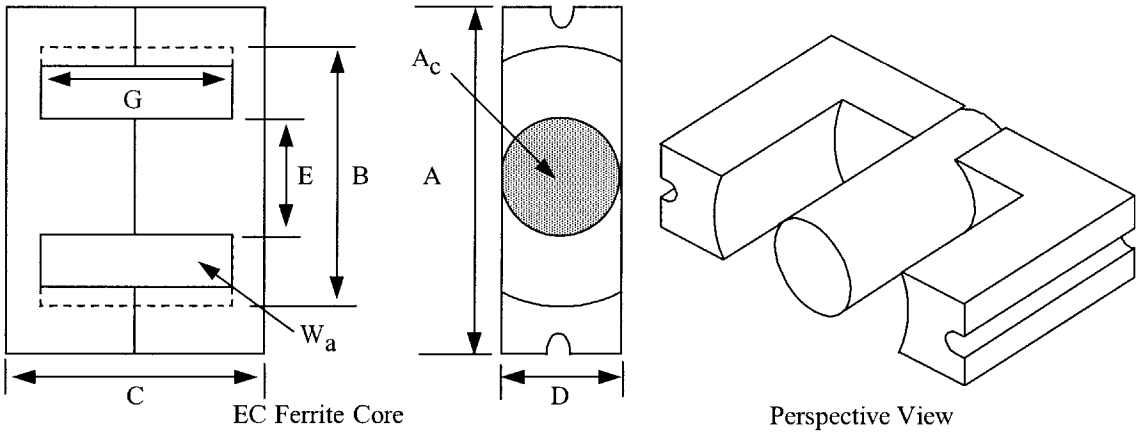


Figure 3-32. Dimension Outline for EC Ferrite Cores.

Table 3-22. Dimensional Data for EC Ferrite Cores.

EC, Ferrite Cores (Magnetics)						
Part No.	A cm	B cm	C cm	D cm	E cm	G cm
EC-35	3.450	2.270	3.460	0.950	0.950	2.380
EC-41	4.060	2.705	3.901	1.161	1.161	2.697
EC-52	5.220	3.302	4.841	1.340	1.340	3.099
EC-70	7.000	4.450	6.900	1.638	1.638	4.465

Table 3-23. Design Data for EC Ferrite Cores.

EC, Ferrite Cores (Magnetics)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
EC-35	35.1	36.0	6.3	7.59	2.213	0.710	1.571	1.115	0.050	50.2	1000
EC-41	55.4	52.0	7.5	8.76	1.964	1.060	2.082	2.207	0.125	67.6	1233
EC-52	97.8	111.0	9.0	10.30	2.156	1.410	3.040	4.287	0.267	106.5	1680
EC-70	256.7	253.0	11.7	14.10	2.927	2.110	6.177	13.034	0.941	201.7	1920

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for ETD, Ferrite Cores

The dimensional outline for ETD ferrite cores is shown in Figure 3-33. Dimensional data for ETD ferrite cores is given in Table 3-24; design data is given in Table 3-25.

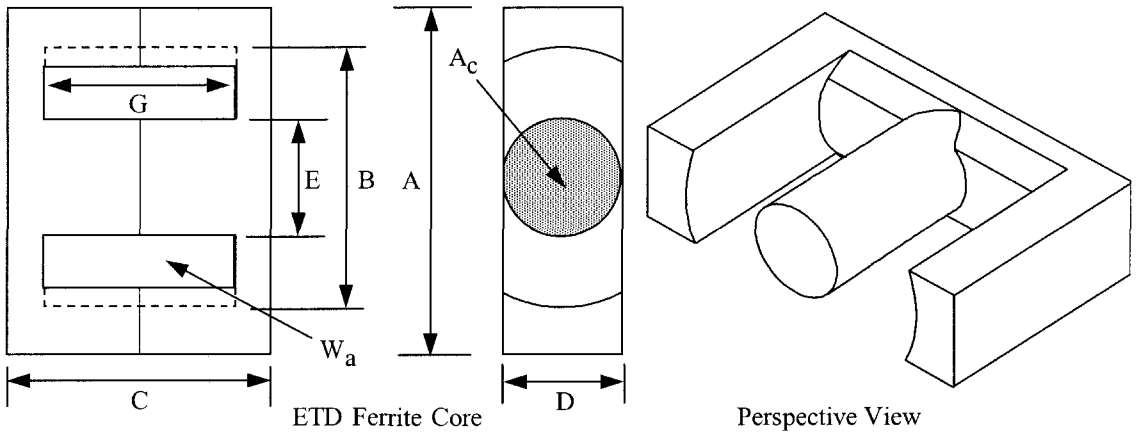


Figure 3-33. Dimension Outline for ETD Ferrite Cores.

Table 3-24. Dimensional Data for ETD Ferrite Cores.

ETD, Ferrite Cores (Ferroxcube)													
Part No.	A cm	B cm	C cm	D cm	E cm	G cm	Part No.	A cm	B cm	C cm	D cm	E cm	G cm
ETD-29	3.060	2.270	3.160	0.980	0.980	2.200	ETD-49	4.980	3.610	4.940	1.670	1.670	3.540
ETD-34	3.500	2.560	3.460	1.110	1.110	2.360	ETD-54	5.450	4.120	5.520	1.890	1.890	4.040
ETD-39	4.000	2.930	3.960	1.280	1.280	2.840	ETD-59	5.980	4.470	6.200	2.165	2.165	4.500
ETD-44	4.500	3.250	4.460	1.520	1.520	3.220							

Table 3-25. Design Data for ETD Ferrite Cores.

ETD, Ferrite Cores (Ferroxcube)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
ETD-29	32.1	28.0	6.4	7.20	1.865	0.761	1.419	1.0800	0.0517	42.5	1000
ETD-34	43.4	40.0	7.1	7.87	1.757	0.974	1.711	1.6665	0.0911	53.4	1182
ETD-39	69.3	60.0	8.3	9.22	1.871	1.252	2.343	2.9330	0.1766	69.9	1318
ETD-44	93.2	94.0	9.4	10.30	1.599	1.742	2.785	4.8520	0.3595	87.9	1682
ETD-49	126.2	124.0	10.3	11.40	1.627	2.110	3.434	7.2453	0.5917	107.9	1909
ETD-54	186.9	180.0	11.7	12.70	1.609	2.800	4.505	12.6129	1.2104	133.7	2273
ETD-59	237.7	260.0	12.9	13.90	1.410	3.677	5.186	19.0698	2.1271	163.1	2727
*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.											

Design and Dimensional Data for ETD/(low profile), Ferrite Cores

The dimensional outline for ETD/lp low profile ferrite cores is shown in Figure 3-34. Dimensional data for ETD/lp low profile ferrite cores is given in Table 3-26; design data is given in Table 3-27.

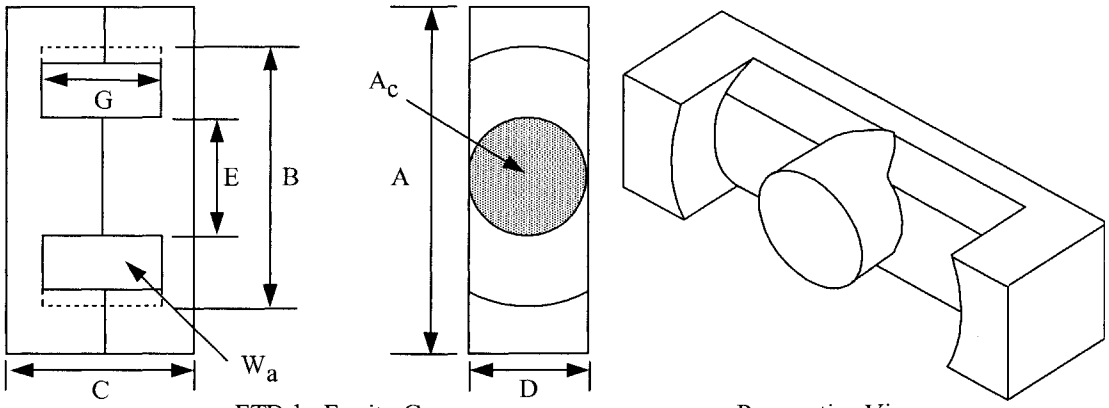


Figure 3-34. Dimension Outline for ETD/lp Ferrite Cores.

Table 3-26. Dimensional Data for ETD/lp Ferrite Cores.

ETD/lp, Ferrite Cores (TSC Ferrite International)						
Part No.	A cm	B cm	C cm	D cm	E cm	G cm
ETD34(lp)	3.421	2.631	1.804	1.080	1.080	0.762
ETD39(lp)	3.909	3.010	1.798	1.250	1.250	0.762
ETD44(lp)	4.399	3.330	1.920	1.481	1.481	0.762
ETD49(lp)	4.869	3.701	2.082	1.631	1.631	0.762

Table 3-27. Design Data for ETD/lp Ferrite Cores.

ETD/lp, Ferrite Cores (TSC Ferrite International)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
ETD34(lp)	15.1	32.7	7.2	4.65	0.609	0.970	0.591	0.5732	0.0310	33.1	2382
ETD39(lp)	20.0	46.3	8.4	5.03	0.559	1.200	0.671	0.8047	0.0461	39.6	2838
ETD44(lp)	24.6	72.1	9.5	5.40	0.420	1.730	0.727	1.2583	0.0914	48.4	3659
ETD49(lp)	29.1	95.0	10.4	5.85	0.374	2.110	0.789	1.6641	0.1353	58.2	4120
*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.											

Design and Dimensional Data for ER, Ferrite Cores

Surface Mount Device, SMD

The dimensional outline for ER ferrite cores is shown in Figure 3-35. Dimensional data for ER ferrite cores is given in Table 3-28; design data is given in Table 3-29.

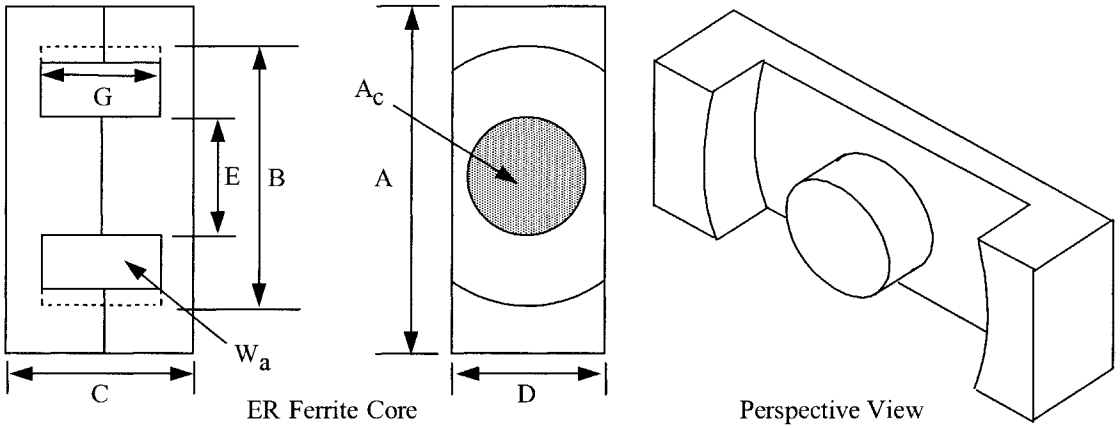


Figure 3-35. Dimension Outline for ER Ferrite Cores.

Table 3-28. Dimensional Data for ER Ferrite Cores.

ER, Ferrite Cores (Ferroxcube)													
Part No.	A cm	B cm	C cm	D cm	E cm	G cm	Part No.	A cm	B cm	C cm	D cm	E cm	G cm
ER 9.5	0.950	0.750	0.490	0.500	0.350	0.320	ER 42	4.200	3.005	4.480	1.560	1.550	3.090
ER 11	1.100	0.870	0.490	0.600	0.425	0.300	ER 48	4.800	3.800	4.220	2.100	1.800	2.940
ER 35	3.500	2.615	4.140	1.140	1.130	2.950	ER 54	5.350	4.065	3.660	1.795	1.790	2.220

Table 3-29. Design Data for ER Ferrite Cores.

ER, Ferrite Cores (Ferroxcube)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
ER 9.5	0.6	0.7	2.700	1.42	0.842	0.076	0.0640	0.00486	0.000054	3.0	435
ER 11	0.7	1.0	3.200	1.47	0.650	0.103	0.0670	0.00688	0.000090	3.7	609
ER 35	56.7	46.0	7.300	9.08	2.190	1.000	2.1900	2.19037	0.120340	62.4	1217
ER 42	72.9	96.0	9.100	9.88	1.189	1.890	2.2480	4.24867	0.352444	81.0	2000
ER 48	120.7	128.0	11.500	10.00	1.185	2.480	2.9400	7.29120	0.626245	100.1	2478
ER 54	101.9	122.0	11.400	9.18	1.052	2.400	2.5250	6.06060	0.512544	96.2	2652
*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.											

Design and Dimensional Data for EFD, Ferrite Cores

Surface Mount Device, SMD

The EFD cores, (**E**conomic **F**lat **D**esign), offer a significant advance in power transformer circuit miniaturization. The dimensional outline for EFD ferrite cores is shown in Figure 3-36. Dimensional data for EFD ferrite cores is given in Table 3-30; design data is given in Table 3-31.

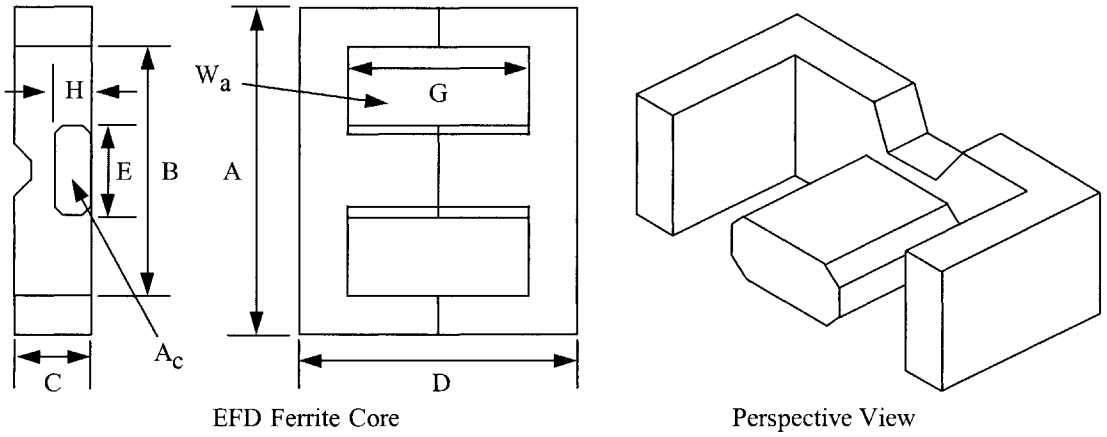


Figure 3-36. Dimension Outline for EFD Ferrite Cores.

Table 3-30. Dimensional Data for EFD Ferrite Cores.

EFD, Ferrite Cores (Ferroxcube)							
Part No.	A cm	B cm	C cm	D cm	E cm	G cm	H cm
EFD-10	1.050	0.765	0.270	1.040	0.455	0.750	0.145
EFD-15	1.500	1.100	0.465	1.500	0.530	1.100	0.240
EFD-20	2.000	1.540	0.665	2.000	0.890	1.540	0.360
EFD-25	2.500	1.870	0.910	2.500	1.140	1.860	0.520
EFD-30	3.000	2.240	0.910	3.000	1.460	2.240	0.490

Table 3-31. Design Data for EFD Ferrite Cores.

EFD, Ferrite Cores (Ferroxcube)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
EFD-10	0.8	0.90	1.8	2.37	1.611	0.072	0.116	0.00837	0.00013	3.3	254
EFD-15	3.0	2.80	2.7	3.40	2.093	0.150	0.314	0.04703	0.00105	7.3	413
EFD-20	6.8	7.00	3.8	4.70	1.616	0.310	0.501	0.15516	0.00506	13.3	565
EFD-25	11.5	16.00	4.8	5.70	1.171	0.580	0.679	0.39376	0.01911	21.6	957
EFD-30	17.0	24.00	5.5	6.80	1.267	0.690	0.874	0.60278	0.03047	28.9	913

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for EPC, Ferrite Cores

Surface Mount Device, SMD

The dimensional outline for EPC ferrite cores is shown in Figure 3-37. Dimensional data for EPC ferrite cores is given in Table 3-32; design data is given in Table 3-33.

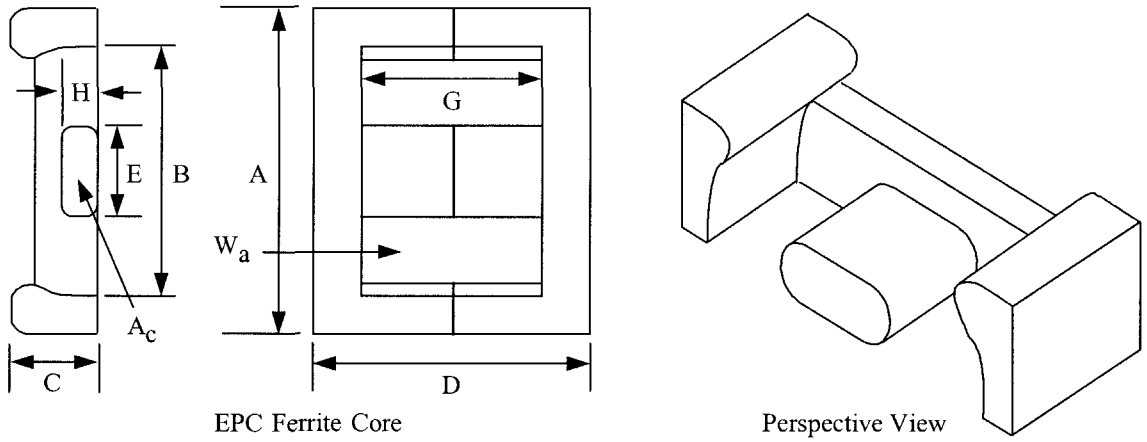


Figure 3-37. Dimension Outline for EPC Ferrite Cores.

Table 3-32. Dimensional Data for EPC Ferrite Cores.

EPC, Ferrite Cores (TDK)							
Part No.	A cm	B cm	C cm	D cm	E cm	G cm	H cm
EPC-10	1.020	0.760	0.340	0.810	0.500	0.530	0.190
EPC-13	1.325	1.050	0.460	1.320	0.560	0.900	0.205
EPC-17	1.760	1.430	0.600	1.710	0.770	1.210	0.280
EPC-19	1.910	1.580	0.600	1.950	0.850	1.450	0.250
EPC-25	2.510	2.040	0.800	2.500	1.150	1.800	0.400
EPC-27	2.710	2.160	0.800	3.200	1.300	2.400	0.400
EPC-30	3.010	2.360	0.800	3.500	1.500	2.600	0.400

Table 3-33. Design Data for EPC Ferrite Cores.

EPC, Ferrite Cores (TDK)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
EPC-10	0.5	1.1	1.9	1.78	0.735	0.094	0.069	0.00647	0.000128	2.9	416
EPC-13	2.0	2.1	2.5	3.06	1.768	0.125	0.221	0.02756	0.000549	5.9	363
EPC-17	4.9	4.5	3.4	4.02	1.750	0.228	0.399	0.09104	0.002428	10.2	479
EPC-19	6.9	5.3	3.7	4.61	2.330	0.227	0.529	0.12014	0.002981	12.1	392
EPC-25	14.8	13.0	5.0	5.92	1.804	0.464	0.837	0.38837	0.014532	20.6	650
EPC-27	18.8	18.0	5.1	7.31	1.890	0.546	1.032	0.56347	0.024036	26.8	642
EPC-30	21.9	23.0	5.5	8.16	1.833	0.610	1.118	0.68198	0.030145	31.5	654

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for PC, Ferrite Cores

The dimensional outline for PC ferrite pot cores is shown in Figure 3-38. Dimensional data for PC ferrite pot cores is given in Table 3-34; design data is given in Table 3-35.

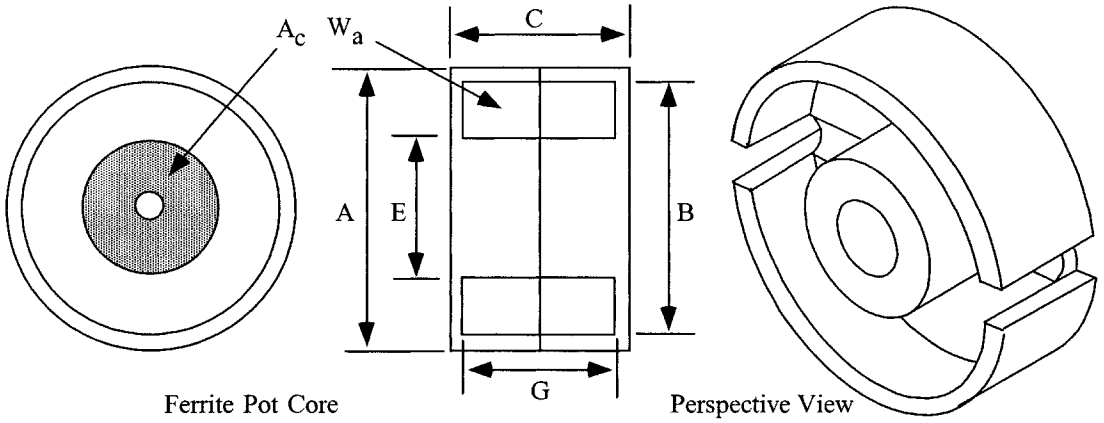


Figure 3-38. Dimension Outline for PC Ferrite Cores.

Table 3-34. Dimensional Data for PC Ferrite Cores.

PC, Ferrite Cores (Magnetics)											
Part No.	A cm	B cm	C cm	E cm	G cm	Part Number	A cm	B cm	C cm	E cm	G cm
PC-40905	0.914	0.749	0.526	0.388	0.361	PC-42616	2.550	2.121	1.610	1.148	1.102
PC-41408	1.400	1.160	0.848	0.599	0.559	PC-43019	3.000	2.500	1.880	1.350	1.300
PC-41811	1.800	1.498	1.067	0.759	0.720	PC-43622	3.560	2.990	2.200	1.610	1.460
PC-42213	2.160	1.790	1.340	0.940	0.920	PC-44229	4.240	3.560	2.960	1.770	2.040

Table 3-35. Design Data for PC Ferrite Cores.

PC, Ferrite Cores (Magnetics)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
PC-40905	0.5	1.0	1.9	1.25	0.650	0.100	0.065	0.00652	0.000134	2.8	455
PC-41408	1.6	3.2	2.9	1.97	0.631	0.249	0.157	0.03904	0.001331	6.8	933
PC-41811	3.5	7.3	3.7	2.59	0.620	0.429	0.266	0.11413	0.005287	11.1	1333
PC-42213	6.2	13.0	4.4	3.12	0.612	0.639	0.391	0.24985	0.014360	16.4	1633
PC-42616	10.1	20.0	5.3	3.76	0.576	0.931	0.536	0.49913	0.035114	23.1	2116
PC-43019	16.7	34.0	6.3	4.50	0.550	1.360	0.748	0.97175	0.080408	31.9	2700
PC-43622	26.7	57.0	7.5	5.29	0.499	2.020	1.007	2.03495	0.220347	44.5	3400
PC-44229	55.9	104.0	8.6	6.85	0.686	2.660	1.826	4.85663	0.600289	67.7	4000
*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.											

Design and Dimensional Data for EP, Ferrite Cores

The EP ferrite cores are typically used in transformer applications. The shape of the assembly is almost cubical, allowing high package densities on the PCB. The dimensional outline for EP ferrite cores is shown in Figure 3-39. Dimensional data for EP ferrite cores is given in Table 3-36; design data is given in Table 3-37.

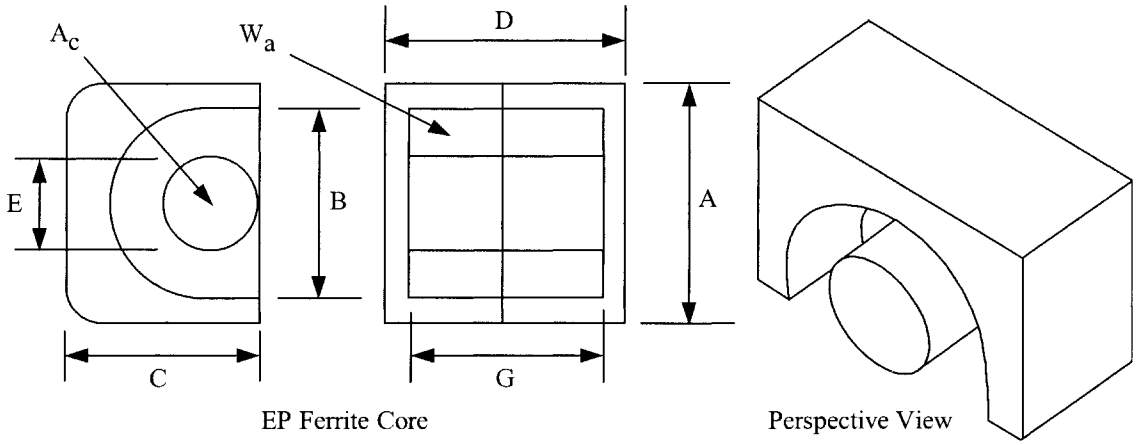


Figure 3-39. Dimension Outline for EP Ferrite Cores.

Table 3-36. Dimensional Data for EP Ferrite Cores.

EP, Ferrite Cores (Magnetics)						
Part No.	A cm	B cm	C cm	D cm	E cm	G cm
EP-07	0.920	0.720	0.635	0.740	0.340	0.500
EP-10	1.150	0.920	0.760	1.030	0.345	0.720
EP-13	1.250	0.972	0.880	1.290	0.452	0.899
EP-17	1.798	1.160	1.100	1.680	0.584	1.118
EP-20	2.400	1.610	1.495	2.139	0.899	1.397

Table 3-37. Design Data for EP Ferrite Cores.

EP, Ferrite Cores (Magnetics)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
EP-07	1.4	1.4	1.8	1.57	0.922	0.103	0.095	0.00979	0.00022	3.5	413
EP-10	1.6	2.8	2.1	1.92	1.832	0.113	0.207	0.02339	0.00049	5.7	400
EP-13	2.0	5.1	2.4	2.42	1.200	0.195	0.234	0.04558	0.00148	7.7	667
EP-17	11.6	11.6	2.9	2.85	0.950	0.339	0.322	0.10915	0.00510	13.7	1033
EP-20	7.4	27.6	4.2	3.98	0.637	0.780	0.497	0.38737	0.02892	23.8	1667

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for PQ, Ferrite Cores

The PQ ferrite cores, (**P**ower **Q**uality), feature round center legs with rather small cross-sections. The dimensional outline for PQ ferrite cores is shown in Figure 3-40. Dimensional data for PQ ferrite cores is given in Table 3-38; design data is given in Table 3-39.

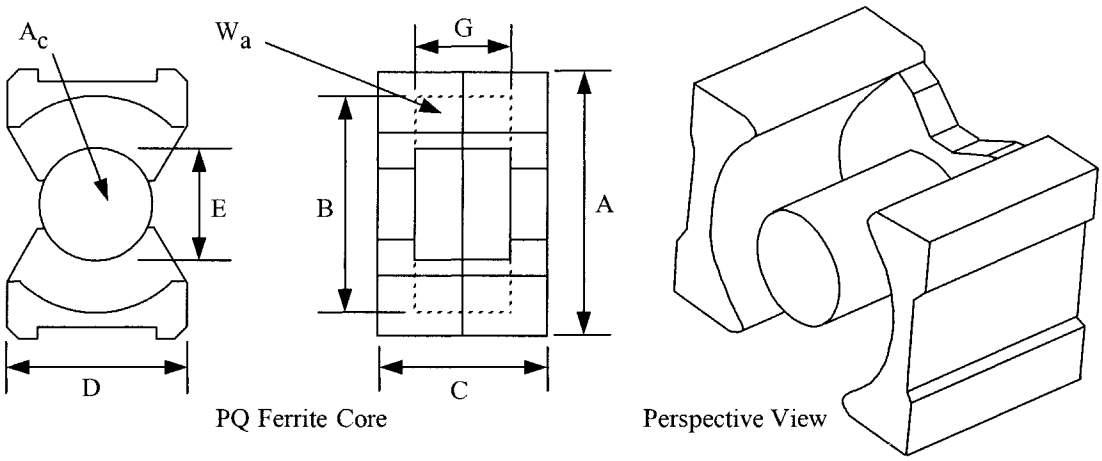


Figure 3-40. Dimension Outline for PQ Ferrite Cores.

Table 3-38. Dimensional Data for PQ Ferrite Cores.

PQ, Ferrite Cores (TDK)													
Part No.	A cm	B cm	C cm	D cm	E cm	G cm	Part No.	A cm	B cm	C cm	D cm	E cm	G cm
PQ20/16	2.050	1.800	1.620	1.400	0.880	1.030	PQ32/30	3.200	2.750	3.035	2.200	1.345	2.130
PQ20/20	2.050	1.800	2.020	1.400	0.880	1.430	PQ35/35	3.510	3.200	3.475	2.600	1.435	2.500
PQ26/20	2.650	2.250	2.015	1.900	1.200	1.150	PQ40/40	4.050	3.700	3.975	2.800	1.490	2.950
PQ26/25	2.650	2.250	2.475	1.900	1.200	1.610	PQ50/50	5.000	4.400	4.995	3.200	2.000	3.610
PQ32/20	3.200	2.750	2.055	2.200	1.345	1.150							

Table 3-39. Design Data for PQ Ferrite Cores.

PQ, Ferrite Cores (TDK)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	$\frac{W_a}{A_c}$	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
PQ20/16	7.4	13.0	4.4	3.74	0.765	0.620	0.474	0.294	0.0167	16.9	1617
PQ20/20	10.4	15.0	4.4	4.54	1.061	0.620	0.658	0.408	0.0227	19.7	1313
PQ26/20	31.0	31.0	5.6	4.63	0.508	1.190	0.604	0.718	0.0613	28.4	2571
PQ26/25	17.0	36.0	5.7	5.55	0.716	1.180	0.845	0.997	0.0832	32.6	2187
PQ32/20	18.9	42.0	6.6	5.55	0.475	1.700	0.808	1.373	0.1417	36.3	3046
PQ32/30	35.5	55.0	6.7	7.46	0.929	1.610	1.496	2.409	0.2326	46.9	2142
PQ35/35	59.0	73.0	7.5	8.79	1.126	1.960	2.206	4.324	0.4510	60.7	2025
PQ40/40	97.2	95.0	8.4	10.20	1.622	2.010	3.260	6.552	0.6280	77.1	1792
PQ50/50	158.5	195.0	10.3	11.30	1.321	3.280	4.332	14.209	1.8120	113.9	2800

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for PQ/(low profile), Ferrite Cores

The PQ/lp cores are a cut down version of the standard PQ cores. The PQ/lp cores have a substantially reduced total height. The dimensional outline for PQ ferrite cores is shown in Figure 3-41. Dimensional data for PQ ferrite cores is given in Table 3-40; design data is given in Table 3-41.

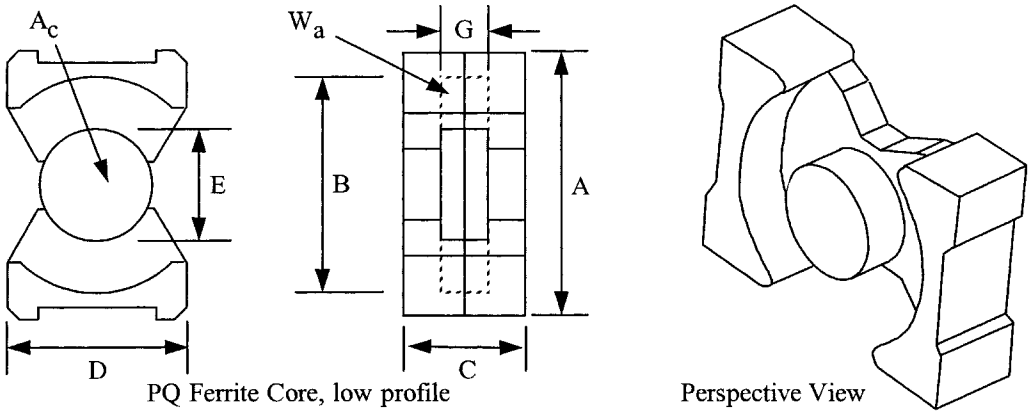


Figure 3-41. Dimension Outline for PQ/lp Ferrite Cores.

Table 3-40. Dimensional Data for PQ/lp Ferrite Cores.

PQ/lp, Ferrite Cores (Ferrite International)						
Part No.	A cm	B cm	C cm	D cm	E cm	G cm
PQ20-14-14lp	2.125	1.801	1.352	1.400	0.884	0.762
PQ26-16-14lp	2.724	2.250	1.630	1.900	1.199	0.762
PQ32-17-22lp	3.302	2.751	1.670	2.200	1.348	0.762
PQ35-17-26lp	3.612	3.200	1.738	2.601	1.435	0.762
PQ40-18-28lp	4.148	3.701	1.784	2.799	1.491	0.762

Table 3-41. Design Data for PQ/lp Ferrite Cores.

PQ/lp, Ferrite Cores (TSC Ferrite International)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
PQ20-14-14lp	5.4	12.5	4.4	3.2	0.563	0.620	0.349	0.217	0.0123	15.4	1948
PQ26-16-19lp	7.9	28.0	5.6	3.9	0.336	1.190	0.400	0.477	0.0407	25.4	3170
PQ32-17-22lp	12.5	39.4	6.6	4.8	0.315	1.700	0.535	0.909	0.0937	32.9	3659
PQ35-17-26lp	17.8	44.9	7.4	5.3	0.343	1.960	0.672	1.318	0.1389	40.4	3893
PQ40-18-28lp	24.9	63.5	8.3	5.8	0.419	2.010	0.842	1.692	0.1637	48.0	3850
*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.											

Design and Dimensional Data for RM, Ferrite Cores

The RM cores, (**R**ectangular **M**odular), were developed for high Printed Circuit Board, (PCB), packing densities. The dimensional outline for RM ferrite cores is shown in Figure 3-42. Dimensional data for RM ferrite cores is given in Table 3-42; design data is given in Table 3-43.

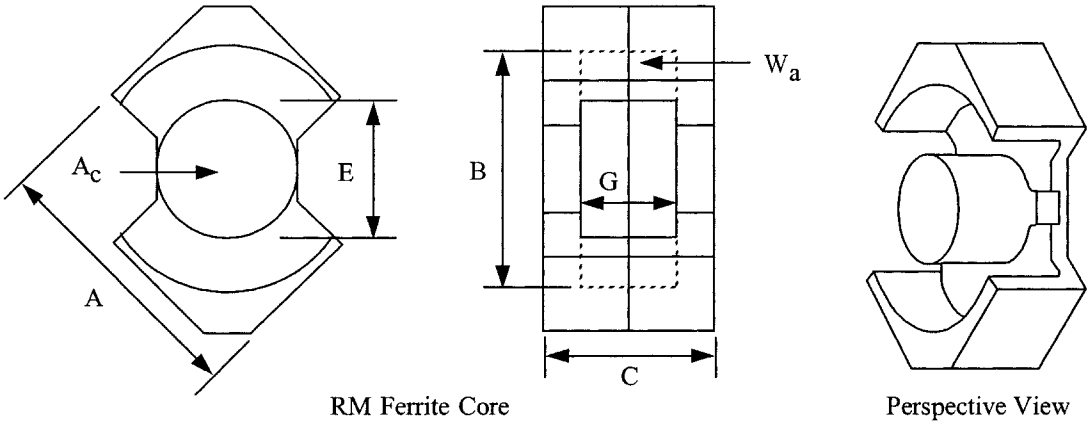


Figure 3-42. Dimension Outline for RM Ferrite Cores.

Table 3-42. Dimensional Data for RM Ferrite Cores.

RM, Ferrite Cores (TDK)											
Part No.	A cm	B cm	C cm	E cm	G cm	Part No.	A cm	B cm	C cm	E cm	G cm
RM-4	0.963	0.815	1.04	0.38	0.72	RM-10	2.415	2.165	1.86	1.07	1.27
RM-5	1.205	1.04	1.04	0.48	0.65	RM-12	2.925	2.55	2.35	1.26	1.71
RM-6	1.44	1.265	1.24	0.63	0.82	RM-14	3.42	2.95	2.88	1.47	2.11
RM-8	1.935	1.73	1.64	0.84	1.1						

Table 3-43. Design Data for RM Ferrite Cores.

RM, Ferrite Cores (TDK)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
RM-4	1.1	1.7	2.0	2.27	1.121	0.140	0.157	0.0219	0.0006	5.9	489
RM-5	1.6	3.0	2.5	2.24	0.768	0.237	0.182	0.0431	0.0016	7.9	869
RM-6	2.9	5.5	3.1	2.86	0.710	0.366	0.260	0.0953	0.0044	11.3	1130
RM-8	7.3	13.0	4.2	3.80	0.766	0.640	0.490	0.3133	0.0191	20.2	1233
RM-10	13.2	23.0	5.3	4.40	0.709	0.980	0.695	0.6814	0.0502	29.6	1833
RM-12	24.4	42.0	6.2	5.69	0.788	1.400	1.103	1.5440	0.1389	44.6	2434
RM-14	39.9	70.0	7.2	6.90	0.830	1.880	1.561	2.7790	0.2755	62.8	2869

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for RM/(low profile), Ferrite Cores

Surface Mount Device, SMD

The RM/lp ferrite cores are a cut down version of the standard RM cores. The dimensional outline for RM/lp ferrite cores is shown in Figure 3-43. Dimensional data for RM/lp ferrite cores is given in Table 3-44; design data is given in Table 3-45.

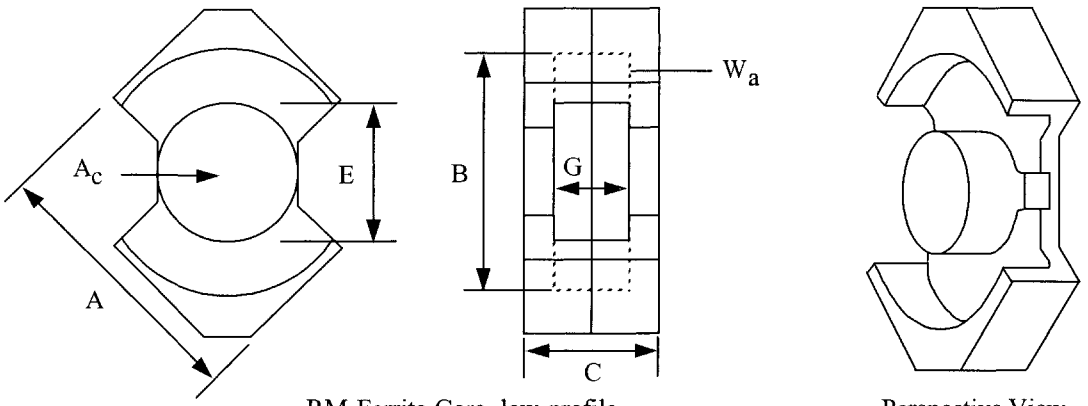


Figure 3-43. Dimension Outline for RM/lp Ferrite Cores.

Table 3-44. Dimensional Data for RM/lp Ferrite Cores.

RM/lp, Ferrite Cores (Ferroxcube)											
Part No.	A cm	B cm	C cm	E cm	G cm	Part No.	A cm	B cm	C cm	E cm	G cm
RM4/ILP	0.980	0.795	0.780	0.390	0.430	RM8/ILP	1.970	1.700	1.160	0.855	0.590
RM5/ILP	1.230	1.020	0.780	0.490	0.360	RM10/ILP	2.470	2.120	1.300	1.090	0.670
RM6S/LP	1.470	1.240	0.900	0.640	0.450	RM12/ILP	2.980	2.500	1.680	1.280	0.900
RM7/ILP	1.720	1.475	0.980	0.725	0.470	RM14/ILP	3.470	2.900	2.050	1.500	1.110

Table 3-45. Design Data for RM/lp Ferrite Cores.

RM/lp, Ferrite Cores (Ferroxcube)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	AL mh/1K
RM4/ILP	0.6	1.5	2.0	1.73	0.770	0.113	0.087	0.00984	0.00022	5.0	609
RM5/ILP	0.9	2.2	2.5	1.75	0.525	0.181	0.095	0.01727	0.00049	6.9	1022
RM6S/LP	1.5	4.2	3.1	2.18	0.433	0.312	0.135	0.04212	0.00169	9.6	1380
RM7/ILP	2.3	6.0	3.6	2.35	0.444	0.396	0.176	0.06979	0.00306	12.7	1587
RM8/ILP	3.7	10.0	4.2	2.87	0.449	0.554	0.249	0.13810	0.00733	16.9	1783
RM10/ILP	6.4	17.0	5.2	3.39	0.426	0.809	0.345	0.27915	0.01736	25.0	2435
RM12/ILP	11.9	34.0	6.1	4.20	0.439	1.250	0.549	0.68625	0.05627	37.8	3087
RM14/ILP	19.5	55.0	7.1	5.09	0.463	1.680	0.777	1.30536	0.12404	52.5	3652
*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.											

Design and Dimensional Data for DS, Ferrite Cores

The DS ferrite cores are similar to standard Pot Cores. These cores have a large opening to bring out many strands of wire, which is convenient for high power and multiple outputs. The dimensional outline for DS ferrite cores is shown in Figure 3-44. Dimensional data for DS ferrite cores is given in Table 3-46; design data is given in Table 3-47.

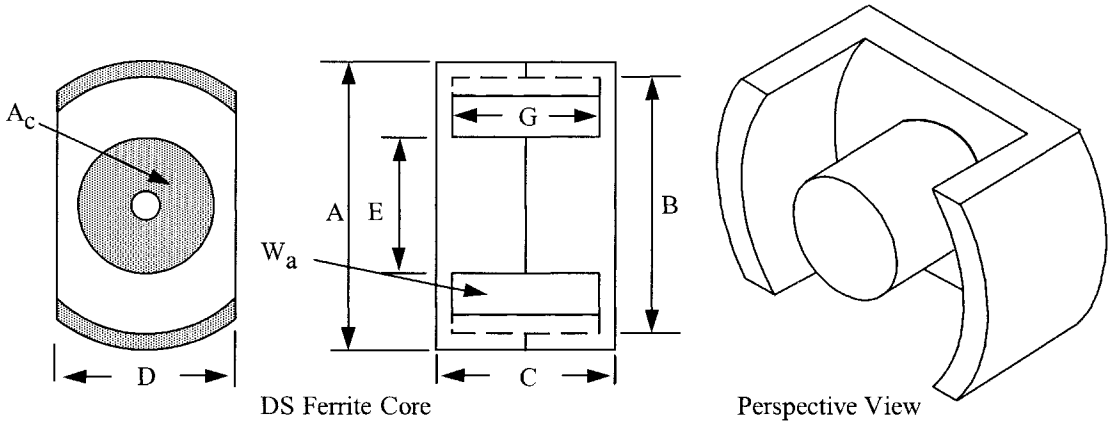


Figure 3-44. Dimension Outline for DS Ferrite Cores.

Table 3-46. Dimensional Data for DS Ferrite Cores.

DS, Ferrite Cores (Magnetics)						
Part No.	A cm	B cm	C cm	D cm	E cm	G cm
DS-42311	2.286	1.793	1.108	1.540	0.990	0.726
DS-42318	2.286	1.793	1.800	1.540	0.990	1.386
DS-42616	2.550	2.121	1.610	1.709	1.148	1.102
DS-43019	3.000	2.500	1.880	1.709	1.351	1.300
DS-43622	3.561	2.985	2.170	2.385	1.610	1.458
DS-44229	4.240	3.561	2.960	2.840	1.770	2.042

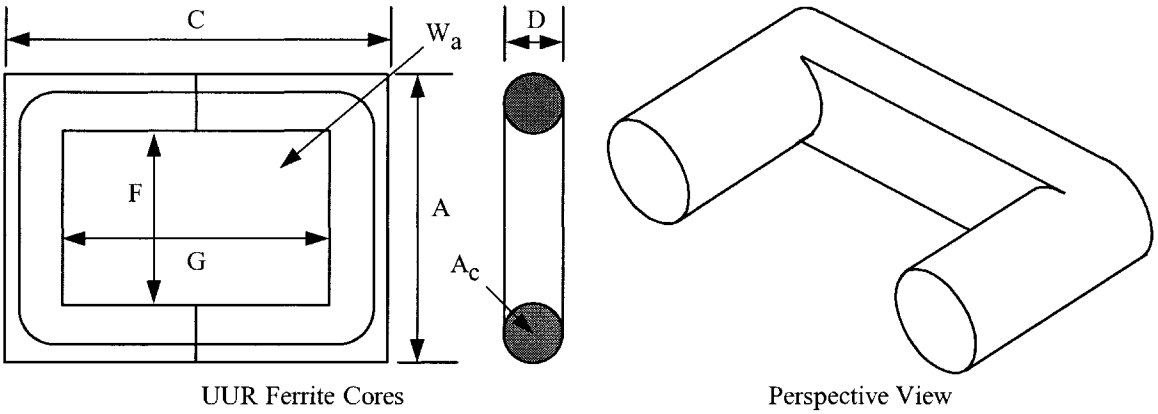
Table 3-47. Design Data for DS Ferrite Cores.

DS, Ferrite Cores (Magnetics)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
DS-42311	4.7	10.0	4.5	2.68	0.770	0.378	0.291	0.110	0.00368	16.2	1487
DS-42318	9.1	13.0	4.6	3.99	1.366	0.407	0.556	0.227	0.00800	21.1	1267
DS-42616	10.1	15.0	5.3	3.89	0.855	0.627	0.536	0.336	0.01593	23.1	1667
DS-43019	16.7	22.0	6.3	4.62	0.778	0.960	0.747	0.717	0.04380	31.9	1933
DS-43622	26.6	37.0	7.5	5.28	0.802	1.250	1.002	1.253	0.08404	44.2	2333
DS-44229	56.0	78.0	8.6	7.17	1.028	1.780	1.829	3.255	0.26917	67.7	2800

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for UUR, Ferrite Cores

The UUR ferrite cores feature round legs with rather small cross sections. The round legs allow easy winding with either wire or foil. U cores are used for power, pulse and high-voltage transformers. The dimensional outline for UUR ferrite cores is shown in Figure 3-45. Dimensional data for UUR ferrite cores is given in Table 3-48; design data is given in Table 3-49.



UUR Ferrite Cores Perspective View

Figure 3-45. Dimension Outline for UUR Ferrite Cores.

Table 3-48. Dimensional Data for UUR Ferrite Cores.

UUR, Ferrite Cores (Magnetics)					
Part No.	A cm	C cm	D cm	F cm	G cm
UUR-44121	4.196	4.120	1.170	1.910	2.180
UUR-44119	4.196	4.180	1.170	1.910	2.680
UUR-44125	4.196	5.080	1.170	1.910	3.140
UUR-44130	4.196	6.100	1.170	1.910	4.160

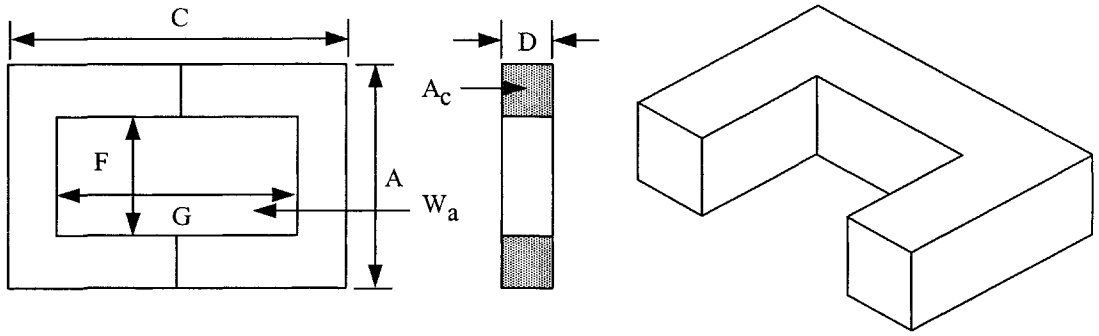
Table 3-49. Design Data for UUR Ferrite Cores.

UUR, Ferrite Cores (Magnetics)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
UUR-44121	119.0	55.0	8.0	11.3	4.215	0.988	4.164	4.114	0.202	98.5	616
UUR-44119	146.2	54.0	8.0	12.1	5.619	0.911	5.119	4.663	0.211	102.9	710
UUR-44125	171.3	64.0	8.0	13.3	6.070	0.988	5.997	5.925	0.291	116.1	702
UUR-44130	227.0	75.0	8.0	15.3	8.043	0.988	7.946	7.850	0.386	134.9	610

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for UUS, Ferrite Cores

The UUS ferrite cores feature square or rectangular legs. U cores are used for power, pulse and high-voltage transformers. The dimensional outline for UUS ferrite cores is shown in Figure 3-46. Dimensional data for UUS ferrite cores is given in Table 3-50; design data is given in Table 3-51.



UUS Ferrite Core

Perspective View

Figure 3-46. Dimension Outline for UUS Ferrite Cores.

Table 3-50. Dimensional Data for UUS Ferrite Cores.

UUS, Ferrite Cores (Ferroxcube)					
Part No.	A cm	C cm	D cm	F cm	G cm
U10-08-03	1.000	1.640	0.290	0.435	1.000
U20-16-07	2.080	3.120	0.750	0.640	1.660
U25-20-13	2.480	3.920	1.270	0.840	2.280
U30-25-16	3.130	5.060	1.600	1.050	2.980
U67-27-14	6.730	5.400	1.430	3.880	2.540
U93-76-16	9.300	15.200	1.600	3.620	9.600

Table 3-51. Design Data for UUS Ferrite Cores.

UUS, Ferrite Cores (Ferroxcube)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
U10-08-03	3.5	1.8	2.2	3.8	5.370	0.081	0.435	0.0352	0.000510	8.1	213
U20-16-07	16.4	19.0	4.4	6.8	1.896	0.560	1.062	0.5949	0.030661	29.5	826
U25-20-13	41.6	47.0	6.1	8.8	1.841	1.040	1.915	1.9920	0.135669	51.1	1261
U30-25-16	83.9	86.0	7.5	11.1	1.943	1.610	3.129	5.0380	0.430427	82.5	1609
U67-27-14	435.0	170.0	12.4	17.3	4.831	2.040	9.855	20.1050	1.321661	240.2	1652
U93-76-16	1875.2	800.0	15.2	35.4	7.757	4.480	34.752	155.6890	18.386023	605.3	1478

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for Toroidal, Ferrite Cores

The toroidal ferrite core has the best possible shape from the magnetic point of view. The magnetic flux path is completely enclosed within the magnetic structure. The toroidal structure fully exploits the capabilities of a ferrite material. The dimensional outline for toroidal ferrite cores is shown in Figure 3-47. Dimensional data for toroidal ferrite cores is given in Table 3-52; design data is given in Table 3-53.

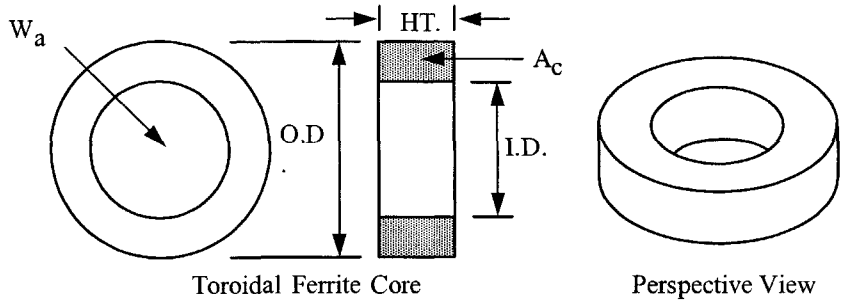


Figure 3-47. Dimension Outline for Toroidal Ferrite Cores.

Table 3-52. Dimensional Data for Toroidal Ferrite Cores.

Toroidal, Ferrite Z Coated Cores (Magnetics)							
Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm
TC-40907	1.016	0.495	0.768	TC-42206	2.286	1.295	0.691
TC-41005	1.016	0.411	0.529	TC-42908	2.990	1.811	0.806
TC-41206	1.334	0.452	0.691	TC-43806	3.925	1.790	0.691
TC-41306	1.334	0.729	0.691	TC-43610	3.689	2.212	1.065
TC-41605	1.664	0.812	0.521	TC-43813	3.925	1.790	1.334
TC-42106	2.134	1.193	0.691	TC-48613	8.738	5.389	1.334

Table 3-53. Design Data for Toroidal Ferrite Cores.

Toroidal, Ferrite Cores (Magnetics)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	*AL mh/1K
TC-41005	0.8	1.2	1.7	2.07	1.243	0.107	0.133	0.014196	0.000366	5.3	657
TC-40907	1.4	1.6	2.0	2.27	1.422	0.135	0.192	0.025980	0.000687	6.6	752
TC-41206	1.2	3.3	2.2	2.46	0.724	0.221	0.160	0.035462	0.001443	8.6	1130
TC-41306	3.2	2.4	2.2	3.12	2.856	0.146	0.417	0.060939	0.001638	10.2	591
TC-41605	4.0	2.8	2.2	3.68	3.386	0.153	0.518	0.079231	0.002240	12.8	548
TC-42106	11.2	5.4	2.8	5.00	4.840	0.231	1.118	0.258216	0.008482	22.7	600
TC-42206	13.7	6.4	2.9	5.42	5.268	0.250	1.317	0.329283	0.011221	25.8	600
TC-42908	33.7	12.9	3.7	7.32	7.196	0.358	2.576	0.922167	0.035869	44.6	630
TC-43806	38.0	29.4	4.2	8.97	4.006	0.628	2.516	1.580357	0.093505	61.2	878
TC-43610	63.6	26.4	4.7	8.30	6.742	0.570	3.843	2.190456	0.107283	68.5	883
TC-43813	47.2	51.7	5.3	8.30	2.188	1.150	2.516	2.893966	0.252394	71.0	1665
TC-48613	740.1	203.0	9.1	21.50	12.197	1.870	22.809	42.652794	3.496437	348.0	1091

*This AL value has been normalized for a permeability of 1K. For a close approximation of AL for other values of permeability, multiply this AL value by the new permeability in kilo-perm. If the new permeability is 2500, then use 2.5.

Design and Dimensional Data for Toroidal, MPP Powder Cores

The dimensional outline for MPP powder cores is shown in Figure 3-48. Dimensional data for MPP powder cores is given in Table 3-54; design data is given in Table 3-55. For more information, see Chapter 2.

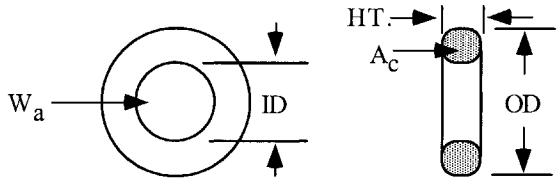


Figure 3-48. Dimension Outline for Toroidal MPP Powder Cores.

Table 3-54. Dimensional Data for Toroidal MPP Powder Cores.

MPP Powder Cores, Magnetics 60 mu (coated)											
Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm
55021	0.699	0.229	0.343	55381	1.803	0.902	0.711	55076	3.670	2.150	1.135
55281	1.029	0.427	0.381	55848	2.110	1.207	0.711	55083	4.080	2.330	1.537
55291	1.029	0.427	0.460	55059	2.360	1.334	0.838	55439	4.760	2.330	1.892
55041	1.080	0.457	0.460	55351	2.430	1.377	0.965	55090	4.760	2.790	1.613
55131	1.181	0.584	0.460	55894	2.770	1.410	1.194	55716	5.170	3.090	1.435
55051	1.346	0.699	0.551	55071	3.380	1.930	1.143	55110	5.800	3.470	1.486
55121	1.740	0.953	0.711	55586	3.520	2.260	0.978				

Table 3-55. Design Data for Toroidal MPP Powder Cores.

MPP Powder Cores, Magnetics 60 mu (coated)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a / A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	AL mh/1K
55021	0.10	0.553	1.10	1.36	0.723	0.047	0.034	0.001610	0.000027	2.30	24
55281	0.70	1.307	1.40	2.18	1.729	0.075	0.130	0.009757	0.000204	4.80	25
55291	0.70	1.645	1.60	2.18	1.376	0.095	0.130	0.012359	0.000301	5.10	32
55041	0.90	1.795	1.60	2.38	1.500	0.100	0.150	0.014998	0.000375	5.60	32
55131	1.50	1.993	1.70	2.69	2.759	0.091	0.250	0.022735	0.000492	6.90	26
55051	2.50	2.886	2.00	3.12	3.175	0.114	0.362	0.041279	0.000961	9.30	27
55121	6.10	6.373	2.50	4.11	3.563	0.192	0.684	0.131267	0.003985	16.00	35
55381	5.60	7.670	2.60	4.14	2.634	0.232	0.611	0.141747	0.005099	16.30	43
55848	11.10	8.836	2.80	5.09	4.898	0.226	1.107	0.250092	0.008001	22.70	32
55059	15.20	14.993	3.20	5.67	4.097	0.331	1.356	0.448857	0.018406	28.60	43
55351	17.90	18.706	3.50	5.88	3.727	0.388	1.446	0.561153	0.024969	31.40	51
55894	22.30	33.652	4.10	6.35	2.320	0.654	1.517	0.992423	0.062916	39.80	75
55071	46.20	44.086	4.50	8.15	4.263	0.672	2.865	1.925420	0.114179	58.30	61
55586	61.40	32.806	4.40	8.95	8.681	0.454	3.941	1.789128	0.074166	64.40	38
55076	60.20	48.692	4.80	8.98	5.255	0.678	3.563	2.415897	0.137877	68.00	56
55083	85.30	86.198	5.70	9.84	3.910	1.072	4.191	4.492709	0.336608	87.50	81
55439	101.90	170.140	6.80	10.74	2.106	1.990	4.191	8.340010	0.971244	112.60	135
55090	136.90	122.576	6.40	11.63	4.497	1.340	6.026	8.075211	0.677485	117.20	86
55716	169.30	132.540	6.40	12.73	5.917	1.251	7.402	9.260268	0.720435	133.10	73
55110	233.30	164.500	7.00	14.300	6.474	1.444	9.348	13.498792	1.111049	164.70	75

Design and Dimensional Data for Toroidal, Iron Powder Cores

The dimensional outline for Iron powder cores is shown in Figure 3-49. Dimensional data for Iron powder cores is given in Table 3-56; design data is given in Table 3-57. For more information, see Chapter 2.

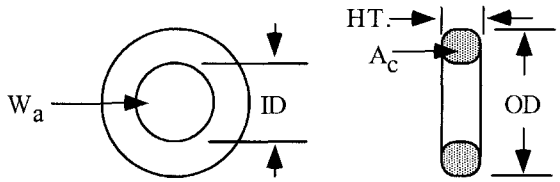


Figure 3-49. Dimension Outline for Toroidal Iron Powder Cores.

Table 3-56. Dimensional Data for Toroidal Iron Powder Cores.

Iron Powder Cores, Micrometals 75 mu (coated)											
Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm
T20-26	0.508	0.224	0.178	T50-26	1.270	0.770	0.483	T130-26	3.300	1.980	1.110
T25-26	0.648	0.305	0.244	T60-26	1.520	0.853	0.594	T132-26	3.300	1.780	1.110
T26-26	0.673	0.267	0.483	T68-26	1.750	0.940	0.483	T131-26	3.300	1.630	1.110
T30-26	0.780	0.384	0.325	T80-26	2.020	1.260	0.635	T141-26	3.590	2.240	1.050
T37-26	0.953	0.521	0.325	T94-26	2.390	1.420	0.792	T150-26	3.840	2.150	1.110
T38-26	0.953	0.445	0.483	T90-26	2.290	1.400	0.953	T175-26	4.450	2.720	1.650
T44-26	1.120	0.582	0.404	T106-26	2.690	1.450	1.110				

Table 3-57. Design Data for Toroidal Iron Powder Cores.

Iron Powder Cores, Micrometals 75 mu (coated)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a / A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	AL mh/1K
T20-26	0.10	0.19	0.70	1.15	1.713	0.023	0.039	0.000900	0.000010	1.2	18.5
T25-26	0.24	0.39	0.90	1.50	1.973	0.037	0.073	0.002700	0.000038	2.0	24.5
T26-26	0.26	0.93	1.30	1.47	0.644	0.090	0.058	0.005030	0.000130	2.6	57
T30-26	0.47	0.77	1.14	1.84	1.933	0.060	0.116	0.006940	0.000140	3.1	33.5
T37-26	0.97	1.04	1.28	2.31	3.328	0.064	0.213	0.013630	0.000270	4.5	28.5
T38-26	0.85	1.74	1.50	2.18	1.360	0.114	0.155	0.017700	0.000520	4.8	49
T44-26	1.46	1.86	1.50	2.68	2.687	0.099	0.266	0.026320	0.000670	6.2	37
T50-26	2.96	2.50	1.80	3.19	4.071	0.112	0.456	0.052120	0.001300	8.8	33
T60-26	4.40	4.89	2.20	3.74	3.053	0.187	0.571	0.106800	0.003680	12.2	50
T68-26	5.36	5.30	2.17	4.23	3.877	0.179	0.694	0.124150	0.004090	14.4	43.5
T80-26	11.66	8.31	2.63	5.14	5.394	0.231	1.246	0.287880	0.010100	21.4	46
T94-26	17.44	15.13	3.10	5.97	4.373	0.362	1.583	0.573000	0.026770	29.6	60
T90-26	18.37	15.98	3.40	5.78	3.894	0.395	1.538	0.607740	0.029600	29.4	70
T106-26	23.05	29.94	3.93	6.49	2.504	0.659	1.650	1.087660	0.072990	38.0	93
T130-26	48.33	40.46	4.40	8.28	4.408	0.698	3.077	2.148800	0.135810	56.9	81
T132-26	39.05	44.85	4.40	7.96	3.089	0.805	2.487	2.002190	0.145990	53.9	103
T131-26	32.75	47.83	4.40	7.72	2.357	0.885	2.086	1.845820	0.147960	51.7	116
T141-26	62.70	45.70	4.60	9.14	5.743	0.674	3.871	2.608887	0.154516	66.6	75
T150-26	62.55	58.24	4.85	9.38	4.091	0.887	3.629	3.218620	0.235550	71.6	96
T175-26	128.04	105.05	6.20	11.20	4.334	1.340	5.808	7.782300	0.672790	107.4	105

Design and Dimensional Data for Toroidal, Sendust Powder Cores

The dimensional outline for Sendust powder cores is shown in Figure 3-50. Dimensional data for Sendust powder cores is given in Table 3-58; design data is given in Table 3-59. For more information, see Chapter 2.

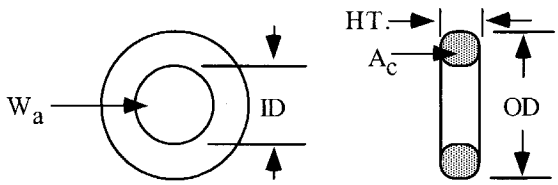


Figure 3-50. Dimension Outline for Toroidal Sendust Powder Cores.

Table 3-58. Dimensional Data for Toroidal Sendust Powder Cores.

Sendust Powder Cores, Magnetics 60 mu (coated)											
Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm
77021	0.699	0.229	0.343	77381	1.803	0.902	0.711	77076	3.670	2.150	1.135
77281	1.029	0.427	0.381	77848	2.110	1.207	0.711	77083	4.080	2.330	1.537
77291	1.029	0.427	0.460	77059	2.360	1.334	0.838	77439	4.760	2.330	1.892
77041	1.080	0.457	0.460	77351	2.430	1.377	0.965	77090	4.760	2.790	1.613
77131	1.181	0.584	0.460	77894	2.770	1.410	1.194	77716	5.170	3.090	1.435
77051	1.346	0.699	0.551	77071	3.380	1.930	1.143	77110	5.800	3.470	1.486
77121	1.740	0.953	0.711	77586	3.520	2.260	0.978				

Table 3-59. Design Data for Toroidal Sendust Powder Cores.

Sendust Powder Cores, Magnetics 60 mu (coated)											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	AL mh/1K
77021	0.10	0.448	1.10	1.36	0.723	0.047	0.034	0.001610	0.000027	2.30	24
77281	0.70	1.148	1.40	2.18	1.729	0.075	0.130	0.009757	0.000204	4.80	25
77291	0.70	1.442	1.60	2.18	1.376	0.095	0.130	0.012359	0.000301	5.10	32
77041	0.90	1.666	1.60	2.38	1.500	0.100	0.150	0.014998	0.000375	5.60	32
77131	1.50	1.706	1.70	2.69	2.759	0.091	0.250	0.022735	0.000492	6.90	26
77051	2.50	2.490	2.00	3.12	3.175	0.114	0.362	0.041279	0.000961	9.30	27
77121	6.10	5.524	2.50	4.11	3.563	0.192	0.684	0.131267	0.003985	16.00	35
77381	5.60	6.723	2.60	4.14	2.634	0.232	0.611	0.141747	0.005099	16.30	43
77848	11.10	8.052	2.80	5.09	4.898	0.226	1.107	0.250092	0.008001	22.70	32
77059	15.20	13.137	3.20	5.67	4.097	0.331	1.356	0.448857	0.018406	28.60	43
77351	17.90	15.970	3.50	5.88	3.727	0.388	1.446	0.561153	0.024969	31.40	51
77894	22.30	29.070	4.10	6.35	2.320	0.654	1.517	0.992423	0.062916	39.80	75
77071	46.20	38.338	4.50	8.15	4.263	0.672	2.865	1.925420	0.114179	58.30	61
77586	61.40	28.443	4.40	8.95	8.681	0.454	3.941	1.789128	0.074166	64.40	38
77076	60.20	42.619	4.80	8.98	5.255	0.678	3.563	2.415897	0.137877	68.00	56
77083	85.30	73.839	5.70	9.84	3.910	1.072	4.191	4.492709	0.336608	87.50	81
77439	101.90	149.608	6.80	10.74	2.106	1.990	4.191	8.340010	0.971244	112.60	135
77090	136.90	109.089	6.40	11.63	4.497	1.340	6.026	8.075211	0.677485	117.20	86
77716	169.30	111.477	6.40	12.73	5.917	1.251	7.402	9.260268	0.720435	133.10	73
77110	233.30	144.544	7.00	14.300	6.474	1.444	9.348	13.498792	1.111049	164.70	75

Design and Dimensional Data for Toroidal, High Flux Powder Cores

The dimensional outline for High Flux powder cores is shown in Figure 3-51. Dimensional data for High Flux powder cores is given in Table 3-60; design data is given in Table 3-61. For more information, see Chapter 2.

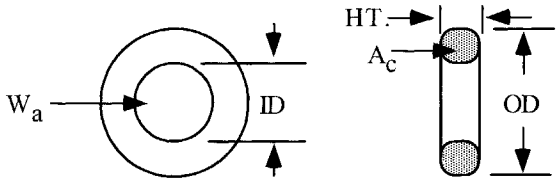


Figure 3-51. Dimension Outline for Toroidal High Flux Powder Cores.

Table 3-60. Dimensional Data for Toroidal High Flux Powder Cores.

High Flux Powder Cores, Magnetics 60 mu (coated)											
Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm	Part No.	OD cm	ID cm	HT cm
58021	0.699	0.229	0.343	58381	1.803	0.902	0.711	58076	3.670	2.150	1.135
58281	1.029	0.427	0.381	58848	2.110	1.207	0.711	58083	4.080	2.330	1.537
58291	1.029	0.427	0.460	58059	2.360	1.334	0.838	58439	4.760	2.330	1.892
58041	1.080	0.457	0.460	58351	2.430	1.377	0.965	58090	4.760	2.790	1.613
58131	1.181	0.584	0.460	58894	2.770	1.410	1.194	58716	5.170	3.090	1.435
58051	1.346	0.699	0.551	58071	3.380	1.930	1.143	58110	5.800	3.470	1.486
58121	1.740	0.953	0.711	58586	3.520	2.260	0.978				

Table 3-61. Design Data for Toroidal High Flux Powder Cores.

High Flux Powder Cores, Magnetics 60 mu (coated)											
Part No.	W_{tcu} grams	Wtfe grams	MLT cm	MPL cm	W_a / A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	AL mh/1K
58021	0.10	0.504	1.10	1.36	0.723	0.047	0.034	0.001610	0.000027	2.30	24
58281	0.70	1.222	1.40	2.18	1.729	0.075	0.130	0.009757	0.000204	4.80	25
58291	0.70	1.598	1.60	2.18	1.376	0.095	0.130	0.012359	0.000301	5.10	32
58041	0.90	1.692	1.60	2.38	1.500	0.100	0.150	0.014998	0.000375	5.60	32
58131	1.50	1.880	1.70	2.69	2.759	0.091	0.250	0.022735	0.000492	6.90	26
58051	2.50	2.726	2.00	3.12	3.175	0.114	0.362	0.041279	0.000961	9.30	27
58121	6.10	6.016	2.50	4.11	3.563	0.192	0.684	0.131267	0.003985	16.00	35
58381	5.60	7.238	2.60	4.14	2.634	0.232	0.611	0.141747	0.005099	16.30	43
58848	11.10	8.366	2.80	5.09	4.898	0.226	1.107	0.250092	0.008001	22.70	32
58059	15.20	14.100	3.20	5.67	4.097	0.331	1.356	0.448857	0.018406	28.60	43
58351	17.90	17.672	3.50	5.88	3.727	0.388	1.446	0.561153	0.024969	31.40	51
58894	22.30	31.772	4.10	6.35	2.320	0.654	1.517	0.992423	0.062916	39.80	75
58071	46.20	41.548	4.50	8.15	4.263	0.672	2.865	1.925420	0.114179	58.30	61
58586	61.40	30.926	4.40	8.95	8.681	0.454	3.941	1.789128	0.074166	64.40	38
58076	60.20	45.966	4.80	8.98	5.255	0.678	3.563	2.415897	0.137877	68.00	56
58083	85.30	81.310	5.70	9.84	3.910	1.072	4.191	4.492709	0.336608	87.50	81
58439	101.90	160.740	6.80	10.74	2.106	1.990	4.191	8.340010	0.971244	112.60	135
58090	136.90	115.620	6.40	11.63	4.497	1.340	6.026	8.075211	0.677485	117.20	86
58716	169.30	125.020	6.40	12.73	5.917	1.251	7.402	9.260268	0.720435	133.10	73
58110	233.30	155.100	7.00	14.300	6.474	1.444	9.348	13.498792	1.111049	164.70	75

Design and Dimensional Data for EE, Iron Powder Cores

The dimensional outline for EE iron powder cores is shown in Figure 3-52. Dimensional data for EE iron powder cores is given in Table 3-62; design data is given in Table 3-63. For more information, see Chapter 2.

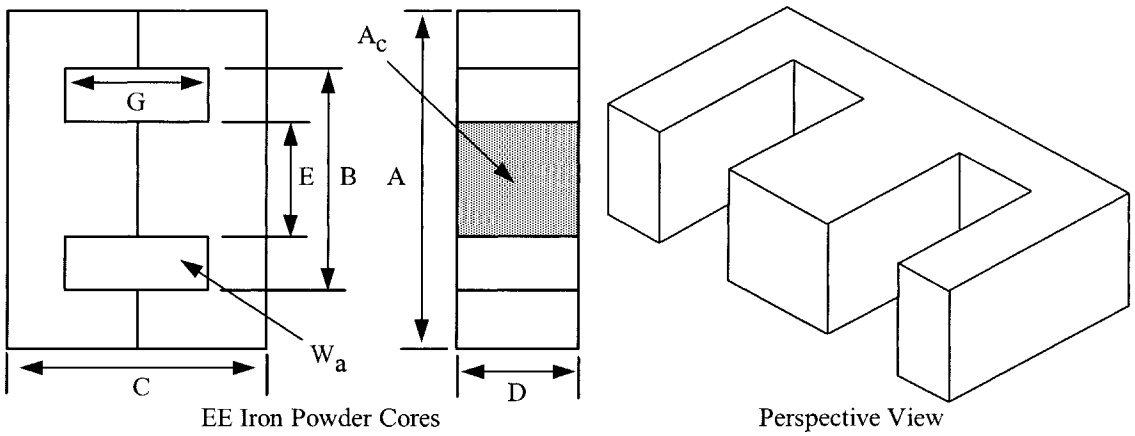


Figure 3-52. Dimension Outline for EE Iron Powder Cores.

Table 3-62. Dimensional Data for EE Iron Powder Cores.

EE, Iron Powder Cores (Micrometals) 75 mu Mix-26													
Part No.	A cm	B cm	C cm	D cm	E cm	G cm	Part No.	A cm	B cm	C cm	D cm	E cm	G cm
DIN-16-5	1.640	1.130	1.630	0.462	0.462	1.200	DIN-42-15	4.280	3.070	4.220	1.500	1.200	3.070
EI-187	1.910	1.430	1.610	0.475	0.475	1.160	DIN-42-20	4.280	3.070	4.220	2.000	1.200	3.070
EE-24-25	2.540	1.910	1.910	0.635	0.635	1.270	EI-625	4.740	3.180	3.940	1.570	1.570	2.420
EI-375	3.490	2.540	2.910	0.953	0.953	1.960	DIN-55-21	5.610	3.860	5.540	2.080	1.730	3.830
EI-21	4.130	2.860	3.410	1.270	1.270	2.140	EI-75	5.690	3.810	4.760	1.890	1.890	2.900

Table 3-63. Design Data for EE Iron Powder Cores.

EE, Iron Powder Cores (Micrometals) 75 mu Mix-26											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	AL mh/1K
DIN-16-5	4.7	5.3	3.3	3.98	1.790	0.224	0.401	0.090	0.00243	11.5	58
EI-187	7.5	5.5	3.8	4.10	2.451	0.226	0.554	0.125	0.00297	14.4	64
E1-24-25	14.3	12.2	5.0	5.10	2.010	0.403	0.810	0.326	0.01062	23.5	92
EI-375	37.1	40.1	6.7	7.40	1.714	0.907	1.555	1.411	0.07624	46.8	134
EI-21	50.2	80.8	8.2	8.40	1.071	1.610	1.725	2.777	0.21852	63.3	210
DIN-42-15	91.3	112.4	8.9	10.40	1.586	1.810	2.870	5.196	0.42050	84.4	195
DIN-42-20	101.5	149.6	9.9	10.40	1.191	2.410	2.870	6.918	0.67054	92.9	232
EI-625	65.2	141.1	9.4	9.5	0.785	2.480	1.948	4.831	0.50894	82.4	265
DIN-55-21	167.9	283.7	11.6	13.2	1.133	3.600	4.079	14.684	1.82699	141.3	275
EI-75	110.7	245.8	11.2	11.5	0.778	3.580	2.784	9.9667	1.27615	119.3	325

Design and Dimensional Data for EE, Sendust Powder Cores

The dimensional outline for EE Sendust cores is shown in Figure 3-53. Dimensional data for EE Sendust powder cores is given in Table 3-64; design data is given in Table 3-65. For more information, see Chapter 2.

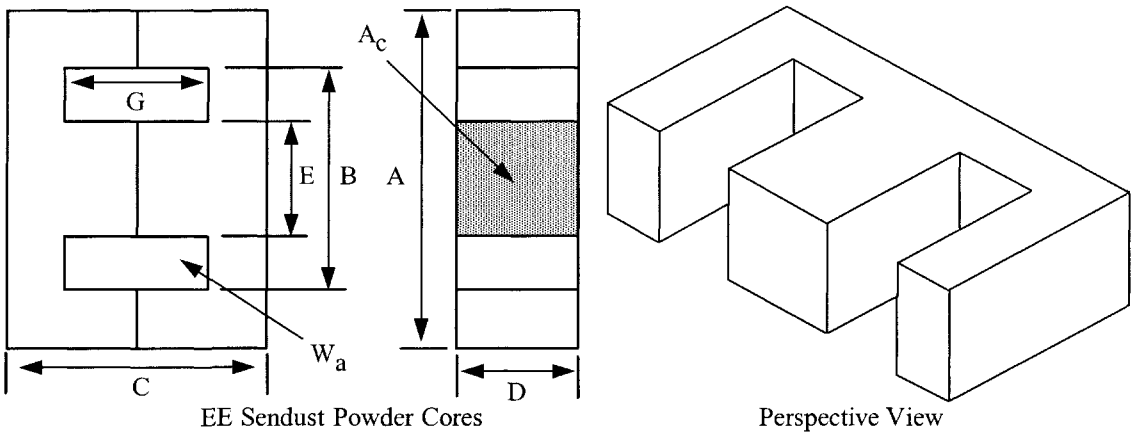


Figure 3-53. Dimension Outline for EE Sendust Powder Cores.

Table 3-64. Dimensional Data for EE Sendust Powder Cores.

EE, Sendust Powder Cores (Magnetics) 60 mu													
Part No.	A cm	B cm	C cm	D cm	E cm	G cm	Part No.	A cm	B cm	C cm	D cm	E cm	G cm
EI-187	1.910	1.430	1.610	0.475	0.475	1.160	DIN-42-15	4.280	3.070	4.220	1.500	1.200	3.070
EE-24-25	2.540	1.910	1.910	0.635	0.635	1.270	DIN-42-20	4.280	3.070	4.220	2.000	1.200	3.070
EI-375	3.490	2.540	2.910	0.953	0.953	1.960	DIN-55-21	5.610	3.860	5.540	2.080	1.730	3.830
EI-21	4.130	2.860	3.410	1.270	1.270	2.140							

Table 3-65. Design Data for EE Sendust Powder Cores.

EE, Sendust Powder Cores (Magnetics) 60 mu											
Part No.	W_{tcu} grams	W_{tfe} grams	MLT cm	MPL cm	W_a/A_c	A_c cm^2	W_a cm^2	A_p cm^4	K_g cm^5	A_t cm^2	AL mh/1K
EI-187	7.5	6.4	3.8	4.01	2.451	0.226	0.554	0.125	0.00297	14.4	48
E1-24-25	14.3	13.1	5.0	4.85	2.010	0.403	0.810	0.326	0.01062	23.5	70
EI-375	37.1	40.8	6.7	6.94	1.714	0.907	1.555	1.411	0.07624	46.8	102
EI-21	50.2	82.6	8.2	7.75	1.071	1.610	1.725	2.777	0.21852	63.3	163
DIN-42-15	91.3	126.0	8.9	9.84	1.586	1.810	2.870	5.196	0.42050	84.4	150
DIN-42-20	101.5	163.0	9.9	9.84	1.191	2.410	2.870	6.918	0.67054	92.9	194
DIN-55-21	167.9	302.0	11.6	12.3	1.133	3.600	4.079	14.684	1.82699	141.3	219

References

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