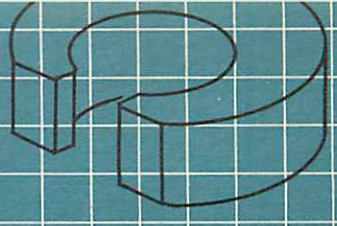
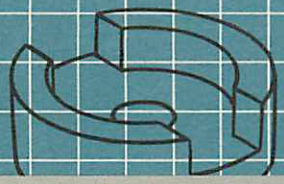
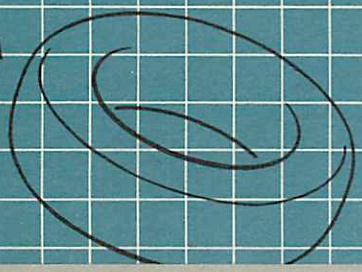
PERMANENT MAGNETS

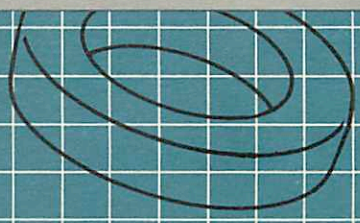




ARNOLD

MOLYBDENUM PERMALLOY POWDER CORES

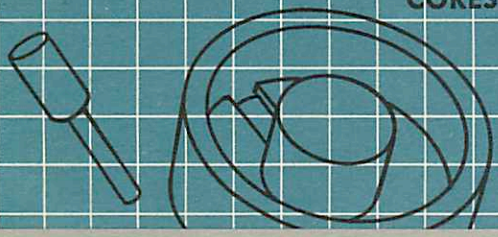


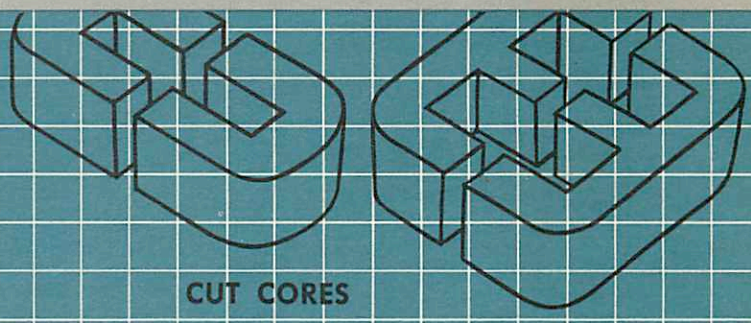


TAPE WOUND CORES

magnetic

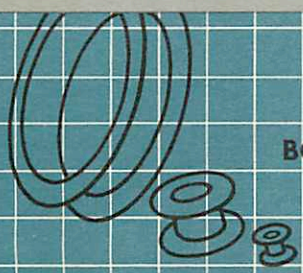
IRON POWDER CORES





CUT CORES

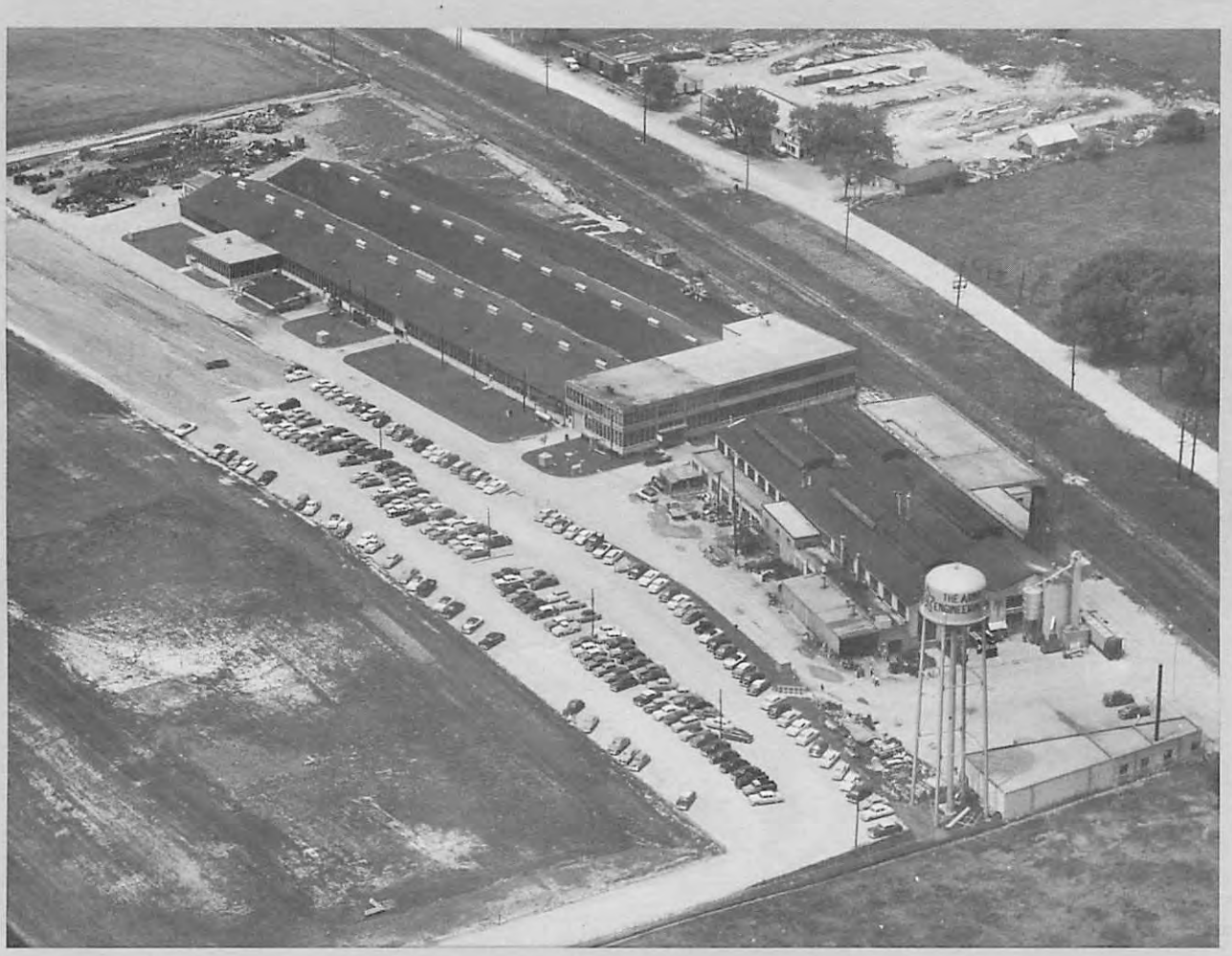
materials



BOBBIN CORES

AL ARNOLD

BULLETIN
GC—106B
AUGUST, 1956



THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

MAIN OFFICE AND PLANT, MARENGO, ILLINOIS

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Specialists in Magnetic Materials

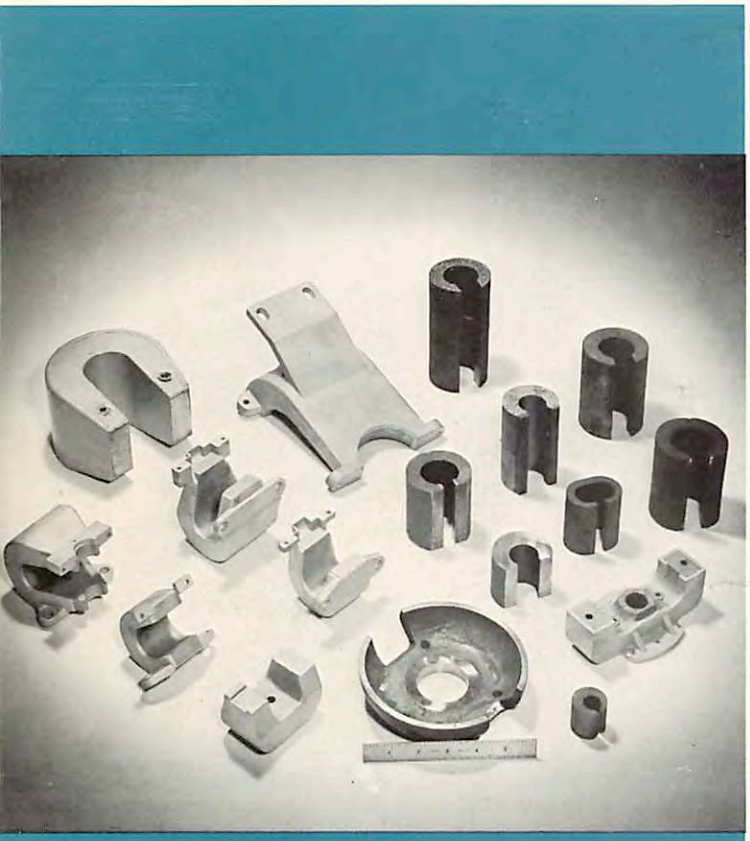
FOREWORD

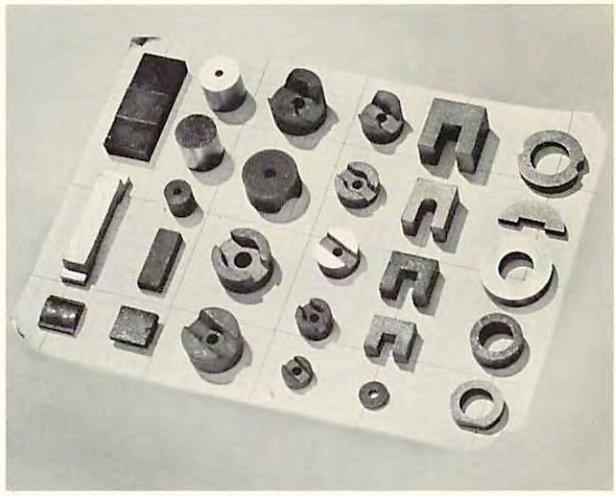
The Arnold Engineering Company, Marengo, Illinois, specializes in the manufacture of magnetic material components for the electrical and electronic industries. The company's growth has kept pace with the phenomenal strides being made in the electrical industry today, largely through the application of improved magnetic and electrical materials.

The latest revision of this catalog is a summary of the more detailed bulletins concerning the magnetic material components manufactured by the Arnold Engineering Company. These components include Alnico permanent magnets as well as other permanent magnet materials, tape wound cores, tape wound bobbin cores, Silectron cores, Molybdenum Permalloy powder cores and iron powder cores. The detailed information on these products may be had by writing for the special bulletin applying to those of interest to you. The bulletin appropriate to each section is listed in the index.

INDEX

PERMANENT MAGNETS





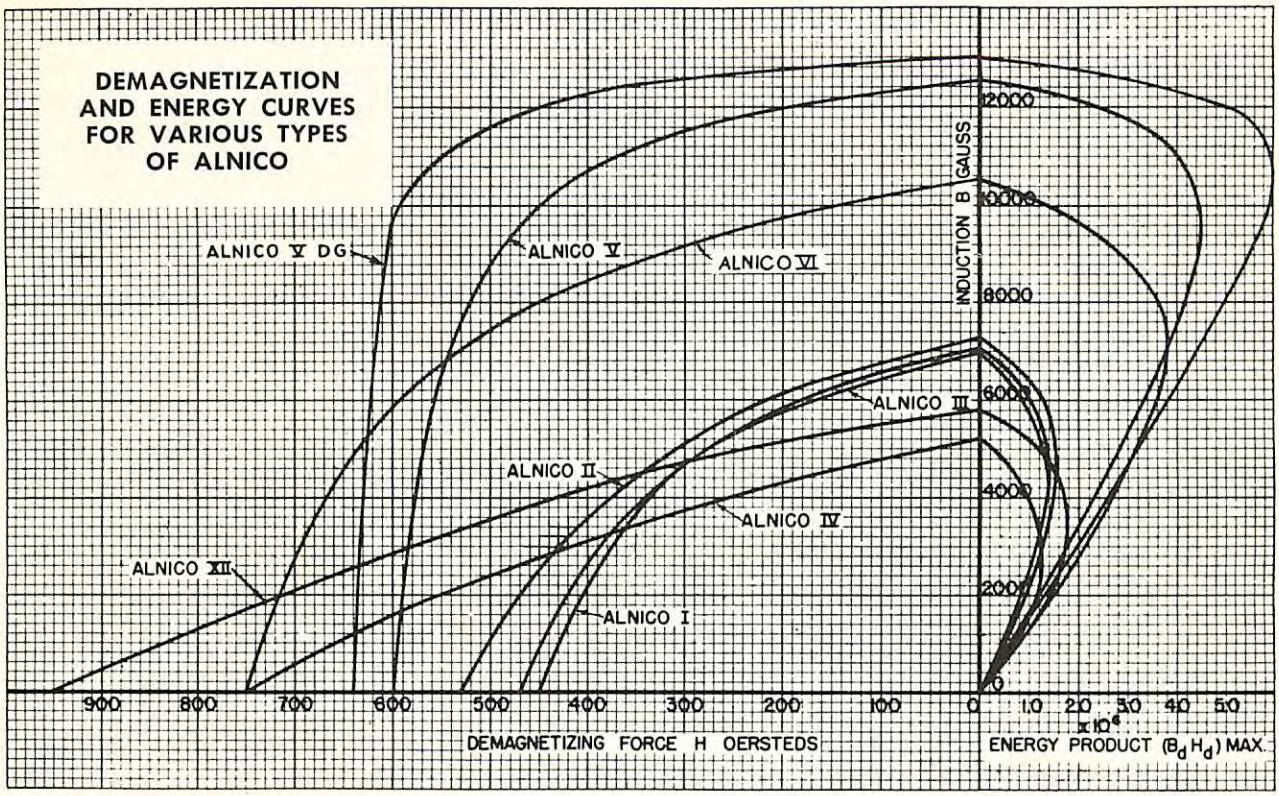
A variety of permanent magnet materials are available, including cast and sintered Alnico, and some special magnet materials. Magnets are usually made to individual customer's requirements. A number of the more popular sizes and shapes of cast and sintered magnets are listed as stock magnets.

Cast Alnico magnets are most commonly made in Alnico V, VI or III. Alnico V has the highest magnetic energy (energy product) and is usually the best choice. Alnico VI has somewhat lower magnetic energy, but better resistance to demagnetization in short lengths. Alnico III has much lower magnetic energy, but is generally more economical for small magnets where high magnetic energy is not required. Alnico castings are limited in the size, shape and direction of magnetization permissible. They are hard, brittle and machinable only by grinding.

Sintered Alnico magnets are commonly made in Alnico II, V or VI. They are slightly lower in magnetic energy than their cast Alnico counterpart. They are economical only in small sizes and of simple shapes adaptable to metal powder pressing.

Magnets made from special material may be machined, formed, punched or otherwise worked at some stage of their processing, depending upon the material. Special consideration is required for each application.

Inquiries for permanent magnets should specify type of magnet material, dimensions and tolerances (include blueprint), surfaces to be ground, finish required, direction of magnetization or location of magnetic poles. Where material or size and shape of magnet required is not known, give complete details on the type of application, magnetic circuit involved (including steel poles, air gaps, etc.) and results desired from the unit (magnetic, electrical and mechanical requirements).



ALNICO PHYSICAL PROPERTIES

Magnet Material	Specific Gravity	Resistivity Microhms/ CM^3 at 25° C.	Mean Coef. of Expansion 20°–300°C.	Tensile Strength Psi.	Transverse Modulus of Rupture —Lbs.	Hardness Rockwell C.
Alnico I	6.9	75	12.6	4197	13973	45
Alnico II	7.1	65	12.4	3080	7230	45
Alnico II-S	6.8	68	12.4	65000	70000	43
Alnico III	6.9	60	13.0	12386	22510	45
Alnico IV	7.0	75	13.1	9174	24483	45
Alnico V	7.3	47	11.3	5456	10826	50
Alnico V DG	7.31	47	11.3	5450	10500	50
Alnico V-S	7.0	50	11.3	—	—	44
Alnico VI	7.3	50	11.4	23000	45000	56
Alnico VI-S	7.0	53	11.3	—	—	44
Alnico VII	7.17	58	11.4	—	2000	60
Alnico X-900	7.2	62	11.0	39500	50000	58

ALNICO MAGNETIC PROPERTIES

Magnet Material	Peak Magnetizing Force Oersteds	Peak Induction Gausses	Remanence Br— Gausses	Coercive Force Hc— Oersteds	Energy Product (BdHd) Max.	Bd Gausses	Hd Oersteds
Alnico I	2000	12500	7100	450	1.40×10^6	4600	305
Alnico II	2000	12900	7300	530	1.55×10^6	4620	335
Alnico II-S	2000	12000	6600	530	1.45×10^6	4320	335
Alnico III	2000	12000	7000	470	1.40×10^6	4300	325
Alnico IV	3000	11600	5200	750	1.25×10^6	3000	415
Alnico V	3000	16500	12500	600	4.50×10^6	9680	465
Alnico V DG*	3000	17100	13100	640	6.00×10^6	10750	560
Alnico V-S	3000	15000	10350	605	3.65×10^6	7850	465
Alnico VI	3000	16000	10500	750	3.75×10^6	7280	515
Alnico VI-S	3000	14500	930	720	2.75×10^6	5500	500
Alnico VII	3000	12450	7200	1050	2.75×10^6	4000	690
Alnico X-900	5000	13500	6500	850	1.80×10^6	3300	540

NOTE: The items in the above tables with the letter "S" after them refer to Sintered Alnico. *NOTE: Limited to certain shapes and sizes.

DIMENSIONAL LIMITATIONS

NORMAL TOLERANCES FOR CAST ALNICO

Magnet Dimensions	"As Cast" Tolerances	
Up to 2"	±1/64"	
Over 2" to 4"	±1/32"	Add ±1/64" for
Over 4" to 6"	±3/64"	every 2" above 6"

RECTANGULAR BARS

No dimension of cast bars should be less than 1/8". Bars should not be less than 1/8" thick and not more than 4" to 6" long if width is less than 1/4".

ROUND RODS

Cast rods less than 1/8" diameter cannot be produced economically.

Maximum lengths of cast rods:

1/8" diameter... 4" long max
1/4" diameter... 6" long max
3/8" diameter...10" long max

FLAT PLATES

No dimension of cast plates or rectangular shapes should be less than 1/8". Pieces 1/8" thick should not have an area greater than one square inch on their largest surface.

MINIMUM STANDARD TOLERANCES "AS SINTERED"

FOR REGULAR SHAPES

Dimension	Tolerance
Up to .125"	±.005"
.126" to .625"	±.010"
.626" to 1.250"	±.015"
1.251" to 3.000"	±.031"

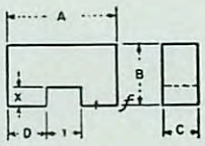
FOR CYLINDERS AND SLEEVES

Dimension	Tolerance
Up to .125"	±.010"
.126" to .500"	±.015"
.501" to .750"	±.020"
.751" to 1.250"	±.025"

STOCK MAGNETS
(ALNICO V)

CHANNEL HORSESHOES

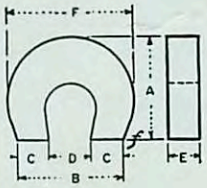
Part No.	Weight Lbs.	A	B	C	D	X	Y
1945	.007	.500	.312	.187	.156	.125	.187
1946	.011	.625	.375	.187	.187	.125	.250
1947	.021	.750	.500	.250	.250	.187	.250
1948	.044	1.000	.625	.312	.312	.250	.375
1949	.089	1.250	.750	.406	.406	.250	.437
1950	.153	1.500	.875	.500	.500	.312	.500
7604	.300	1.750	1.062	.750	.500	.500	.750



NOTE: Parts 1945 through 1950 are all available in bars of 6" length along the "C" dimension. We can furnish these shapes with the "C" dimension of any value between that listed in the table and the 6" maximum bar length.

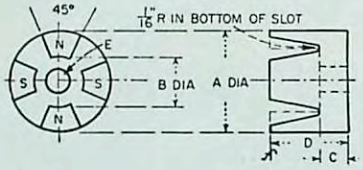
HORSESHOES

Part No.	Weight Lbs.	A	B	C	D	E	F
244	.138	1.250	1.250	.437	.375	.437	1.500
286	.922	2.500	3.000	.750	1.500	.750	3.000
537	.283	1.562	1.625	.625	.375	.625	1.812
642	.292	1.375	2.000	.625	.750	.609	2.000
812	4.67	4.125	4.000	1.250	1.500	1.250	5.000
1386	.063	1.125	.718	.187	.343	.250	1.125
1426	.420	1.875	1.875	.625	.625	.672	1.875
1598	2.37	3.312	4.000	1.000	1.250	1.000	4.000
2614	7.48	3.437	2.750	1.000	.750	3.000	4.000
3112	.710	1.687	3.000	.625	1.750	1.000T	3.000
9195	.540	1.437	2.375	.750	.875	.875	2.375
9196	.440	1.594	1.031	.375	.281	1.000	1.625



NOTE: Part No. 3112 is tapered (T) along the "E" dimension so that the pole is ¾" thick. This horseshoe has a 3/16" hole through the back at the arch.

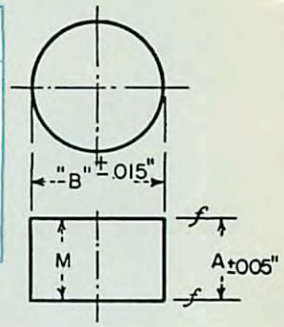
HOLDING MAGNETS



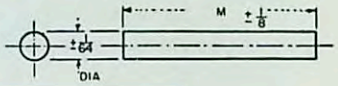
Part No.	Weight Lbs.	Number of Poles	A	B	C	D	E
2225	.344	2	1.250	.531	.687	1.375	.312
2226	.630	2	1.500	.625	.875	1.750	.375
2227	1.44	2	2.125	.968	1.125	2.062	.375
2889	.117	2	.875	.375	.500	1.000	.250
3130	.163	6	1.250	.625	.250	.750	.250
3131	.042	2	.750	.375	.250	.500	.218
3133	.270	6	1.500	.750	.312	.875	.375
3136	.102	4	1.000	.500	.250	.750	.250

PLUGS

Part No.	Weight Lbs.	A	B
10001	.043	.430	.689
10002	.063	.522	.759
10003	.092	.626	.840
10004	.092	.535	.908
10005	.134	.648	.998
10006	.198	.765	1.114
10007	.198	.633	1.224
10008	.290	.748	1.365
10009-A	.425	.970	1.451

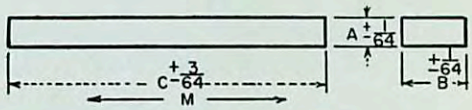


RODS



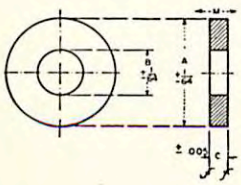
Part No.	Weight Lbs.	Dia.	Length
2056	.013	.125	4
2058	.037	.188	5
2061	.081	.250	6
2064	.151	.300	8
2065	.244	.375	8
2067	.416	.500	8
2070	.529	.563	8
1 Rod	.799	.689	8
2 Rod	.948	.759	8
3 Rod	1.175	.840	8
4 Rod	1.389	.908	8
5 Rod	1.664	.998	8

BARS



Part No.	Weight Lbs.	A	B	C
3113	.050	.125	.375	4
7602	.066	.125	.500	4
3114	.075	.187	.375	4
3115	.100	.250	.250	6
3116	.225	.375	.375	6
2589	.200	.250	.500	6
7565-2	.300	.250	.750	6
3117	.398	.500	.500	6
3118	.596	.500	.750	6
3119	.796	.500	1.000	6
3120	.895	.750	.750	6
3121	1.590	1.000	1.000	6

WASHER TYPE



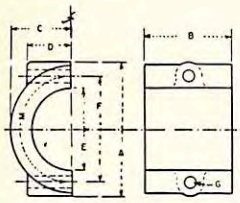
Part No.	Weight Lbs.	A	B	C
3149	.020	1.000	.500	.125
3150	.038	1.250	.625	.156
3151	.067	1.500	.750	.187

These discs are usually used in conjunction with the holding magnets listed above.

STOCK MAGNETS

(ALNICO V)

SEPARATOR MAGNETS

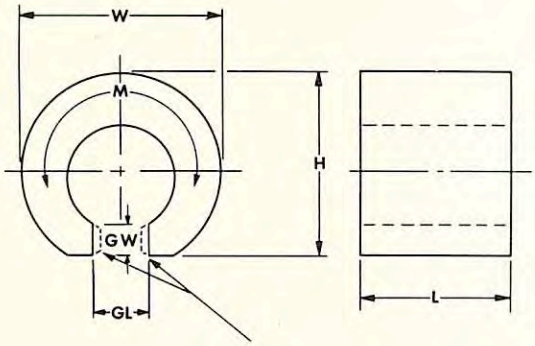


Part No.	Weight Lbs.	A	B	C	D	E	F	G
3201	1.50	3.500	2.375	1.687	1.250	2.125	2.750	.312
3202	7.25	6.437	3.250	3.125	2.062	4.000	5.625	.312
3203	14.80	7.750	4.000	4.062	3.500	5.250	6.500	.437
3204	2.35	4.437	2.000	2.187	1.687	2.750	3.625	.312
2115-A	4.73	5.000	2.375	2.500	2.062	2.500	3.625	.312
2106	2.99	3.750	2.375	1.625	1.625	1.750	2.750	.312
3111	.285	1.625	1.125	.843	—	.812	—	.250
7923	2.10	3.875	2.688	1.875	1.438	2.312	3.063	.313

PART NO. 2106 is similar to sketch except surface opposite to poles is flat.

PART NO. 3111 is also flat on back and has only one ¼" hole in center.

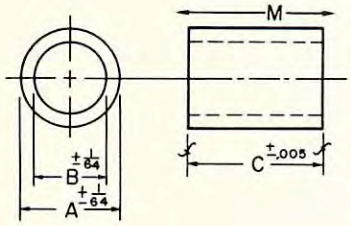
"C" TYPE MAGNETS



NOTE: POLE PIECES USED TO REDUCE GAP LENGTH AND INCREASE GAP FLUX DENSITY

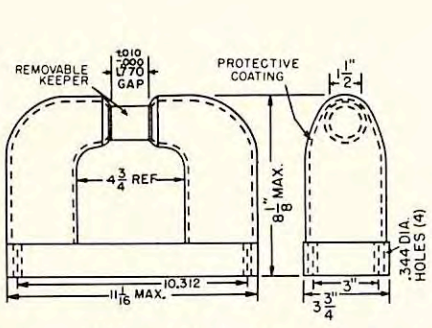
Drawing No.	Weight Lbs.	W	H	L	GL	GW	Approx. Gauss in Gap
9283	7.22	3½	3 3/16	2.735	1.250	7/16	1950
9282	6.91	3⅛	2 15/16	3.000	0.750	7/32	3150
9280	2.52	2⅝	2 13/32	3.000	0.750	⅜	3000
8757	1.13	2½	2 7/32	2.880	0.635	¼	3200
8756	.484	1¾	1 23/32	1.300	0.515	¼	2200
8009	.575	1½	1 15/32	2.000	0.492	¼	2000
8678	.178	1¼	1 3/16	1.000	0.300	¼	2500
9281	.126	1 3/32	1 5/64	0.840	0.200	5/32	3200

CYLINDERS

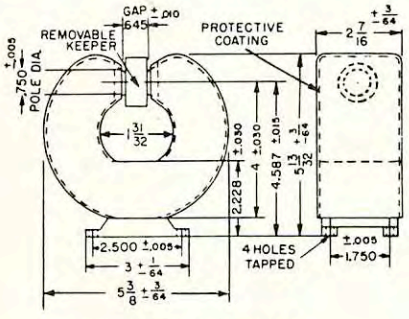


Part No.	Weight Lbs.	A	B	C
3124	.050	1"	¾"	.500
3125	.150	1½"	1⅛"	.750
3126	.365	2"	1½"	1.000
3127	.712	2½"	1⅞"	1.250
1806	.100	⅞"	⅜"	.750

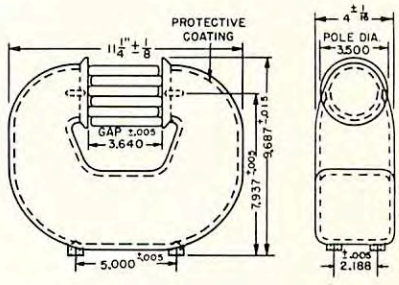
MAGNET ASSEMBLIES



Drawing No. 7434
Weight: Approximately 50 pounds
Flux Density between poles:
2700 ± 50 gausses



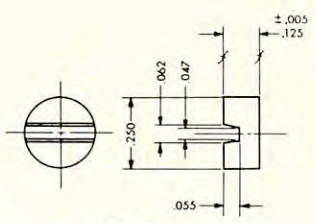
Drawing No. 4931
Weight: Approximately 8 pounds
Flux Density between poles:
5250 ± 50 gausses



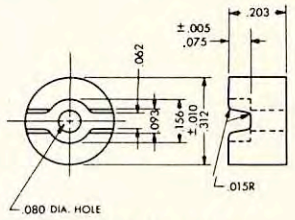
Drawing No. 5725
Weight: Approximately 48 pounds
Flux Density between poles:
1600 ± 50 gausses

SINTERED ALNICO

Small permanent magnets (less than 20 grams) may be produced economically in Sintered Alnico. Since the pressing die required for the manufacture of such parts is comparatively expensive, sintered magnets are used where the quantity required is large. They are machinable by grinding if closer than as-sintered tolerances are required. Sintered magnets are usually made in Alnico II but can be made in most of the Alnico compositions. Sintered Alnico V magnets are available with a minimum energy product (BdHd) max of 3.5 x 10^6 gauss-oersteds, a minimum residual induction (Br) of 10,000 gausses and a minimum coercive force (Hc) of 600 oersteds. There are certain limitations to the shape of sintered Alnico V and VI magnets due to the necessity of magnetically stressing the parts during processing.



PART NO. 7532



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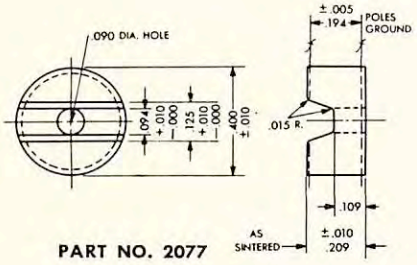

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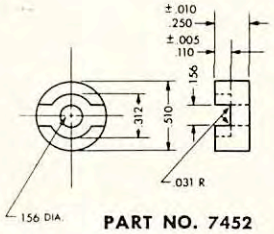

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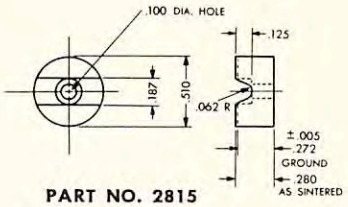

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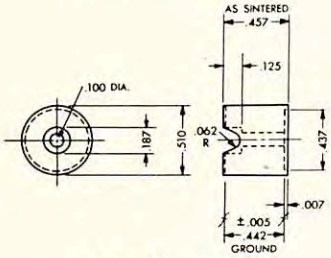

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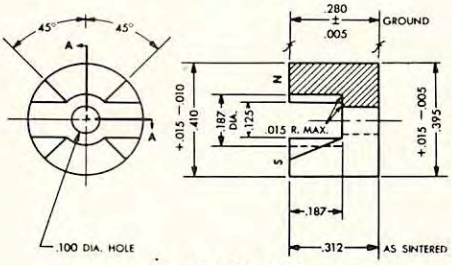

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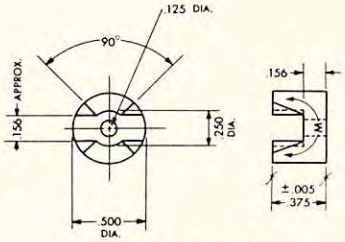

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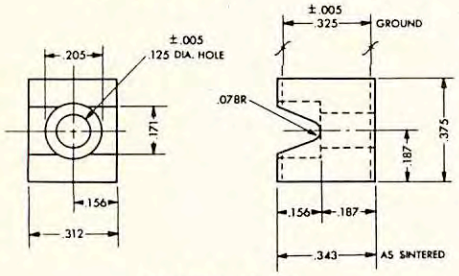

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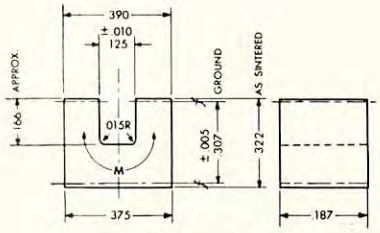

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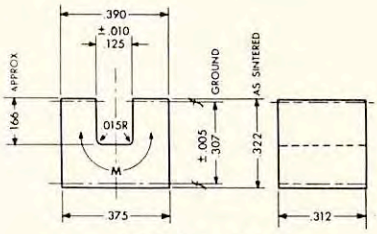

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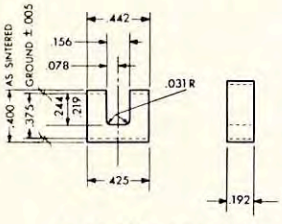

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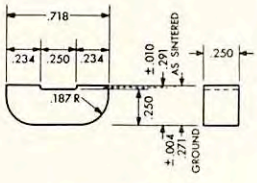

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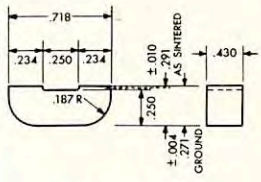

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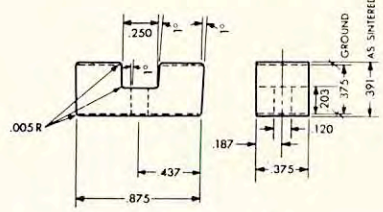

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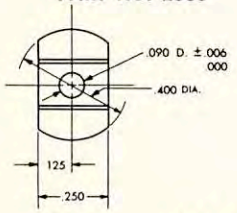

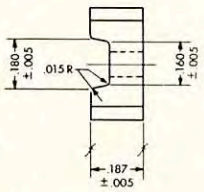

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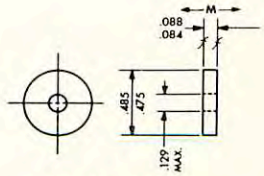

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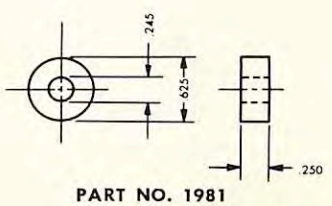


PART NO. 1981

ARNOLD . . . SPECIALISTS IN MAGNETIC MATERIALS

SPECIAL PERMANENT MAGNET MATERIALS

● **VICALLOY** is a permanent magnet alloy containing 10% vanadium, 50% cobalt and 40% iron. It is made in a fashion similar to high-speed steel, and may be fabricated in the form of hot-rolled bars, forgings, castings, as well as cold-rolled strip, wire, and tubing. The alloy may be machined, but requires a final heat treatment of 2-4 hours of 1110° F to develop its permanent magnet properties. It has found wide application in the form of stamped parts, machined rotors, and special recording tape.

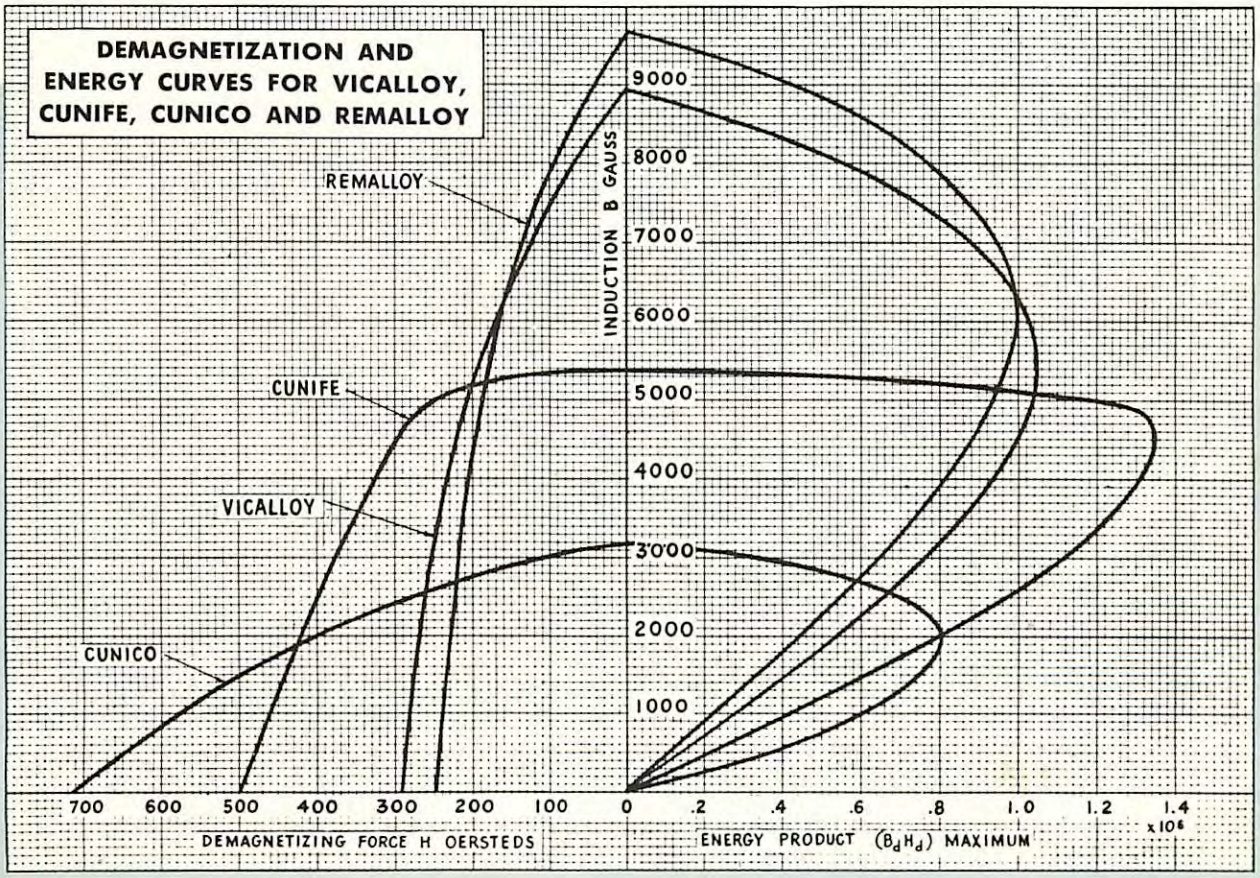
● **CUNICO** is a permanent magnet alloy which can be produced in a large variety of forms, since it is ductile, malleable and machinable, even in its final heat-treated form. It contains 50% copper, 21% nickel, and 29% cobalt. It is hot-short, and may only be cold worked. It has found a number of applications where a high coercive force, machinable permanent magnet is required.

● **CUNIFE** is another copper-nickel permanent magnet alloy which is malleable, ductile, and machinable after its final heat treatment. Its nominal analysis is 60% Cu, 20% Ni, and 20% Fe. The magnetic properties are developed by cold working the alloy to a reduction of at least 80%. Cunife is anisotropic, and the best properties are found only in the smaller sizes of wire (.060" diameter and less). Larger wire sizes and cold rolled strip show lower values of coercive force and energy product.

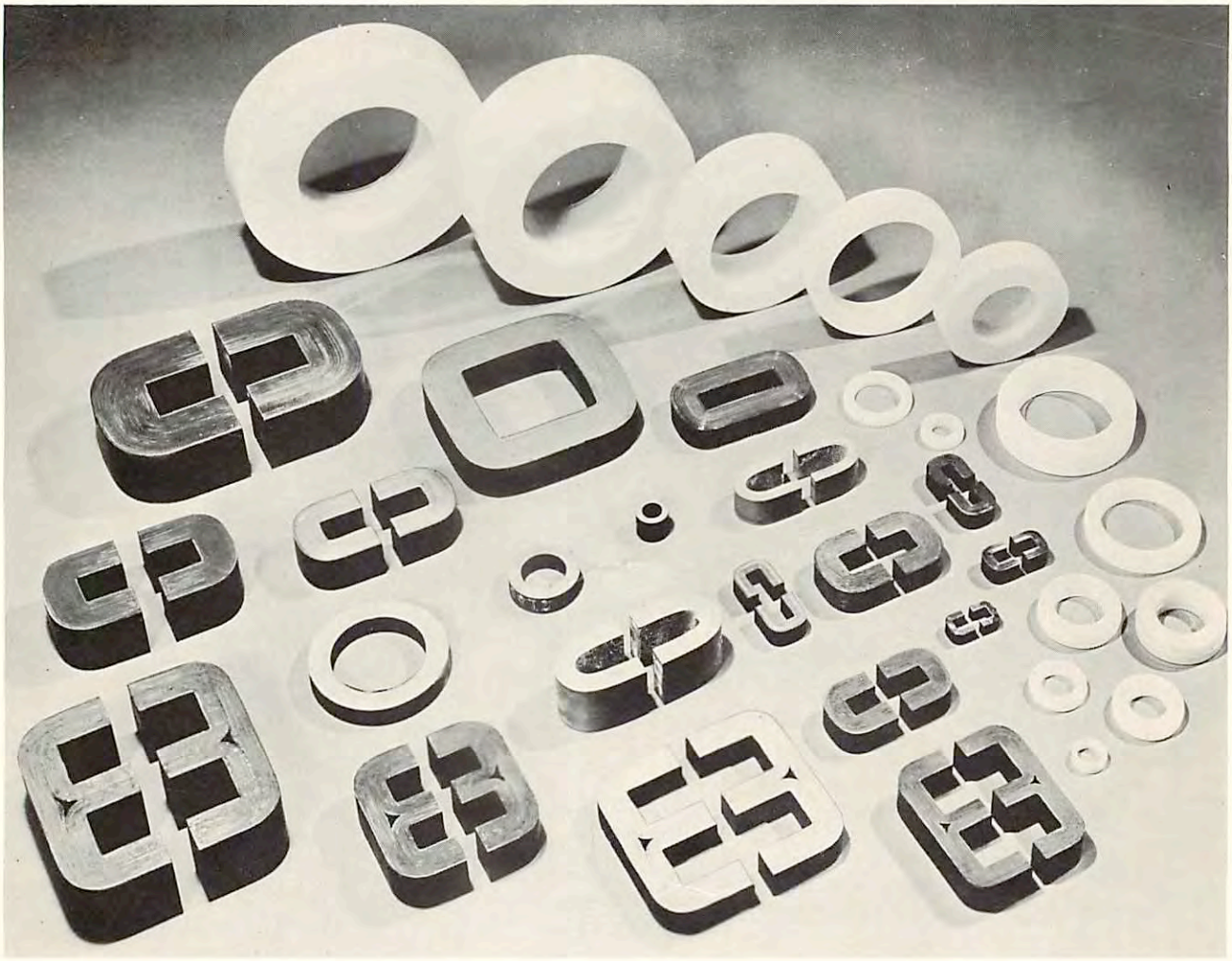
● **REMALLOY** (Comol) contains 17% molybdenum, 12% cobalt, and 71% iron. It has magnetic properties similar to 36% cobalt magnet steel, but is less expensive and easier to machine. It must be heat treated by oil-quenching from 2200°F and drawing at 1265°F. It may be made in the form of sand-castings as well as hot-rolled bars and forgings.

TYPICAL MAGNETIC PROPERTIES

Alloy	Hp	Bp	Br	Hc	(BdHd)max	Bd	Hd
Vicalloy	1000	13,000	9,000	300	1.00 x 10^6	5,550	180
Cunico	3500	8,000	3,400	710	0.85 x 10^6	2,000	425
Cunife	2500	8,400	5,400	500	1.35 x 10^6	4,400	306
Remalloy	1000	15,200	9,700	250	1.00 x 10^6	6,200	160



SILECTRON CORES



Silectron cut cores are made from highly oriented silicon steel. Insulated strip of the proper width is wound on a mandrel and the resultant core assembly is heat-treated, bonded, and cut so as to provide two core halves. Careful production control of this process results in accurately dimensioned and matched core halves where effective air gap at the butt joint is very small.

TYPE AM 1 MIL cores, when tested at 0.25 microseconds, 1000 pulses per second, at a peak flux density of 2500 gausses, are supplied with a guaranteed minimum pulse permeability of 300.

TYPE AL 2 MIL cores, when tested at 2 microseconds, 400 pulses per second, at a peak flux density of 10,000 gausses, are supplied with a guaranteed minimum pulse permeability of 600.

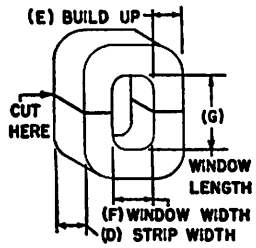
TYPE AJ 4 MIL cores, when tested at 400 cps, at a peak flux density of 15,000 gausses, have a guaranteed maximum core loss of 10.0 watts per pound and a maximum apparent watt loss of 13.1 VA per pound plus 29.9A. When A* exceeds 2.25 square inches or build-up (E) exceeds 1″, use 59.8A*.

TYPE AZ 4 MIL cores, when tested at 400 cps, at a peak flux density of 17,600 gausses, have a guaranteed maximum core loss of 15.0 watts per pound, and a maximum apparent watt loss of 39.5 VA per pound plus 41.1A*. When A* exceeds 2.25 square inches or build-up (E) exceeds 1″, use 82.2A* in place of 41.1A*.

TYPES AA and AXC 12 MIL cores, when tested at 60 cps and a peak flux density of 15,000 gausses, have a guaranteed maximum core loss of 0.90 watts per pound, and a maximum apparent watt loss of 1.75 VA per pound plus 5.0A*. When A* exceeds 2.25 square inches or build-up (E) exceeds 1″, or window width (F) exceeds $1\frac{5}{8}$″, or window length (G) exceeds $4\frac{3}{16}$″, use 10.0A* in place of 5.0A*.

SPECIAL TESTS may be made to fit particular applications. Cores of many different sizes and weighing up to several thousand pounds have been made to meet specific requirements.

*A equals gross core area in square inches



SILECTRON CORES

1 MIL SILECTRON "C" CORES

CORE NO.	WT. LBS.	DIMENSIONS (Inches) D	E	F	G
AM-3	.013	1/4	1/8	1/4	1/2
AM-1	.023	1/4	3/16	1/4	5/8
AM-21	.031	1/4	1/4	1/4	1/2
AM-10	.035	1/4	1/4	1/4	5/8
AM-6	.037	3/8	3/16	1/4	5/8
AM-2	.042	1/4	1/4	1/4	7/8
AM-8	.060	3/8	7/32	5/16	1
AM-4	.063	3/8	1/4	1/4	7/8
AM-7	.084	1/2	1/4	1/4	7/8
AM-33	.10	3/8	1/4	7/8	1 1/4
AM-5	.13	3/8	3/8	3/8	1 3/16
AM-30	.13	3/8	3/8	7/16	1 1/8
AM-37	.13	3/8	3/8	1/2	1 1/8
AM-15	.17	1/2	3/8	3/8	1 3/16
AM-24	.20	1/2	7/16	1/2	1 1/8
AM-16	.26	3/4	3/8	3/8	1 3/16
AM-12	.31	1/2	1/2	1/2	1 5/16
AM-32	.36	3/4	3/8	7/8	1 1/2
AM-22	.38	5/8	1/2	1/2	1 5/16
AM-40	.41	3/4	1/2	5/8	1 1/8
AM-31	.48	1	7/16	1/2	1 1/8
AM-19	.62	1	1/2	1/2	1 5/16
AM-14	.64	1	1/2	5/8	1 5/16
AM-9	.72	3/4	5/8	5/8	1 15/16
AM-39	.96	1	5/8	5/8	1 15/16
AM-23	.96	1	5/8	5/8	1 15/16
AM-35	1.77	1	1	5/8	1 15/16
AM-20	1.82	1	7/8	1 5/16	2 1/2

2 MIL SILECTRON "C" CORES

CORE NO.	WT. LBS.	DIMENSIONS (Inches) D	E	F	G
AL-1	.015	1/4	1/8	1/4	1/2
AL-163	.018	1/4	5/32	1/4	1/2
AL-147	.024	1/4	1/8	5/16	1
AL-2	.028	1/4	3/16	1/4	5/8
AL-143	.036	1/4	1/4	1/4	1/2
AL-3	.039	3/8	3/16	1/4	5/8
AL-161	.040	1/4	1/4	1/4	5/8
AL-4	.048	1/4	1/4	1/4	7/8
AL-71	.054	3/8	3/16	5/16	1
AL-7	.065	3/8	7/32	5/16	1
AL-69	.068	1/4	1/4	1/2	1 1/4
AL-5	.068	3/8	1/4	1/4	7/8
AL-6	.092	1/2	1/4	1/4	7/8
AL-121	.100	3/8	1/4	1/2	1 5/16
AL-88	.130	3/8	3/8	5/16	1
AL-8	.150	3/8	3/8	3/8	1 3/16
AL-13	.16	5/8	1/4	1/2	1 1/8
AL-9	.19	1/2	3/8	3/8	1 3/16
AL-12	.24	1/2	7/16	1/2	1 1/8
AL-10	.24	5/8	3/8	3/8	1 3/16
AL-11	.29	3/4	3/8	3/8	1 3/16
AL-142	.30	3/4	3/8	1/2	1 1/8
AL-18	.31	1/2	7/16	5/8	1 5/16
AL-14	.35	1/2	1/2	1/2	1 5/16
AL-78	.35	3/4	5/16	5/16	2 1/4
AL-152	.36	1/2	1/2	1/2	1 5/8
AL-15	.43	5/8	1/2	1/2	1 9/16
AL-16	.52	3/4	1/2	1/2	1 9/16
AL-17	.69	1	1/2	1/2	1 9/16
AL-19	.72	1	1/2	5/8	1 9/16
AL-21	.81	3/4	5/8	5/8	1 15/16
AL-20	.95	1	5/8	5/8	1 9/16
AL-22	1.07	1	5/8	5/8	1 15/16
AL-24	1.22	1	5/8	3/4	2 5/16
AL-23	1.34	1 1/4	5/8	5/8	1 15/16
AL-25	2.02	1	7/8	1 5/16	2 1/2
AL-60	2.03	1 1/2	1/2	3/4	4
AL-47	2.22	1	1	3/4	2 5/16
AL-70	2.41	1 3/8	5/8	1 5/16	3 1/2
AL-103	3.01	1 1/4	1	1 5/16	2 1/2
AL-36	3.59	1 1/4	1	1 3/8	3
AL-130	4.02	1 1/2	1	1	3
AL-54	4.31	2	3/4	3/4	4

4 MIL SILECTRON "C" CORES

CORE NO.	WT. LBS.	DIMENSIONS (Inches) D	E	F	G
AJ-H38	.07	1/4	1/4	1/2	1 5/16
AJ-H115	.08	3/8	1/4	3/8	1
AJ-H215	.09	1/2	1/4	1/4	7/8
AJ-H39	.10	3/8	1/4	1/2	1 5/16
AJ-H1	.10	1/2	1/4	1/2	1 1/8
AJ-H126	.11	3/8	5/16	3/8	1
AJ-H114	.12	1/2	1/4	1/2	1
AJ-H2	.13	3/4	3/16	1/2	1 1/8
AJ-H40	.14	1/2	1/4	1/2	1 5/16
AJ-H43	.15	3/8	5/16	5/8	1 9/16
AJ-H140	.16	5/8	1/4	1/2	1 1/8
AJ-H41	.17	5/8	1/4	1/2	1 5/16
AJ-H316	.19	3/8	3/8	5/8	1 9/16
AJ-H3	.19	3/4	1/4	1/2	1 1/8
AJ-H9	.20	5/8	1/4	5/8	1 9/16
AJ-H42	.20	3/4	1/4	1/2	1 5/16
AJ-H44	.21	1/2	5/16	5/8	1 9/16
AJ-H4	.22	7/8	7/32	1/2	1 1/2
AJ-H49	.23	3/8	3/8	3/4	1 15/16
AJ-H270	.24	1/2	7/16	1/2	1 1/8
AJ-H45	.25	5/8	5/16	5/8	1 9/16
AJ-H108	.25	5/8	3/8	3/8	1 3/16
AJ-H253	.27	5/8	3/8	1/2	1 5/16
AJ-H138	.29	1/2	1/2	1/2	1 1/8
AJ-H50	.30	1/2	3/8	3/4	1 15/16
AJ-H5	.30	1	1/4	1/2	1 1/2
AJ-H46	.31	3/4	5/16	5/8	1 9/16
AJ-H47	.36	7/8	5/16	5/8	1 9/16
AJ-H11	.36	1	9/32	5/8	1 9/16
AJ-H245	.37	3/4	3/8	1/2	1 9/16
AJ-H51	.38	5/8	3/8	3/4	1 15/16
AJ-H57	.41	1/2	7/16	7/8	2 1/4
AJ-H48	.41	1	5/16	5/8	1 9/16
AJ-H282	.42	5/8	1/2	5/8	1 5/16
AJ-H177	.43	5/8	1/2	1/2	1 9/16
AJ-H52	.45	3/4	3/8	3/4	1 15/16
AJ-H129	.47	7/8	7/16	1/2	1 5/16
AJ-H14	.48	1 1/8	5/16	5/8	1 11/16
AJ-H7	.49	1	3/8	1/2	1 9/16
AJ-H58	.51	5/8	7/16	7/8	2 1/4
AJ-H53	.52	7/8	3/8	3/4	1 15/16
AJ-H117	.52	5/8	9/16	5/8	1 9/16
AJ-H65	.53	1/2	1/2	1	2 5/16
AJ-H54	.60	1	3/8	3/4	1 15/16
AJ-H161	.60	5/8	5/8	5/8	1 9/16
AJ-H59	.61	3/4	7/16	7/8	2 1/4
AJ-H296	.62	7/8	3/8	3/4	2 1/2
AJ-H24	.65	7/8	3/8	15/16	2 1/2
AJ-H66	.67	5/8	1/2	1	2 5/16
AJ-H20	.68	1 1/4	5/16	3/4	2 5/16
AJ-H55	.68	1 1/8	3/8	3/4	1 15/16
AJ-H223	.68	1	1/2	1/2	1 1/2
AJ-H8	.69	1	1/2	1/2	1 9/16
AJ-H209	.70	1	7/16	5/8	1 15/16
AJ-H60	.71	7/8	7/16	7/8	2 1/4
AJ-H17	.72	1 1/4	3/8	5/8	1 15/16
AJ-H12	.72	1	1/2	5/8	1 9/16
AJ-H56	.75	1 1/4	3/8	3/4	1 15/16
AJ-H67	.80	3/4	1/2	1	2 5/16
AJ-H61	.82	1	7/16	7/8	2 1/4
AJ-H75	.84	5/8	9/16	1 1/8	2 7/8
AJ-H10	.84	7/8	5/8	5/8	1 9/16
AJ-H208	.89	1 1/8	5/8	1/2	1 1/8
AJ-H62	.92	1 1/8	7/16	7/8	2 1/4
AJ-H68	.94	7/8	1/2	1	2 5/16
AJ-H272	.96	1	1/2	7/8	2 1/4
AJ-H13	.96	1	5/8	5/8	1 9/16
AJ-H76	1.01	3/4	9/16	1 1/8	2 7/8
AJ-H22	1.01	1 1/2	3/8	3/4	2 5/16
AJ-H63	1.02	1 1/4	7/16	7/8	2 1/4
AJ-H86	1.04	5/8	5/8	1 1/4	3 3/16
AJ-H69	1.06	1	1/2	1	2 5/16
AJ-H15	1.08	1	5/8	5/8	1 15/16
AJ-H27	1.12	1 1/2	3/8	15/16	2 1/2
AJ-H35	1.13	3/4	3/4	1 3/16	1 3/4
AJ-H64	1.13	1 3/8	7/16	7/8	2 1/4

4 MIL SILECTRON "C" CORES

CORE NO.	WT. LBS.	DIMENSIONS (Inches) D	E	F	G
AJ-H77	1.18	7/8	9/16	1 1/8	2 7/8
AJ-H70	1.20	1 1/8	1/2	1	2 5/16
AJ-H16	1.21	1 1/8	5/8	5/8	1 15/16
AJ-H87	1.24	3/4	5/8	1 1/4	3 3/16
AJ-H26	1.29	1 1/4	1/2	15/16	2 1/2
AJ-H71	1.33	1 1/4	1/2	1	2 5/16
AJ-H78	1.35	1	9/16	1 1/8	2 7/8
AJ-H18	1.35	1 1/4	5/8	5/8	1 15/16
AJ-H88	1.45	7/8	5/8	1 1/4	3 3/16
AJ-H72	1.47	1 3/8	1/2	1	2 5/16
AJ-H79	1.51	1 1/8	9/16	1 1/8	2 7/8
AJ-H28	1.55	1 1/2	1/2	15/16	2 1/2
AJ-H289	1.56	1 1/8	1 1/16	3/4	2 5/16
AJ-H73	1.60	1 1/2	1/2	1	2 5/16
AJ-H309	1.63	1 3/8	9/16	15/16	2 1/2
AJ-H89	1.66	1	5/8	1 1/4	3 3/16
AJ-H80	1.69	1 1/4	9/16	1 1/8	2 7/8
AJ-H74	1.73	1 5/8	1/2	1	2 5/16
AJ-H19	1.74	1 1/8	3/4	3/4	2 5/16
AJ-H30	1.76	1 1/2	1/2	1	3
AJ-H81	1.85	1 3/8	9/16	1 1/8	2 7/8
AJ-H90	1.87	1 1/8	5/8	1 1/4	3 3/16
AJ-H82	2.02	1 1/2	9/16	1 1/8	2 7/8
AJ-H29	2.02	1 1/2	5/8	15/16	2 1/2
AJ-H91	2.07	1 1/4	5/8	1 1/4	3 3/16
AJ-H21	2.13	1 3/8	3/4	3/4	2 5/16
AJ-H204	2.16	1 3/8	3/4	3/4	2 3/8
AJ-H83	2.19	1 5/8	9/16	1 1/8	2 7/8
AJ-H37	2.21	1 3/4	1/2	1 3/8	3
AJ-H92	2.28	1 3/8	5/8	1 1/4	3 3/16
AJ-H23	2.32	1 1/2	3/4	3/4	2 5/16
AJ-H84	2.35	1 3/4	9/16	1 1/8	2 7/8
AJ-H93	2.49	1 1/2	5/8	1 1/4	3 3/16
AJ-H85	2.52	1 7/8	9/16	1 1/8	2 7/8
AJ-H94	2.69	1 5/8	5/8	1 1/4	3 3/16
AJ-H36	2.44	1 3/8	5/8	15/16	3 1/2
AJ-H95	2.91	1 3/4	5/8	1 1/4	3 3/16
AJ-H25	3.07	1 3/8	15/16	15/16	2 1/2
AJ-H96	3.11	1 7/8	5/8	1 1/4	3 3/16
AJ-H97	3.32	2	5/8	1 1/4	3 3/16
AJ-H31	4.07	1 1/2	1	1	3
AJ-H32	4.40	1 5/8	1	1	3
AJ-H33	4.74	1 3/4	1	1	3
AJ-H34	5.42	2	1	1	3

4 MIL SILECTRON "C" CORES TYPE "AZ"

CORE NO.	WT. LBS.	DIMENSIONS (Inches) D	E	F	G
AZ-2	.04	3/8	3/16	1/4	5/8
AZ-4	.06	3/8	3/16	3/8	1
AZ-45	.08	3/8	1/4	3/8	1
AZ-44	.11	3/8	5/16	3/8	1
AZ-46	.11	1/2	1/4	1/2	1
AZ-1	.12	1/2	1/4	1/2	1 1/8
AZ-56	.14	1/2	1/4	1/2	1 5/16
AZ-55	.17	5/8	1/4	1/2	1 5/16
AZ-25	.23	1/2	13/32	5/16	1 1/8
AZ-53	.21	1/2	5/16	3/8	1 5/16
AZ-5	.34	3/4	3/8	3/8	1 1/4
AZ-48	.52	3/4	1/2	1/2	1 5/16
AZ-14	.58	1	3/8	3/8	1 13/16
AZ-12	.67	1 1/4	3/8	3/8	1 11/16
AZ-8	.89	1	5/16	3/8	1 3/4
AZ-15	.65	1	3/8	13/16	1 3/4
AZ-38	1.01	1 3/8	7/16	11/16	2 1/16
AZ-6	.91	1	1/2	1 3/16	1 3/4
AZ-10	1.28	1 1/8	5/8	1	1 3/4
AZ-9	1.03	1	1/2	1 7/16	2
AZ-7	1.88	1 1/2	5/8	1	2 1/8
AZ-39	2.11	1 1/2	5/8	13/16	2 11/16
AZ-16	2.56	1 1/2	11/16	1	3
AZ-42	3.60	1 3/4	3/4	13/16	3 1/2
AZ-13	3.93	1 3/4	1 3/16	1 3/8	3

12 MIL SILECTRON "C" CORES

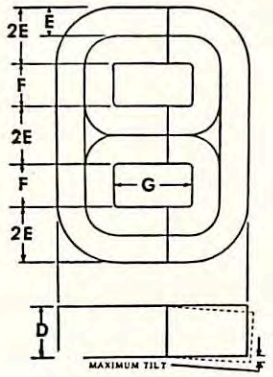
TYPE "AA"						TYPE "AXC"					
AECo. Part Number	Nominal Weight (Lbs.)	NOMINAL CORE DIMENSIONS				AECo. Part Number	Nominal Weight (Lbs.)	NOMINAL CORE DIMENSIONS			
		D	E	F	G			D	E	F	G
AA-1	.16	5/8	1/4	1/2	1 1/8	AXC-154	11.9	2 13/16	1 3/32	1 5/8	4 3/16
AA-2	.20	3/4	1/4	1/2	1 1/8	AXC-22	12.9	2 13/16	1 3/32	1 3/4	4 11/16
AA-4	.35	3/4	3/8	7/16	1 3/8	AXC-156	14.1	2 13/16	1 3/32	2	5
AA-5	.43	1	5/16	5/8	1 9/16	AXC-165	17.5	3 1/8	1 1/4	1 13/16	4 7/8
AA-3	.51	1	3/8	1/2	1 9/16	AXC-177	18.9	3 1/8	1 7/32	1 7/8	5 13/16
AA-7	.61	1	3/8	5/8	1 15/16						
AA-87	.62	1	7/16	1/2	1 9/16	AXC-152	18.0	3 1/8	1 5/32	2 3/16	5 5/8
AA-85	.68	1	3/8	1 3/16	1 3/4	AX-79	23.4	3 3/8	1 3/8	2	5 7/16
AA-163	.74	1	7/16	5/8	1 15/16	AXC-161	24.2	3 3/8	1 11/32	2 1/8	6 1/16
AA-8	.76	1 1/4	3/8	5/8	1 15/16	AXC-1197	32.0	1 3/4	3	2 1/4	5
AA-81	.76	1	1/2	5/8	1 9/16	AXC-255	26.2	3 3/8	1 13/32	2 1/8	6 5/16
AA-10	.89	1 1/4	3/8	3/4	2 5/16						
AA-6	1.02	1	5/8	5/8	1 9/16	AXC-295	29.0	3 3/4	1 13/32	2 3/16	6 1/16
AA-9	1.08	1 1/4	1/2	5/8	1 15/16	AXC-183	30.6	3 3/4	1 13/32	2 1/4	6 9/16
AA-11	1.17	1 1/2	3/8	15/16	2 1/2	AXC-157	34.8	4	1 9/16	2 1/8	6 1/8
AA-126	1.29	1 1/4	5/8	5/8	1 15/16	AXC-182	32.7	3 3/4	1 15/32	2 1/4	6 3/4
AA-32	1.44	1	3/4	5/8	1 15/16	AXC-217	29.5	2 1/2	1 25/32	2 3/4	7 3/16
AA-12	1.63	1 1/2	1/2	15/16	2 1/2						
AA-17	1.58	1	3/4	1 3/16	1 3/4	AX-87	38.6	4	1 9/16	2 1/8	7 3/16
AA-13	1.85	1 1/2	1/2	1	3	AXC-1179	36.2	2 1/4	2 1/4	2 3/8	8
AA-28	1.95	1 1/2	5/8	3/4	2 5/16	AXC-235	34.0	2 1/2	1 25/32	2 3/4	8 5/8
AA-18	2.34	1 3/4	1/2	1 3/8	3	AXC-242	33.2	2 1/2	1 13/16	2 3/4	8 5/8
AA-14	2.48	2	1/2	1	3	AXC-178	42.7	4	1 21/32	2 3/8	7 5/16
AA-93	2.67	1 1/2	3/4	15/16	2 1/2	AXC-202	46.5	4	1 13/16	2 1/4	7 1/4
AA-177	3.00	1 1/2	3/4	1	3	AXC-203	50.3	4	1 13/16	2 1/4	8 1/8
AA-15	3.60	2	1 1/16	1	3	AXC-238	40.3	2 13/16	1 29/32	3 1/16	8 1/4
AA-111	4.28	1 1/2	1	1	3	AXC-158	45.1	2 13/16	1 31/16	3 1/16	9 3/8
AA-19	4.35	2	3/4	1 3/8	3	AXC-293	49.1	2 13/16	2 3/32	3 1/8	9 5/8
AA-16	5.71	2	1	1	3	AXC-296	54.0	3 1/8	2 1/16	3 1/8	9 5/8
AA-35	6.11	2	1	1 3/8	3	AXC-186	54.3	3 1/8	2 1/16	3 3/16	9 5/8
						AXC-148	58.9	3 1/8	2 7/32	3	10

THREE PHASE CORES

Three phase "E" cores operated at high inductions will have core losses approximately 25% greater than for single phase cores because of third harmonic flux. The exciting current requirement, however, will be similar to that for single phase "C" cores, with an air gap allowance required for each leg. They are tested with three-phase delta-connected excitation at 15,000 gausses as follows:

TYPE AJT 4 MIL cores have a guaranteed maximum core loss of 12.0 watts per pound, and a maximum apparent watt loss of 13.1 VA per pound plus 29.9A* at 400 cps. When A* exceeds 2.25 square inches or build-up (E) exceeds 1", use 59.8A* in place of 29.9A*.

TYPE ATA 12 MIL cores have a guaranteed maximum core loss of 1.08 watts per pound, and a maximum apparent watt loss of 1.75 VA per pound plus 5.0A*, at 60 cps. When A* exceeds 2.25 square inches or build-up (E) exceeds 1" or window width (F) exceeds 1 5/8" or window length exceeds 4 3/16", use 10.0A* instead of 5.0A*.



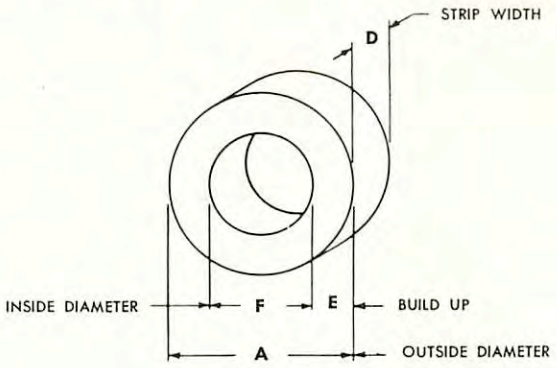
*A equals gross core area in square inches

4 MIL SILECTRON "E" CORES							4 MIL SILECTRON "E" CORES						
CORE NUMBER	WEIGHT (LBS.)	DIMENSIONS IN INCHES					CORE NUMBER	WEIGHT (LBS.)	DIMENSIONS IN INCHES				
		STRIP WIDTH D	BUILD UP E	TOTAL BUILD UP 2E	WINDOW WIDTH F	WINDOW LENGTH G			STRIP WIDTH D	BUILD UP E	TOTAL BUILD UP 2E	WINDOW WIDTH F	WINDOW LENGTH G
AJ-TH43	0.25	3/8	3/16	3/8	1/2	1 1/8	AJ-TH71	2.96	1 1/8	3/8	3/4	7/8	2 1/4
AJ-TH69	0.31	1/2	3/16	3/8	7/16	1	AJ-TH35	3.05	1	3/8	3/4	1 1/4	2 1/2
AJ-TH53	0.32	3/4	1/8	1/4	7/16	1	AJ-TH91	3.33	7/8	7/16	7/8	1	3
AJ-TH25	0.44	1/2	3/16	3/8	5/8	1 5/8	AJ-TH70	3.78	1 1/4	7/16	7/8	15/16	1 7/8
AJ-TH55	0.59	5/8	3/16	3/8	3/4	1 3/16	AJ-TH4	3.80	1 1/4	3/8	3/4	1 1/4	2 1/2
AJ-TH89	0.72	1/2	1/4	1/2	3/4	2	AJ-TH92	4.51	1	1/2	1	1	3
AJ-TH83	0.75	3/4	1/4	1/2	1/2	1 1/8	AJ-TH64	4.58	1 1/2	3/8	3/4	1 1/4	2 1/2
AJ-TH84	0.83	5/8	1/4	1/2	3/4	1 5/8	AJ-TH2	4.93	1 1/2	1/2	1	1	2 1/4
AJ-TH67	0.93	5/8	1/4	1/2	3/4	2	AJ-TH72	4.94	1 1/8	1/2	1	1 1/4	2 1/2
AJ-TH87	0.96	3/4	1/4	1/2	11/16	1 5/8	AJ-TH73	4.95	1 1/4	3/8	3/4	1 1/8	4 1/16
AJ-TH56	0.99	3/4	1/4	1/2	5/8	1 9/16	AJ-TH82	5.30	1	1/2	1	1 5/8	3 3/8
AJ-TH66	1.06	7/8	1/4	1/2	11/16	1 5/8	AJ-TH79	5.34	1 3/4	3/8	3/4	1 1/4	2 1/2
AJ-TH78	1.15	1	1/4	1/2	1/2	1 9/16	AJ-TH45	5.70	1 1/8	9/16	1 1/8	1 1/2	2
AJ-TH65	1.28	1	1/4	1/2	11/16	1 5/8	AJ-TH68	8.05	2	1/2	1	1	3
AJ-TH90	1.45	1	1/4	1/2	3/4	2	AJ-TH86	10.12	2	1/2	1	1 3/8	3 7/8
AJ-TH31	1.53	3/4	3/8	3/4	1 3/16	1 1/4	AJ-TH75	10.66	1 5/8	1/2	1	1 1/2	5 1/16
AJ-TH47	2.05	1 1/8	5/16	5/8	5/8	1 15/16							
AJ-TH80	2.14	1	3/8	3/4	11/16	1 5/8							
AJ-TH30	2.15	1 1/4	5/16	5/8	5/8	1 15/16							
AJ-TH58	2.26	1 1/4	5/16	5/8	11/16	2 1/16							
AJ-TH61	2.36	1 1/4	5/16	5/8	7/8	1 13/16	12 MIL SILECTRON "E" CORES						
AJ-TH95	2.47	1	3/8	3/4	1	1 3/4	A-TA2	1.22	3/8	3/8	3/4	1 1/4	2 1/2
AJ-TH94	2.63	1	3/8	3/4	1 1/4	1 3/4	A-TA7	2.30	1 1/8	1/4	1/2	1 1/4	2 5/8
AJ-TH85	2.80	1	3/8	3/4	1	2 3/8	A-TA8	6.96	1 1/2	1/2	1	1 1/4	2 1/2
							A-TA4	9.48	1 3/8	5/8	1 1/4	1 3/8	3

SILECTRON TOROIDS

Silectron tape wound toroids are available in all sizes, shapes and gages, either cased or uncased and either varnish impregnated or not impregnated. They utilize effectively the high permeability and low loss characteristics of oriented silicon steel. Common applications include current, potential and low leakage toroidal transformers, magnetic amplifiers, saturable reactors and magnetic shields.

Silectron toroids are normally tested for either maximum permeability or low density permeability. Tests for various dynamic hysteresis loop characteristics may also be made to permit grading and matching of cores for magnetic amplifiers and similar applications.

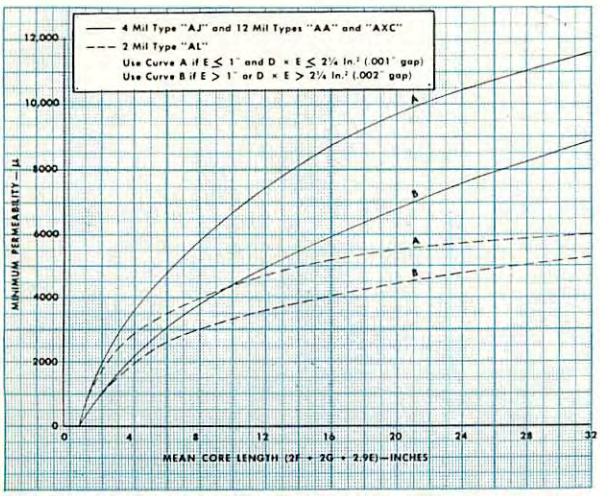


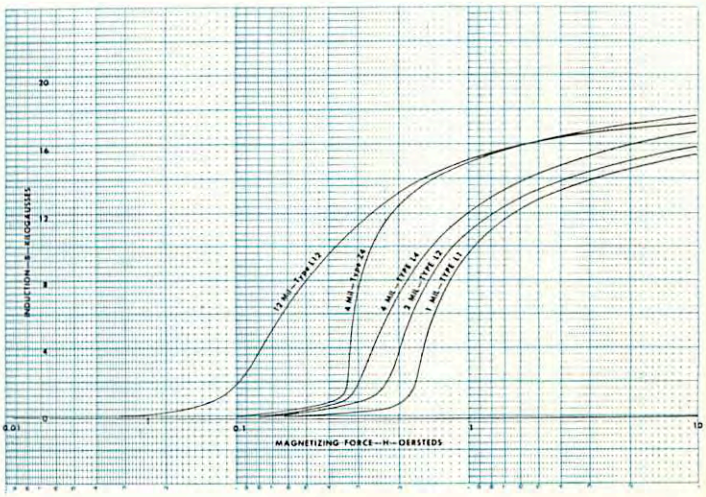
AECo. Core Size Designation	Gross Core Volume (in.³) **	NOMINAL CORE DIMENSIONS			
		D	E	F	A
*5340	.031	1/8	1/8	1/2	3/4
*5515	.038	1/8	1/8	.650	.900
*6592	.061	1/4	1/8	1/2	3/4
8233	.043	1/8	1/8	3/4	1
*4168	.055	1/8	1/8	1	1 1/4
*5651	.120	1/4	3/16	5/8	1
*5504	.104	3/16	3/16	3/4	1 1/8
6600	.295	1/2	1/4	1/2	1
*6180	.265	3/8	1/4	.650	1.15
*4635	.175	1/4	3/16	1	1 3/8
5759	.497	3/8	3/8	3/4	1 1/2
*5233	.368	3/8	1/4	1	1 1/2
*5387	.295	1/4	1/4	1 1/4	1 3/4
6351	.319	1/4	1/4	1 3/8	1 7/8
*4179	.267	1/4	3/16	1 5/8	2
*5762	.785	1	1/4	3/4	1 1/4
*5778	.540	1/2	1/4	1 1/8	1 5/8
6272	1.10	3/4	3/8	7/8	1 5/8
5772	.718	3/8	3/8	1 1/4	2
7874	1.01	5/8	3/8	1	1 3/4
7998	1.18	1/2	1/2	1	2
8234	.773	3/8	3/8	1 3/8	2 1/8
5924	1.48	3/4	7/16	1	1 7/8
*7189	1.18	1	1/4	1 1/4	1 3/4
*4178	.884	1/2	1/4	2	2 1/2
*5320	1.57	1/2	1/2	1 1/2	2 1/2
*4180	1.08	1/2	1/4	2 1/2	3
7808	2.50	1/2	1 1/16	1 5/8	3
5552	1.77	1	1/4	2	2 1/2
6785	3.14	1	1/2	1 1/2	2 1/2

AECo. Core Size Designation	Gross Core Volume (in.³) **	NOMINAL CORE DIMENSIONS			
		D	E	F	A
7519	2.45	5/8	1/2	2	3
6366	4.17	1	5/8	1 1/2	2 3/4
7875	2.95	3/4	1/2	2	3
*6100	2.36	1/2	1/2	2 1/2	3 1/2
6211	5.30	1	3/4	1 1/2	3
8027	3.93	1	1/2	2	3
6284	5.89	1	3/4	1 3/4	3 1/4
8235	4.12	7/8	1/2	2 1/2	3 1/2
*5468	4.71	1	1/2	2 1/2	3 1/2
6494	3.53	1/2	1/2	4	5
5953	9.72	1 1/2	3/4	2	3 1/2
*6464	11.5	1 1/8	1	2 1/4	4 1/4
*5690	9.20	1 1/2	5/8	2 1/2	3 3/4
8022	6.28	1	1/2	3 1/2	4 1/2
5575	4.32	1/2	1/2	5	6
6141	12.9	1 1/2	7/8	2 1/4	4
5579	7.06	1	1/2	4	5
*6379	12.6	1	1	3	5
*5737	11.4	1 1/2	5/8	3 1/4	4 1/2
*5581	13.2	1 1/2	3/4	3	4 1/2
6234	14.1	1	1	3 1/2	5 1/2
6865	20.9	1 1/4	1 1/4	3	5 1/2
6124	29.4	2	1 1/4	2 1/2	5
6119	18.0	1 1/2	7/8	3 1/2	5 1/4
*5582	26.6	1 3/8	1 3/8	3.10	5.85
5563	16.4	1 7/8	9/16	4 3/8	5 1/2
6348	35.6	2	1 3/8	2 3/4	5 1/2
5477	18.0	1 7/8	9/16	4 7/8	6
7683	20.1	2	5/8	4 1/2	5 3/4
6320	50.2	2 1/4	1 5/8	2 3/4	6

* Standard molded core cases available for these core sizes. Special cases may be made for all other sizes.

** Nominal core weight in pounds for various tape thicknesses is computed by multiplying the gross core volume by the following factors:
1 mil..... .229 2 mil..... .246 4 mil..... .248 12 mil..... .262

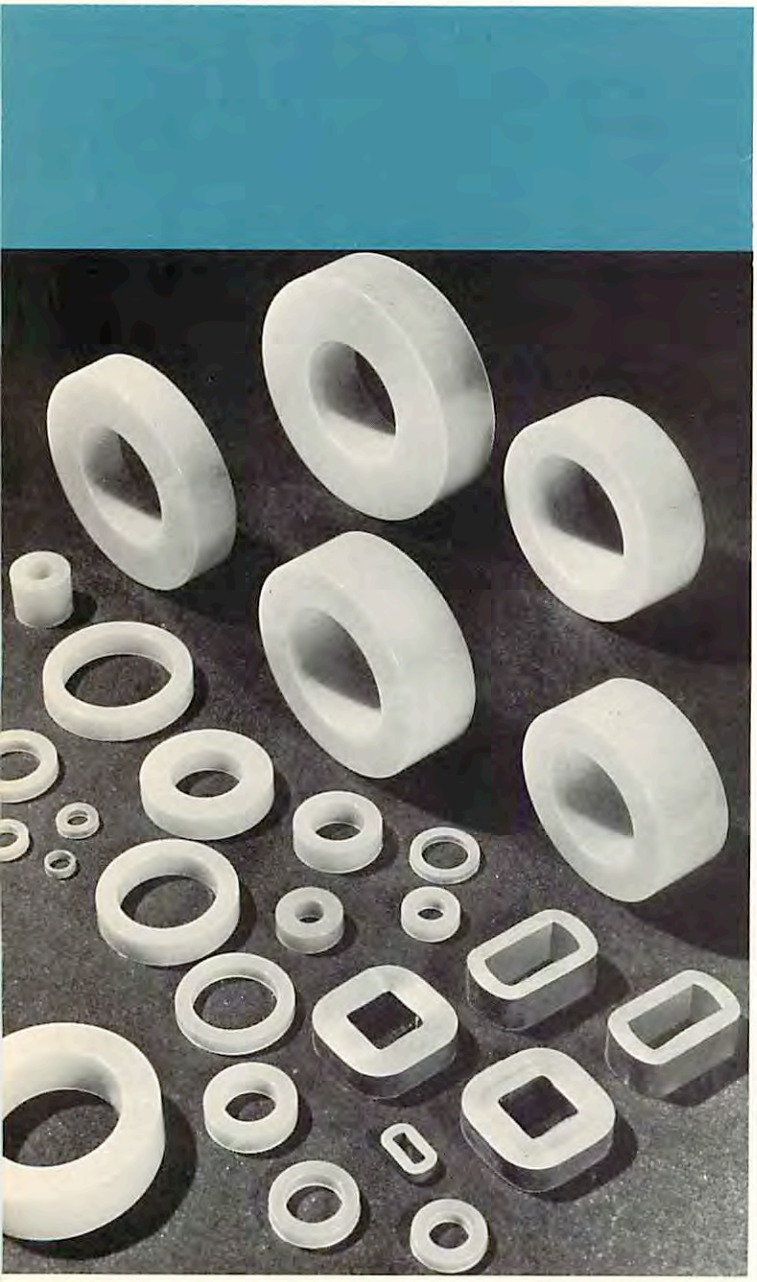




TAPE WOUND CORES

Magnetic alloys of high permeability have found many applications as core materials, in the form of tape wound cores, in various types of electromagnetic devices. These include all types of transformers, saturable reactors, and magnetic amplifiers. Although almost every type of ferromagnetic material known to man might be used in one of the above applications, only Deltamax, 4-79 Permalloy, and Supermalloy are considered here. Reference to Table I on page 15 will show many of the other alloys that may be considered.

Deltamax is used chiefly in saturable reactor and magnetic amplifier applications, due mainly to the rectangularity of its hysteresis loop. This "squareness" factor is expressed as the ratio Br/Bp, and is shown in Table II on page 15 to be 0.92 minimum for this alloy. The maximum differential permeability, or the slope of the sides of the hysteresis loop, is also an expression of "squareness", and is akin to a gain figure in a magnetic amplifier. This property is effected by core geometry: the lower the value of the core area to length ratio, the higher the value of maximum differential permeability. Deltamax has been used in many devices, including servo amplifiers, voltage regulators, modulators, harmonic generators, peaking transformers and contact rectifiers.



The regular type of 4-79 Permalloy has found applications where high permeabilities at moderate to low magnetizing fields are required. The low coercive force (0.02-0.07 dc) and high value of maximum differential permeability of this alloy have contributed to its usefulness in current transformers, wide-band communication transformers, magnetic amplifiers, magnetic modulators, pulse transformers and peaking transformer applications. A special type of 4-79 Permalloy is sometimes used which has a somewhat more rectangular hysteresis loop than the regular material. The ratio Br/Bp will range from 0.70 to 0.90 in cores with a tape thickness of 1 or 2 mils for this material.

Supermalloy is the latest development in the field of high permeability nickel-iron alloys. It is closely related to 4-79 Mo-Permalloy in chemical composition and has the highest initial and maximum permeability, and the lowest core loss, of any commercially available material. In the form of 1, 2 and 4 mil tape cores, it has found application in pulse transformers, modulators, low-level magnetic amplifiers, ratio transformers and wide band communication transformers.

Tape wound cores are fabricated most readily in the form of a toroid although square or rectangular shapes may be made. Since Deltamax, 4-79 Permalloy and Supermalloy are strain sensitive, it has been commercial practice to encase toroidal cores of these materials in plastic or metal containers to prevent any depreciation of magnetic properties by handling or by wire winding. Standard cores are supplied in nylon cases (grade FM 10001) with a filling of silicone grease (DC33). Aluminum cases may also be provided when requested.

Either nylon or aluminum cases may be supplied to a new design which permits filling with silicone oil and hermetically sealing the case. This construction permits core and coil assemblies to be vacuum impregnated and gives improved resistance to shock and vibration. The oil filled and hermetically sealed case construction is standard for all Supermalloy cores.

TAPE WOUND CORES

Testing is performed on a 100% basis. Deltamax is tested with a sinusoidal exciting current at a peak magnetizing force of one oersted at 60 or 400 cps. Core properties that are normally tested are Bp, Hc, Br/Bp and $\Delta \mu$ max.

Permalloy is normally supplied on the basis of guaranteed initial permeability of 10,000 at 20B and 100 cps. Upon request, these cores will be tested at 60 or 400 cps for Bp, Hc, Br/Bp and $\Delta \mu$ max.

Supermalloy is normally supplied on the basis of 55,000 guaranteed initial permeability at 20B and 100 cps.

The practice of grading or matching cores may be used to facilitate the core production of transformers and reactors. When establishing limits to graded or matched groups of cores, it is necessary that the type of test equipment required be considered and the limits established accordingly. It would be illogical, for example, to specify cores graded within 5% of each other when the accuracy of the instrument required to make the measurement is no better than 3%. Where close matching is needed to meet the requirements of a particular application, cores may be graded within practical limits to facilitate winding. The wound units may then be matched within each grade after one or more windings have been completed. This matching of a wound coil and core assembly permits matching to a degree not practical by production methods of testing the core alone.

TABLE I—TAPE CORE MATERIALS

BASIC MATERIAL TYPE	ORIENTATION	TRADE NAMES OF SIMILAR CORE MATERIALS	FORMS AVAILABLE	THICKNESSES AVAILABLE
78% Nickel-Iron	Non-Oriented	Supermalloy	Tape Wound Toroids Bobbin cores Gapless laminations	0.5 to 14 mils 0.125 to 1.0 mils 4 mils and thicker
	Non-Oriented	4-79 Molybdenum Permalloy, Mumetal, Hymu 80, Carpenter 78, Permanal, Permalloy C	Tape wound Toroids Bobbin cores Laminations	0.5 to 14 mils 0.5 to 1.0 mils 4 mils and thicker
	Non-Oriented	Square Permalloy, 79 Square Mu, Hymu 80	Tape wound Toroids Bobbin cores	0.5 to 2 mils 0.125 to 1.0 mils
50% Nickel-Iron	Grain-Oriented	Deltamax, Orthonol, Orthonik, Hipernik V, Permeron, H.C.R. Metal, Permenorm 5000Z, 49 Squaremu	Tape wound Toroids Bobbin cores Rectangular Laminations	0.5 to 6 mils 0.125 to 1.0 mils 4 to 8 mils
	Non-Oriented	4750, Carpenter 49, Armco 48, Hipernik, Permalloy B	Tape wound Toroids Bobbin cores Laminations	0.5 to 14 mils 0.125 to 1.0 mils 4 mils and thicker

TABLE II—TYPICAL PROPERTIES*

		DELTAMAX	4-79 MO-PERMALLOY	SUPERMALLOY
Specific Gravity		8.25	8.74	8.77
Electrical Resistivity		45	55	65
Temperature for Heat Treatment		1075° C	1100° C	1300° C
Initial Permeability. μi (at 20B, 100 cps)		400-1700	10,000-40,000	55,000-120,000
Maximum Permeability μm	dc 60 cps	70,000-250,000 40,000-100,000	70,000-250,000 40,000-100,000	300,000-900,000 100,000-500,000
Maximum Differential Permeability $\Delta \mu max$	60 cps 400 cps	100,000-400,000 55,000-250,000	125,000-450,000 70,000-300,000	....
Residual Induction Br	dc 60 cps 400 cps	12,500-15,000 12,500-15,000 12,500-15,000	4,000-7,000 4,000-7,000 4,000-7,000	4,000-5,500 4,000-5,500 4,000-5,500
Peak Flux Density Bp	dc 60 cps 400 cps	13,500-15,500 13,500-15,500 13,500-15,500	6,500-8,000 6,500-8,000 6,500-8,000	6,500-7,800 6,500-7,800 6,500-7,800
Br/Bp	60 cps 400 cps	0.92 min. 0.92 min.	0.50-0.90 0.50-0.90	0.50-0.80 0.50-0.80
Coercive Force Hc	dc 60 cps 400 cps	0.04-0.16 0.20-0.40 0.35-0.60	0.02-0.07 0.05-0.15 0.05-0.25	0.003-0.009 0.02-0.06 0.03-0.10

* The ac properties vary with core size and tape thickness, and are measured with a peak magnetizing force approximately equal to twice the coercive force.

NOTE: All ac measurements were made under conditions of sinusoidal current (see page 4).

The minimum guaranteed stacking factors for the above tape wound cores are as follows:

.004" tape = 85% .002" tape = 80% .001" tape = 70%

Minimum guaranteed core weights were calculated on the basis of these stacking factors and the specific gravities tabulated above. The maximum guaranteed core weight is 10% above the minimum weights shown on page 16.

STANDARD TAPE-WOUND CORE SIZES

AECo. Case No.	CORE SIZE (Inches)			CASE SIZE (Inches)			AECo. Case No.	CORE SIZE (Inches)			CASE SIZE (Inches)		
	O.D.	I.D.	H.	O.D.	I.D.	H.		O.D.	I.D.	H.	O.D.	I.D.	H.
5694	1¼-10 turns*	0.500	0.125	0.590	0.435	0.190	5762	1.250	0.750	1.000	1.340	0.660	1.080
7428	30 turns**	0.500	0.125	0.660	0.425	0.190	†4178	2.500	2.000	0.500	2.652	1.860	0.610
†5340	0.750	0.500	0.125	0.820	0.430	0.195	†4180	3.000	2.500	0.500	3.152	2.360	0.610
†5515	0.900	0.650	0.125	0.970	0.580	0.195	7189	1.750	1.250	1.000	1.850	1.150	1.090
†4168	1.250	1.000	0.125	1.330	0.920	0.195	†5320	2.500	1.500	0.500	2.610	1.390	0.610
6592	0.750	0.500	0.250	0.820	0.430	0.320	6100	3.500	2.500	0.500	3.630	2.370	0.610
†5504	1.125	0.750	0.188	1.215	0.660	0.262	†5468	3.500	2.500	1.000	3.630	2.370	1.120
†5651	1.000	0.625	0.250	1.080	0.545	0.320	5690	3.750	2.500	1.500	3.920	2.330	1.645
†4635	1.375	1.000	0.250	1.455	0.920	0.320	†5737	4.500	3.250	1.500	4.680	3.070	1.645
6180	1.150	0.650	0.375	1.240	0.560	0.450	6464	4.250	2.250	1.125	4.430	2.070	1.266
†4179	2.000	1.625	0.250	2.110	1.525	0.330	6379	5.000	3.000	1.000	5.180	2.820	1.140
†5387	1.750	1.250	0.250	1.830	1.170	0.320	5581	4.500	3.000	1.500	4.680	2.820	1.645
†5233	1.500	1.000	0.375	1.580	0.920	0.445	5582	5.850	3.100	1.375	6.030	2.920	1.605
5778	1.625	1.125	0.500	1.705	1.045	0.575							

* A minimum of 1¼ turns is necessary to reduce the effect of the air gap. ** Based on 1-mil tape. † Preferred core sizes.

STANDARD 1 MIL CORES

AECo. Case No.	DELTAMAX		SUPERMALLOY		4-79 MO-PERMALLOY		AECo. Case No.	DELTAMAX		SUPERMALLOY		4-79 MO-PERMALLOY	
	Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)		Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)
5694	5694-D1		5694-S1		5694-P1		5762	5762-D1	74.3	5762-S1	79.0	5762-P1	78.8
7428	7428-D1	0.866	7428-S1	0.921	7428-P1	0.918	4178	4178-D1	83.6	4178-S1	88.9	4178-P1	88.5
5340	5340-D1	2.90	5340-S1	3.09	5340-P1	3.08	4180	4180-D1	102	4180-S1	109	4180-P1	108
5515	5515-D1	3.60	5515-S1	3.83	5515-P1	3.81	7189	7189-D1	111	7189-S1	118	7189-P1	118
4168	4168-D1	5.22	4168-S1	5.55	4168-P1	5.53	5320	5320-D1	149	5320-S1	158	5320-P1	157
6592	6592-D1	5.81	6592-S1	6.17	6592-P1	6.15	6100	6100-D1	223	6100-S1	237	6100-P1	236
5504	5504-D1	9.79	5504-S1	10.4	5504-P1	10.4	5468	5468-D1	446	5468-S1	474	5468-P1	472
5651	5651-D1	11.3	5651-S1	12.0	5651-P1	12.0	5690	5690-D1	871	5690-S1	926	5690-P1	923
4635	4635-D1	16.5	4635-S1	17.6	4635-P1	17.5	5737	5737-D1	1080	5737-S1	1150	5737-P1	1140
6180	6180-D1	25.1	6180-S1	26.7	6180-P1	26.6	6464	6464-D1	1090	6464-S1	1160	6464-P1	1150
4179	4179-D1	25.3	4179-S1	26.8	4179-P1	26.7	6379	6379-D1	1190	6379-S1	1260	6379-P1	1260
5387	5387-D1	27.9	5387-S1	29.6	5387-P1	29.5	5581	5581-D1	1250	5581-S1	1330	5581-P1	1330
5233	5233-D1	34.8	5233-S1	37.0	5233-P1	36.9	5582	5582-D1	2510	5582-S1	2670	5582-P1	2660
5778	5778-D1	51.1	5778-S1	54.3	5778-P1	54.1							

*These are guaranteed minimum core weights. The maximum core weight is guaranteed not to exceed the minimum weight by more than 10%.

STANDARD 2 MIL CORES

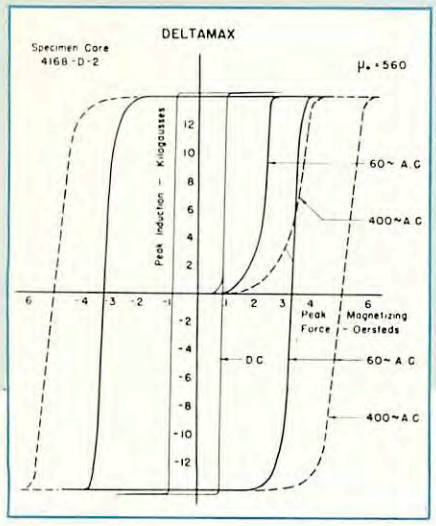
AECo. Case No.	DELTAMAX		SUPERMALLOY		4-79 MO-PERMALLOY		AECo. Case No.	DELTAMAX		SUPERMALLOY		4-79 MO-PERMALLOY	
	Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)		Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)
5694	5694-D2		5694-S2		5694-P2		5762	5762-D2	85.0	5762-S2	90.3	5762-P2	90.0
7428	7428-D2		7428-S2		7428-P2		4178	4178-D2	95.5	4178-S2	102	4178-P2	101
5340	5340-D2	3.32	5340-S2	3.53	5340-P2	3.51	4180	4180-D2	117	4180-S2	124	4180-P2	124
5515	5515-D2	4.11	5515-S2	4.37	5515-P2	4.36	7189	7189-D2	127	7189-S2	135	7189-P2	135
4168	4168-D2	5.97	4168-S2	6.35	4168-P2	6.33	5320	5320-D2	170	5320-S2	181	5320-P2	180
6592	6592-D2	6.64	6592-S2	7.06	6592-P2	7.03	6100	6100-D2	255	6100-S2	271	6100-P2	270
5504	5504-D2	11.2	5504-S2	11.9	5504-P2	11.9	5468	5468-D2	509	5468-S2	542	5468-P2	540
5651	5651-D2	12.9	5651-S2	13.8	5651-P2	13.7	5690	5690-D2	995	5690-S2	1060	5690-P2	1050
4635	4635-D2	18.9	4635-S2	20.1	4635-P2	20.0	5737	5737-D2	1230	5737-S2	1310	5737-P2	1310
6180	6180-D2	28.7	6180-S2	30.5	6180-P2	30.4	6464	6464-D2	1240	6464-S2	1320	6464-P2	1320
4179	4179-D2	28.9	4179-S2	30.7	4179-P2	30.6	6379	6379-D2	1360	6379-S2	1440	6379-P2	1440
5387	5387-D2	31.8	5387-S2	33.8	5387-P2	33.7	5581	5581-D2	1430	5581-S2	1520	5581-P2	1520
5233	5233-D2	39.8	5233-S2	42.3	5233-P2	42.2	5582	5582-D2	2870	5582-S2	3050	5582-P2	3040
5778	5778-D2	58.4	5778-S2	62.1	5778-P2	61.8							

*These are guaranteed minimum core weights. The maximum core weight is guaranteed not to exceed the minimum weight by more than 10%.

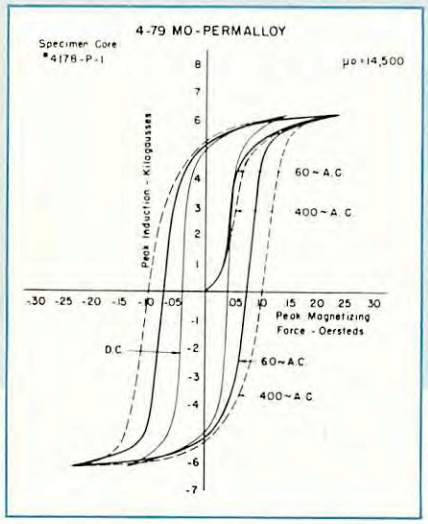
STANDARD 4 MIL CORES

AECo. Case No.	DELTAMAX		SUPERMALLOY		4-79 MO-PERMALLOY		AECo. Case No.	DELTAMAX		SUPERMALLOY		4-79 MO-PERMALLOY	
	Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)		Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)	Part No.	Min. Wt.* (Grams)
5694							5762	5762-D4	90	5762-S4	95.9	5762-P4	95.6
7428							4178	4178-D4	101	4178-S4	108	4178-P4	108
5340					5340-P4	3.73	4180	4180-D4	124	4180-S4	132	4180-P4	131
5515					5515-P4	4.63	7189	7189-D4	135	7189-S4	135	7189-P4	143
4168			4168-S4	6.74	4168-P4	6.72	5320	5320-D4	180	5320-S4	192	5320-P4	191
6592			6592-S4	7.50	6592-P4	7.47	6100	6100-D4	271	6100-S4	288	6100-P4	287
5504			5504-S4	12.6	5504-P4	12.6	5468	5468-D4	540	5468-S4	575	5468-P4	573
5651	5651-D4	14.0	5651-S4	14.6	5651-P4	14.6	5690	5690-D4	1056	5690-S4	1120	5690-P4	1120
4635	4635-D4	20.1	4635-S4	21.4	4635-P4	21.3	5737	5737-D4	1310	5737-S4	1390	5737-P4	1390
6180	6180-D4	30.4	6180-S4	32.4	6180-P4	32.3	6464	6464-D4	1320	6464-S4	1400	6464-P4	1400
4179	4179-D4	31.0	4179-S4	32.6	4179-P4	32.5	6379	6379-D4	1440	6379-S4	1530	6379-P4	1530
5387	5387-D4	33.8	5387-S4	36.0	5387-P4	35.8	5581	5581-D4	1520	5581-S4	1620	5581-P4	1610
5233	5233-D4	42	5233-S4	45.0	5233-P4	44.8	5582	5582-D4	3050	5582-S4	3250	5582-P4	3230
5778	5778-D4	62	5778-S4	65.9	5778-P4	65.7							

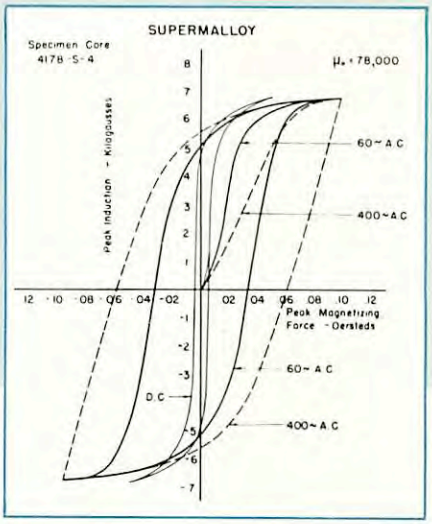
*These are guaranteed minimum core weights. The maximum core weight is guaranteed not to exceed the minimum weight by more than 10%.



D.C. AND A.C. MAGNETIZATION CURVES AND HYSTERESIS LOOPS OF DELTAMAX

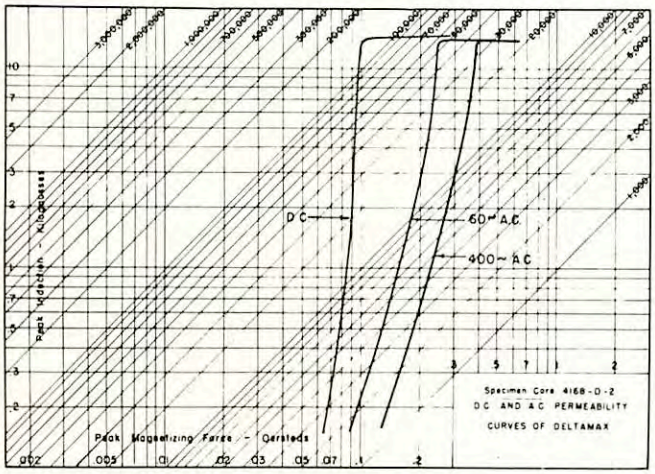


D.C. AND A.C. MAGNETIZATION CURVES AND HYSTERESIS LOOPS OF 4-79 MO-PERMALLOY

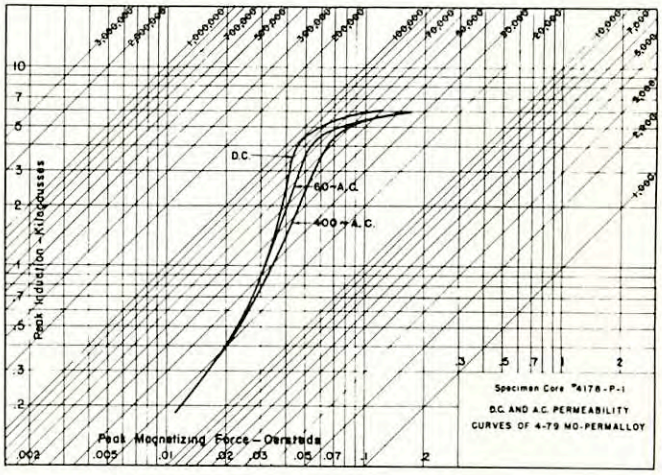


D.C. AND A.C. MAGNETIZATION CURVES AND HYSTERESIS LOOPS OF SUPERMALLOY

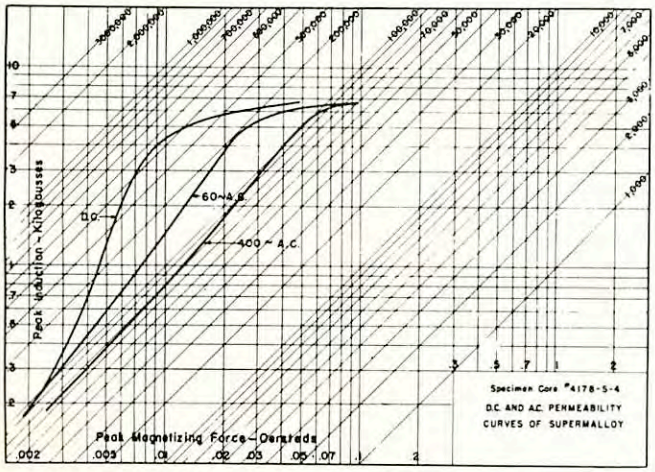
DELTAMAX



4-79 MO-PERMALLOY



SUPERMALLOY



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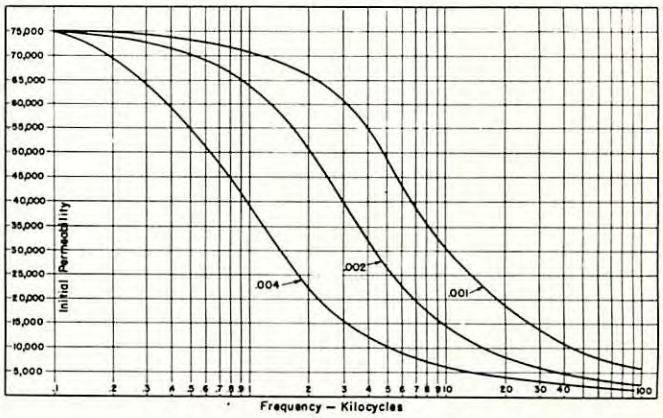


EFFECT OF TAPE THICKNESS ON THE INITIAL PERMEABILITY OF SUPERMALLOY AT VARIOUS FREQUENCIES

TAPE WOUND BOBBIN CORES

APPLICATIONS AND PROPERTIES: Cores made from ultra-thin tape of high permeability magnetic material are used in a wide variety of applications. These include shift registers, coincident current matrix systems, pulse transformers, static magnetic memory elements, harmonic generators and high frequency magnetic amplifiers.

Cores fabricated from thin tape have the properties of a rectangular hysteresis loop with relatively low coercive force. When used under conditions of pulse excitation, these materials have the ability to switch from a state of negative remanence to positive saturation, or from positive remanence to negative saturation, in a few microseconds.

FABRICATION: The thin tape magnetic materials are wound on ceramic bobbins to provide the necessary support for the tape during the high temperature annealing cycle. The bobbin also acts as a support for the wire windings. The shoulders of the bobbin must extend beyond the outer diameter of the metal wraps to prevent stressing the metal core.

The magnetic materials generally used for this type of core are Permalloy, Deltamax and Supermalloy. These materials are supplied in standard thicknesses of 0.001″, 0.0005″, 0.00025″, and 0.000125″ and in standard widths of .062″, 0.093″, 0.125″, and 0.250″. The number of wraps and thickness of magnetic material on a bobbin is dependent on the ultimate use of the core and is normally specified by the user.

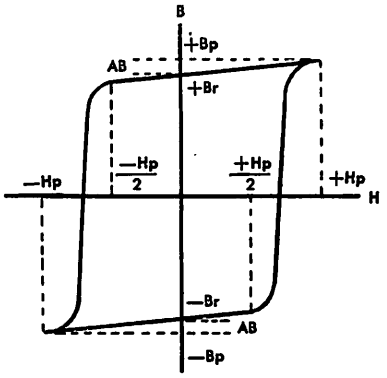
The process of reducing magnetic tapes to the thin gages necessary for bobbin cores requires extreme precision. The Arnold Engineering Company maintains complete control over this process by rolling all tape materials for bobbin cores on its ZR 32-4 Sendzimir Rolling Mill. On this equipment the thickness of the magnetic materials is accurately measured and controlled by means of gauges utilizing beta rays.

TESTING: In general, bobbin cores are tested under conditions of pulse excitation. These tests apply various sequences of square wave current pulses to the core at repetition rates up to 1 megacycle per second. The core properties obtained from this type of test are the switching time, flux reversal, squareness and noise output.

TABLE I

Typical DC Properties of Thin Tape Magnetic Materials

Material	Thickness (Inches)	Hc Oersteds	Br/Bp
Deltamax	0.001	.12	.96
	0.0005	.24	.94
	0.00025	.30	.93
	0.000125	.40	.87
Permalloy	0.001	.02	.83
	0.0005	.06	.87
	0.00025	.08	.90
	0.000125	.12	.92



Typical Hysteresis Loop of Thin Tape Bobbin Cores

TABLE II

Standard Bobbin Sizes

Bobbin No.	Strip Width	Nominal Dimensions in Inches				
		A ±.010	B +.010 −.000	C +.010 −.000	D ±.010	E +.015 −.000
10	.093	.240	.100	.175	.180	.317
1	.125	.112	.135	.082	.198	.180
15	.125	.188	.135	.148	.180	.227
16	.125	.188	.135	.148	.190	.248
17	.125	.250	.135	.210	.198	.312
18	.125	.312	.135	.270	.198	.375
11	.125	.375	.135	.312	.198	.437
5	.125	.437	.135	.375	.198	.500
12	.125	.500	.135	.437	.198	.562
6	.125	.562	.135	.500	.198	.656
13	.125	.625	.135	.562	.198	.687
7	.125	.812	.135	.750	.198	.906
3	.250	.250	.265	.187	.328	.375
14	.250	.500	.265	.437	.328	.625
8	.250	1.250	.265	1.125	.390	1.375
19	.125	.312	.135	.270	.198	.435
20	.062	.125	.070	.095	.110	.155
21	.062	.250	.070	.210	.110	.312
22	.062	.188	.070	.148	.110	.248

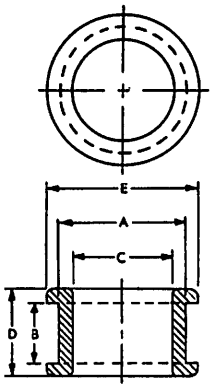


TABLE III

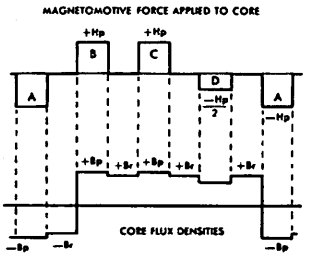
Typical Tape Wound Bobbin Cores

Part Number	Bobbin Number	Number of Wraps	Gage and Material	Application	NOTE
15P.250-6	15	6	.000250" Permalloy	Shift Register	The letters D, P or S designate the type of material, namely Deltamax, Permalloy or Supermalloy. The digits following the material designation indicate the tape thickness in mils.
16P.125-9	16	9	.000125" Permalloy	Shift Register	
18P.125-20	18	20	.000125" Permalloy	Shift Register	
19P.500-46	19	46	.000500" Permalloy	Pulse Transformer	Tape wound bobbin cores can be supplied with a protective covering of Mylar Film wrapped around the outer periphery of the core.
20P.125-10	20	10	.000125" Permalloy	Shift Register	
21P.125-12	21	12	.000125" Permalloy	Shift Register	

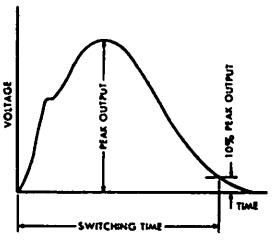
TABLE IV

Maximum Allowable Number of Wraps of Tape For Each Bobbin Size

Bobbin Number	Section A				Section B			
	Tape Thickness in Mils				Tape Thickness in Mils			
	⅛	¼	½	1	⅛	¼	½	1
1	57	42	34	20	35	28	22	16
3	115	86	74	42	73	57	46	35
5	55	42	35	19	33	26	21	16
6	88	63	55	31	53	42	34	26
7	88	63	55	31	53	42	34	26
8	115	86	74	44	73	57	46	35
10	69	48	44	24	41	33	26	20
11	55	42	35	19	33	26	21	16
12	55	42	35	19	33	26	21	16
13	55	42	35	19	33	26	21	16
14	115	86	74	44	73	57	46	35
15	28	21	18	10	17	14	11	8
16	52	38	32	18	31	25	20	14
17	55	42	35	19	35	26	21	16
18	55	42	35	19	33	26	21	16
19	108	83	68	37	65	52	41	31
20	20	15	12	7	12	10	8	5
21	55	42	35	19	33	26	21	16
22	52	38	32	18	31	25	20	14



Typical Sequence of Test Pulses and Resulting Core Flux Densities



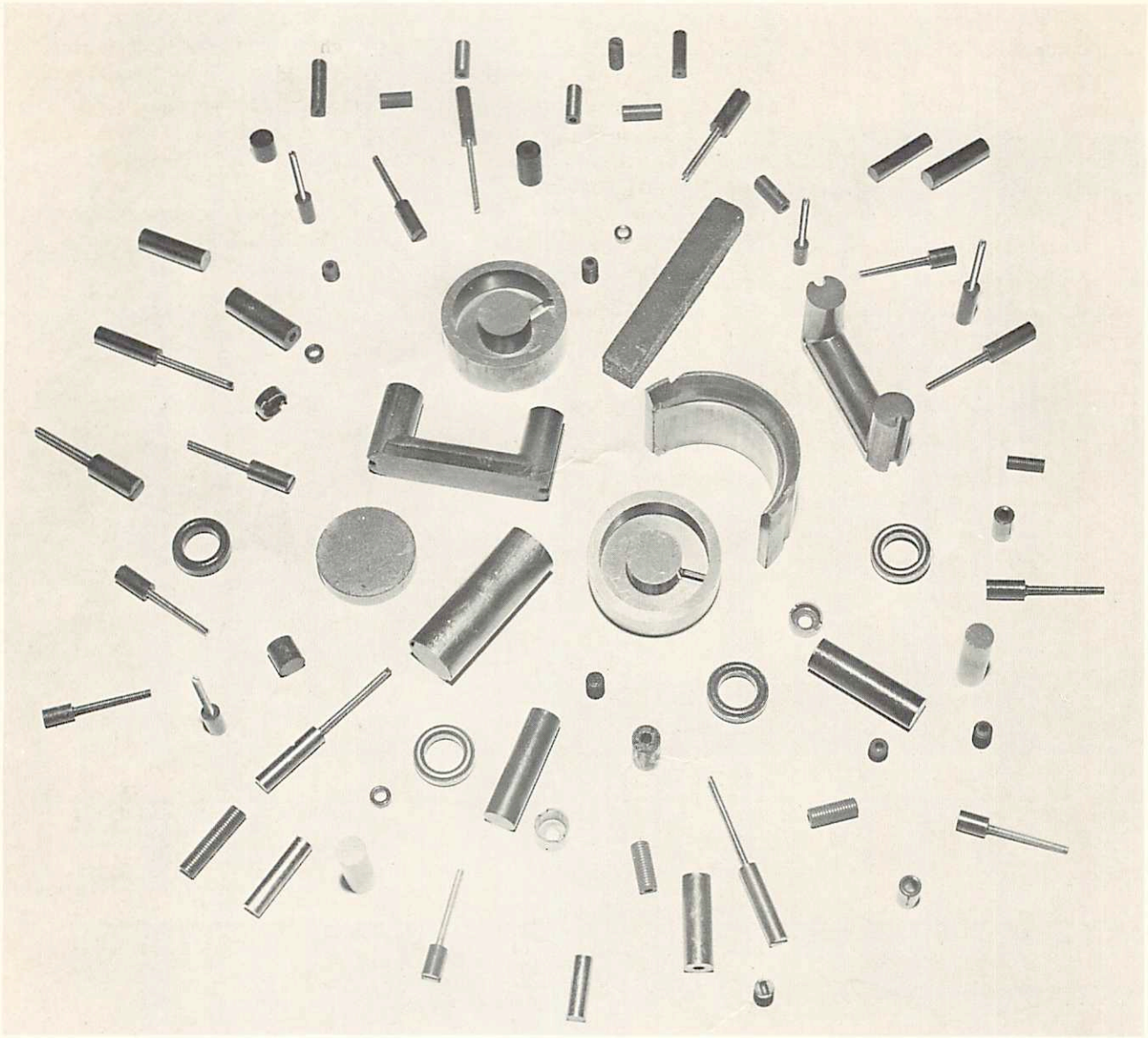
Typical Oscillographic Presentation of Pulse Test Information

	Section A				Section B			
	Tape Thickness in Mils				Tape Thickness in Mils			
	⅛	¼	½	1	⅛	¼	½	1
% Stacking Factor	24	36	58	69	15	24	38	50
	26	40	67	74	16	25	41	61

Section A applies to all Permalloy and all Deltamax except ⅛ mil. Section B applies to all Supermalloy and ⅛ mil Deltamax.

This table was compiled on the basis of the following stacking factors:

IRON POWDER CORES



Iron powder cores are made from finely divided iron powder produced by various processes, which has been insulated and mixed with a thermo-setting binder. After the material has been pressed to shape and size at pressures ranging from 10 to 50 tons per square inch, the core is baked to polymerize the plastic binder.

The cured parts may be readily finished to closer tolerances, or threaded on the outside diameter, by grinding. The surface of the core can be rust proofed, if desired.

Although the cores were developed originally for use in inductance coils for the telephone system, they were used in radio coils as early as 1933. Iron powder cores are now used over a very wide frequency range, from the audio to the radar end of the frequency spectrum. The present uses include RF coils, IF coils, FM coils, noise filter coils, induction heating and bombarder coils, antenna leading coils, high frequency transformers and deflection yokes.

Iron powder cores are made under carefully controlled conditions to maintain uniform physical and mechanical properties throughout each production run. Permeability and "Q" are checked on a quality control basis against carefully selected reference standards. Physical size and mechanical strength are also checked on a quality control basis using standard testing and gaging procedures.

IRON POWDER CORES

The many uses of iron powder cores require a variety of core shapes and sizes. These have been classified into eleven groups, numbered from A0 to A10. The more popular types are described.

The insert core, type A0, is a cylindrical iron core in which an insert is molded or cemented in one or both ends of the core. It is recommended wherever a precision adjustable core is required. It is somewhat more expensive than the threaded core, but eliminates the high adjusting torque required in using threaded cores.

The threaded core, type A1, is threaded on the outside diameter. It is used wherever a compact, high "Q", adjustable core is required. It is made with a variety of center hole configurations which permit convenient top adjustment of both cores in a double tuned I.F. transformer.

The toroidal core, type A4, is a ring shaped core with a radius on both the top and bottom of the ring. These cores are used for inductors and filters at frequencies from 1 kc to 1000 mc. They are produced in a number of standard sizes, as shown in Table III. Toroidal cores may be supplied with an insulating enamel finish.

CHART I

Iron Powder Core Materials	Audio Freq. to 50 kc	50 kc to 250 kc	250 kc to 500 kc	500 kc to 2000 kc	2 mc to 10 mc	10 mc to 40 mc	40 mc to 150 mc	150 mc to 250 mc	Above 250 mc
ELECTROLYTIC	■								
SPONGE IRON	■								
H_2 REDUCED IRON OXIDES	■								
IRON ALLOYS	■	■							
CARBONYL L	■	■	■	■					
CARBONYL HP	■	■	■	■					
CARBONYL GQ-4	■	■	■	■					
CARBONYL C	■	■	■	■					
CARBONYL GS-6	■	■	■	■	■				
CARBONYL E			■	■	■	■			
CARBONYL TH					■	■			
CARBONYL SF							■	■	■
CARBONYL J							■		
CARBONYL W								■	
IRON OXIDES		■	■	■					
SYNTHETIC OXIDES						■	■	■	■

Suggested frequency ranges for iron powder core materials as formulated by The Arnold Engineering Company.

NOTE: The materials in this chart are listed in order of their permeability, the highest permeability material being listed first.

The cup core, type A6, is a cylinder with one end closed. A center core inside the inductor is normally used, which may or may not be part of the cup core itself. It is used where a compact, high "Q", self-shielding inductor is required. It can be mounted close to a chassis or metal shield with minimum effect on the inductance and "Q" of the coil. A number of miniature size cups are now being made for use in transistorized RF and IF circuits.

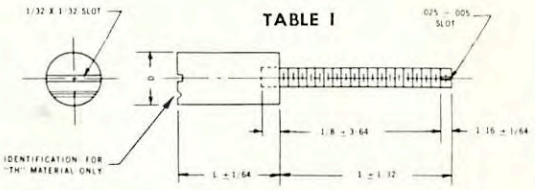


TABLE I

TYPE "AO" INSERT CORES

Part No.	Material	Q Tol. %	Perm. Tol. %	Insert	Length Inches	Diameter Inches
A0-02	E	± 7½	± 2	4-40	⅜	.245-.250
A0-03	E	± 7½	± 2	4-40	½	.245-.250
A0-04	TH	± 7½	± 2	4-40	⅜	.245-.250
A0-05	TH	± 7½	± 2	4-40	½	.245-.250
A0-08	E	± 7½	± 2	4-40	¾	.245-.250
A0-06	HR	±10	± 4	4-40	⅝	.245-.250
A0-07	HR	±10	± 4	6-32	¾	.304-.309
A0-111	HR	±10	±10	4-40	1	.245-.250

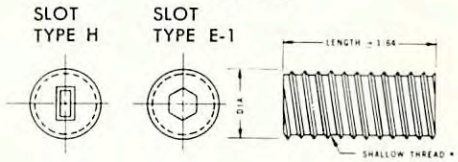


TABLE II

TYPE "A1" THREADED CORES

Part No.	Material	Slot Type	Q Tol. %	Perm. Tol. %	Length Inches	Diameter Inches	Pitch*
A1-01	E	E-1	±7½	±4	⅜	.248-.250	28
A1-02	E	E-1	±7½	±4	⅜	.237-.239	32
A1-06	E	E-1	±7½	±4	⅝	.247-.249	28
A1-09	E	E-1	±7½	±4	½	.247-.249	28
A1-05	E	H	±7½	±4	½	.247-.249	28
A1-08	E	H	±7½	±4	⅜	.248-.250	28
A1-10	TH	E-1	±7½	±4	⅜	.248-.250	28
A1-11	E	E-1	±7½	±4	¼	.248-.250	28
A1-12	TH	E-1	±7½	±4	¼	.248-.250	28
A1-13	J	E-1	±7½	±4	⅜	.248-.250	28
A1-14	IRN-8	E-1	±7½	±4	⅜	.248-.250	28
A1-15	J	E-1	±7½	±4	½	.247-.249	28
A1-16	E	H	±7½	±4	¼	.180-.182	32

TABLE III

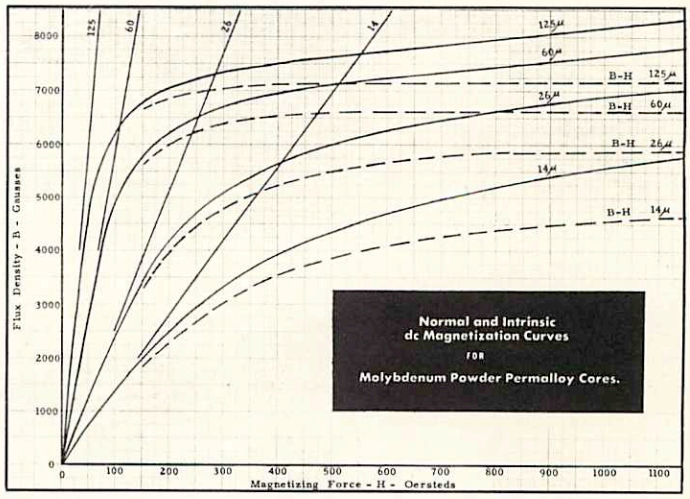
TYPE A4 TOROIDAL CORES

Outside Diameter in.	Inside Diameter in.	Height in.	Approx. Corner Radii in.
0.307/0.312	0.151/0.161	.115/.135	.032
0.490/0.510	0.295/0.305	.177/.197	.032
0.790/0.810	0.495/0.505	.240/.260	.032
1.050/1.070	0.575/0.585	.428/.452	.075
1.278/1.312	0.780/0.795	.421/.454	.062
1.558/1.582	0.938/0.955	.555/.585	.100
1.980/2.020	1.235/1.255	.507/.553	.062

MOLYBDENUM PERMALLOY POWDER CORES

Molybdenum Permalloy powder cores are made by compressing insulated Molybdenum Permalloy powder under high pressure, annealing, and then finishing. Although developed originally by Bell Telephone Laboratories for telephone loading coils, they are used in many other applications. These include filters, oscillators, repeaters and chokes for use at frequencies up to 200 kc. They have also been used in noise suppression filters at frequencies as high as 1,000 megacycles per second.

These cores are furnished in many standard toroidal sizes from ½″ diameter up to 5″ diameter. They are made in four standard permeabilities: 125, 60, 26 and 14. Most of these cores can be furnished with a controlled temperature co-efficient of inductance in the range of 30°F to 130°F.



STANDARD MOLYBDENUM PERMALLOY POWDER CORES

AECo. Part No.	Nominal Permeability	NOMINAL DIMENSIONS (Inches before finish)			INDUCTANCE (mh) FOR 1000 TURN WINDING		
		O.D.	I.D.	H.	Min.	Nominal	Max.
A-050056-2	125	0.500	0.300	0.187	45	56	69
A-051027-2	60	0.500	0.300	0.187	22	27	33
A-052012-2	26	0.500	0.300	0.187	9.4	12	14
A-053006-2	14	0.500	0.300	0.187	5.1	6.3	7.7
A-206068-2	125	0.800	0.500	0.250	58	68	83
D-951068-4	125	0.800	0.500	0.250	58	68	83
A-848032-2	60	0.800	0.500	0.250	28	32	39
A-511014-2	26	0.800	0.500	0.250	12	14	17
D-608014-4	26	0.800	0.500	0.250	12	14	17
A-057008-2	14	0.800	0.500	0.250	6.6	7.8	9.2
A-310090-2	125	0.900	0.550	0.300	77	90	104
A-059043-2	60	0.900	0.550	0.300	36	43	49
A-060019-2	26	0.900	0.550	0.300	16	19	21
A-062010-2	14	0.900	0.550	0.300	8.5	9.9	11
A-930157-2	125	1.060	0.580	0.440	136	157	179
D-671157-3	125	1.060	0.580	0.440	136	157	179
W-098157-3	125	1.060	0.580	0.440	136	157	179
A-395075-5	60	1.060	0.580	0.440	65	75	86
D-269075-4	60	1.060	0.580	0.440	65	75	86
W-099075-4	60	1.060	0.580	0.440	65	75	86
A-066032-2	26	1.060	0.580	0.440	28	32	37
W-105032-4	26	1.060	0.580	0.440	28	32	37
A-068018-2	14	1.060	0.580	0.440	15	18	20
A-548127-2	125	1.300	0.785	0.420	106	127	148
A-071065-2	60	1.300	0.785	0.440	53	65	74
D-381065-3	60	1.300	0.785	0.440	53	65	74
A-073028-2	26	1.300	0.785	0.440	23	28	32
D-270028-3	26	1.300	0.785	0.440	23	28	32
A-074015-2	14	1.300	0.785	0.440	13	15	17
D-013015-3	14	1.300	0.785	0.440	13	15	17
A-585079-2	125	1.350	0.920	0.350	71	79	91
A-324117-2	125	1.410	0.880	0.412	101	117	137
A-076056-2	60	1.410	0.880	0.412	48	56	66
A-078024-2	26	1.410	0.880	0.412	21	24	28
A-080013-2	14	1.410	0.880	0.412	11	13	15
A-254168-2	125	1.570	0.950	0.570	146	168	195
D-082168-3	125	1.570	0.950	0.570	146	168	195
W-110168-3	125	1.570	0.950	0.570	146	168	195
A-083081-2	60	1.570	0.950	0.570	70	81	94
A-085035-2	26	1.570	0.950	0.570	30	35	40
A-086019-2	14	1.570	0.950	0.570	17	19	22
A-438281-2	125	1.840	0.950	0.710	248	281	325
D-466281-3	125	1.840	0.950	0.710	248	281	325
W-108281-3	125	1.840	0.950	0.710	248	281	325
A-759135-2	60	1.840	0.950	0.710	119	135	157
A-087059-2	26	1.840	0.950	0.710	52	59	67
A-088032-2	14	1.840	0.950	0.710	28	32	36
A-089178-2	125	1.840	1.130	0.600	151	178	210
A-090086-2	60	1.840	1.130	0.600	72	86	101
A-091037-2	26	1.840	1.130	0.600	32	37	40
B-411037-3	26	1.840	1.130	0.600	32	37	40
A-092020-2	14	1.840	1.130	0.600	17	20	23
B-957020-3	14	1.840	1.130	0.600	17	20	23
A-715152-2	125	2.000	1.250	0.530	130	152	180
A-106073-2	60	2.000	1.250	0.530	62	73	87
A-109156-2	125	2.250	1.400	0.550	134	156	188
D-927156-3	125	2.250	1.400	0.550	134	156	188
W-107156-3	125	2.250	1.400	0.550	134	156	188
A-488075-2	60	2.250	1.400	0.550	64	75	89
B-377033-3	26	2.250	1.400	0.550	28	33	38
A-096018-2	14	2.250	1.400	0.550	15	18	21
A-866142-2	125	3.063	1.938	0.500	119	142	169
D-627142-3	125	3.063	1.938	0.500	119	142	169
A-123068-2	60	3.063	1.938	0.500	57	68	81
A-124033-2	26	3.063	1.938	0.560	28	33	39
B-673033-3	26	3.063	1.938	0.560	28	33	39
A-542232-2	125	4.000	2.250	0.650	198	232	271
A-125112-2	60	4.000	2.250	0.650	95	112	130
A-126040-2	26	4.000	2.250	0.535	33	40	48
B-600040-3	26	4.000	2.250	0.535	33	40	48
A-127259-2	125	5.218	3.094	0.800	224	259	300
A-128124-2	60	5.218	3.094	0.800	107	124	146
A-129054-2	26	5.218	3.094	0.800	47	54	62
B-694054-3	26	5.218	3.094	0.800	47	54	62

MOLYBDENUM PERMALLOY POWDER CORES

CORE SPECIFICATION—Molybdenum Permalloy powder cores are manufactured to the electrical specifications of permeability, core loss, and magnetic stability listed in Table I.

Permeability is calculated from the inductance of a uniformly wound toroid, as measured on a sensitive bridge as follows:

$$\mu = \frac{(L) \times 10^9}{11.7 \log_{10} \frac{OD}{ID} H_e N^2} + 1$$

L — measured inductance (henries)
OD — measured average outside diameter (inches) before finish
ID — mean effective inside diameter corrected for 2° taper (inches) before finish
H_e — effective height corrected for radii (inches)
N — number of turns in test winding

Core loss is determined by measuring the effective ac resistance at a 2 milliampere test current of the core, with either an 89 millihenry (125 Mu) or a 6 millihenry winding (60, 26, or 14 Mu). This effective resistance, corrected for the dc winding resistance and the ac skin effect, represents the core loss resistance, R. The total core loss, as shown by Legg, may be expressed as follows:

$$\frac{R}{\mu L} = aB_m f + cf + ef^2$$

R — effective resistance in ohms due to core losses
L — inductance in henries
μ — permeability of core
f — frequency in cycles per second
B_m — peak induction in gausses
a — hysteresis loss coefficient
c — residual loss coefficient
e — eddy current loss coefficient

Magnetic stability to dc magnetization is determined by measuring the test core inductance before and after the application of a dc magnetizing field of 20 oersteds.

CORE GRADING—It is common practice for most users of cores to grade them into groups by some simple inductance test. This facilitates the toroidal winding operation, as the inductance specification for any particular core has rather wide limits because of combined variations of core size and permeability. A number of suitable methods for rapid testing and grading of cores are available. Several commercial equipments are now on the market for core grading. They consist of multi-turn test jigs coupled to appropriate detecting devices, such as a sensitive inductance bridge. The Kelsall Permeameter was one of the first devices used for this purpose.

TABLE I

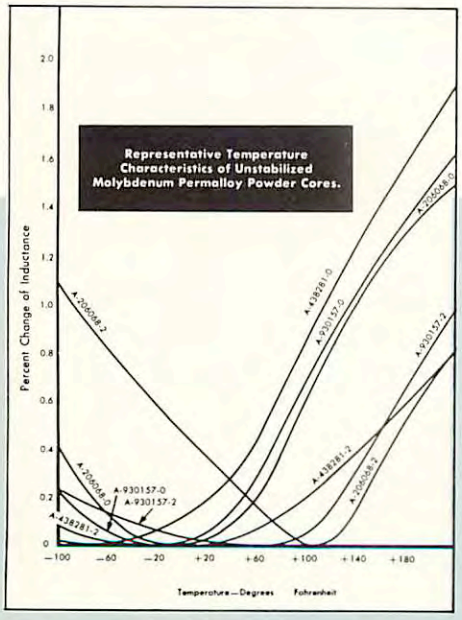
Permeability, μ	Core Loss Ohms/Henry/ unit of μ	Core Loss Test Frequency	Magnetic Stability to dc Magnetization
125 ± 10	0.24 max.	1800 cps	± 0.5%
60 ± 5	1.70 max.	8000 cps	± 0.3%
26 ± 2	76 max.	75 kc.	± 0.2%
14 ± 1	65 max.	75 kc.	± 0.1%

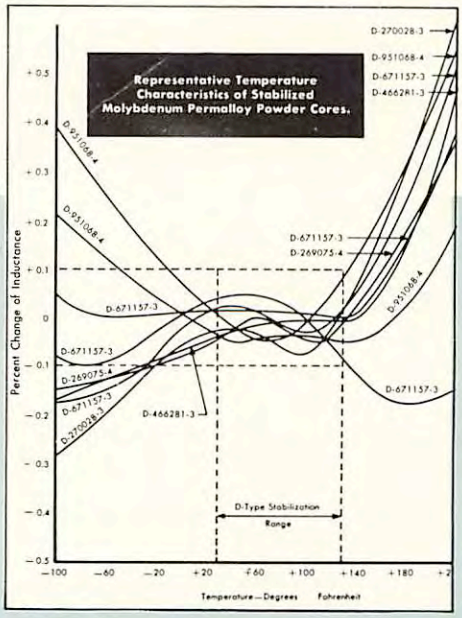
TABLE II
TYPES OF STABILIZATION

Type	Maximum Inductance Change	Temperature Range
A — Unstabilized	.....	.....
B — Stabilized	±0.1 %	55°F. to 95°F.
D — Stabilized	±0.1 %	30°F. to 130°F.
W — Stabilized	±0.25%	−65°F. to + 185°F.

TABLE III
TYPES OF CORE FINISH

Finish No.	Type	Breakdown Requirement
0	None	None
2	Enamel	500 volts rms, 60 cps
3	Wax tight varnish	None
4	Wax tight varnish	500 volts rms, 60 cps
5	Enamel	1000 volts rms, 60 cps





Tape Core Department

Testing Tape Wound Cores

Testing "E" Cores

Grinding Speaker Magnets made of Alnico V

Automatic inspection of speaker magnets

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THE ARNOLD ENGINEERING COMPANY

MARENGO, ILLINOIS

ALNICO MAGNET PRICE LIST

15 DECEMBER 1955

Parts listed hereon are of Alnico V unless otherwise noted and magnets will be shipped magnetized unless specifically ordered not magnetized. Horseshoe shapes, holding magnets, separator magnets and sintered parts are ground on the pole faces only, with the other surfaces as-cast. Plug magnets are ground on the two parallel end faces, while all rods and bars are furnished with no surfaces ground. Prices on quantities greater than those listed will be quoted upon request. These Prices are subject to change without notice.

CAST ALNICO MAGNETS —

Part Number	Quantity and Price Per Magnet		
244	1 - 36 ..... $ 2.02	37 - 72 ..... $ 1.77	73 - 180 ..... $ 1.52
286	1 - 5 ..... 9.26	6 - 10 ..... 8.11	11 - 27 ..... 6.96
537	1 - 16 ..... 3.69	17 - 33 ..... 3.23	34 - 84 ..... 2.77
642	1 - 16 ..... 3.72	17 - 33 ..... 3.26	34 - 83 ..... 2.80
812	1 - 42.51	2 - 37.23	3 - 5 ..... 31.94
1386	1 - 49 ..... 0.66	50 - 397 ..... 0.59	398 - 793 ..... 0.58
1426	1 - 11 ..... 4.90	12 - 23 ..... 4.29	24 - 59 ..... 3.68
1598	1 - 2 ..... 22.84	3 - 4 ..... 20.00	5 - 10 ..... 17.16
1806	1 - 50 ..... 1.76	51 - 102 ..... 1.54	103 - 255 ..... 1.32
1945	1 - 25 ..... 0.85	26 - 124 ..... 0.75	125 - 624 ..... 0.64
1946	1 - 25 ..... 0.86	26 - 124 ..... 0.76	125 - 624 ..... 0.65
1947	1 - 25 ..... 0.91	26 - 124 ..... 0.80	125 - 624 ..... 0.69
1948	1 - 50 ..... 1.03	51 - 226 ..... 0.90	227 - 567 ..... 0.77
1949	1 - 25 ..... 1.48	26 - 111 ..... 1.30	112 - 280 ..... 1.12
1950	1 - 25 ..... 2.18	26 - 64 ..... 1.91	65 - 162 ..... 1.64
2056	1 - 124 ..... 0.90	125 - 249 ..... 0.79	250 - 624 ..... 0.68
2058	1 - 124 ..... 1.20	125 - 249 ..... 1.05	250 - 624 ..... 0.90
2061	1 - 61 ..... 1.43	62 - 122 ..... 1.25	123 - 308 ..... 1.07
2064	1 - 32 ..... 2.38	33 - 65 ..... 2.08	66 - 165 ..... 1.79
2065	1 - 19 ..... 3.34	20 - 40 ..... 2.92	41 - 102 ..... 2.51
2067	1 - 11 ..... 4.69	12 - 23 ..... 4.11	24 - 59 ..... 3.52
2070	1 - 8 ..... 5.75	9 - 18 ..... 5.04	19 - 47 ..... 4.32
2106	1 - 32.83	2 - 3 ..... 28.75	4 - 7 ..... 24.66
2115A	1 - 47.36	2 - 41.47	3 - 5 ..... 35.57
2225	1 - 14 ..... 4.38	15 - 29 ..... 3.84	30 - 72 ..... 3.29
2226	1 - 7 ..... 7.22	8 - 15 ..... 6.32	16 - 39 ..... 5.42
2227	1 - 3 ..... 14.82	4 - 6 ..... 12.97	7 - 16 ..... 11.12
2589	1 - 24 ..... 2.61	25 - 50 ..... 2.29	51 - 125 ..... 1.96
2614	1 - 59.14	2 - 50.74	3 - 33.95
2889	1 - 41 ..... 2.08	42 - 84 ..... 1.82	85 - 211 ..... 1.57
3111	1 - 17 ..... 3.77	18 - 34 ..... 3.30	35 - 87 ..... 2.83
3112	1 - 6 ..... 8.00	7 - 13 ..... 7.01	14 - 35 ..... 6.01
3113	1 - 99 ..... 1.12	100 - 199 ..... 0.98	200 - 499 ..... 0.84
3114	1 - 66 ..... 1.19	67 - 134 ..... 1.04	135 - 334 ..... 0.90
3115	1 - 49 ..... 1.65	50 - 99 ..... 1.45	100 - 249 ..... 1.24
3116	1 - 21 ..... 2.83	22 - 43 ..... 2.48	44 - 110 ..... 2.13
3117	1 - 12 ..... 4.33	13 - 24 ..... 3.79	25 - 62 ..... 3.25
3118	1 - 8 ..... 6.16	9 - 16 ..... 5.40	17 - 41 ..... 4.63
3119	1 - 5 ..... 8.16	6 - 11 ..... 7.15	12 - 31 ..... 6.13
3120	1 - 5 ..... 9.09	6 - 10 ..... 7.96	11 - 27 ..... 6.83
3121	1 - 3 ..... 15.88	4 - 6 ..... 13.91	7 - 15 ..... 11.93
3124	1 - 108 ..... 1.87	109 - 217 ..... 1.64	218 - 543 ..... 1.41
3125	1 - 32 ..... 2.77	33 - 64 ..... 2.43	65 - 161 ..... 2.08
3126	1 - 13 ..... 4.37	14 - 27 ..... 3.83	28 - 68 ..... 3.28
3127	1 - 6 ..... 7.33	7 - 13 ..... 6.42	14 - 34 ..... 5.50
3130	1 - 30 ..... 2.56	31 - 60 ..... 2.25	61 - 152 ..... 1.96
3131	1 - 118 ..... 1.24	119 - 237 ..... 1.08	238 - 594 ..... 0.93
3132	1 - 124 ..... 0.88	125 - 249 ..... 0.77	250 - 624 ..... 0.67
3133	1 - 18 ..... 3.70	19 - 36 ..... 3.26	37 - 92 ..... 2.81
3136	1 - 48 ..... 1.68	49 - 97 ..... 1.48	98 - 244 ..... 1.28
3149	1 - 124 ..... 0.89	125 - 249 ..... 0.78	250 - 624 ..... 0.67
3150	1 - 124 ..... 0.98	125 - 249 ..... 0.86	250 - 624 ..... 0.74
3151	1 - 74 ..... 1.23	75 - 149 ..... 1.08	150 - 373 ..... 0.93
3201	1 - 3 ..... 12.20	4 - 32 ..... 8.16	33 - 66 ..... 6.14

(over)

CAST ALNICO MAGNETS—(Continued)

Part Number	Quantity and Price Per Magnet		
3202	1 - $36.23	2 - 6..... $31.75	7 - 13..... $27.26
3203	1 - 2..... 73.98	3 - 6..... 55.67	7 - 16..... 46.52
3204	1 - 3..... 18.75	4 - 21..... 12.54	22 - 42..... 9.44
7565-2	1 - 16..... 3.71	17 - 32..... 3.25	33 - 83..... 2.79
7602	1 - 75..... 1.10	76 - 151..... 0.96	152 - 378..... 0.83
7604	1 - 16..... 3.70	17 - 33..... 3.24	34 - 84..... 2.78
7923	1 - 2..... 22.42	3 - 4..... 19.63	5 - 11..... 16.84

PLUG MAGNETS —

10001	1 - 115..... 0.66	116 - 231..... 0.58	232 - 580..... 0.50
10002	1 - 78..... 0.82	79 - 157..... 0.72	158 - 395..... 0.62
10003	1 - 53..... 1.07	54 - 107..... 0.97	108 - 270..... 0.83
10004	1 - 53..... 1.07	54 - 107..... 0.97	108 - 270..... 0.83
10005	1 - 36..... 1.44	37 - 73..... 1.26	74 - 185..... 1.08
10006	1 - 24..... 2.03	25 - 49..... 1.78	50 - 125..... 1.53
10007	1 - 24..... 2.03	25 - 49..... 1.78	50 - 125..... 1.53
10008	1 - 16..... 2.88	17 - 34..... 2.52	35 - 85..... 2.16
10009A	1 - 11..... 4.01	12 - 23..... 3.52	24 - 58..... 3.02

ROD MAGNETS—8″ LONG

No. 1 Rod	1 - 6..... 8.24	7 - 12..... 7.22	13 - 31..... 6.19
No. 2 Rod	1 - 5..... 9.89	6 - 10..... 8.66	11 - 25..... 7.43
No. 3 Rod	1 - 4..... 12.08	5 - 8..... 10.53	9 - 21..... 9.03
No. 4 Rod	1 - 3..... 13.99	4 - 7..... 12.25	8 - 18..... 10.51
No. 5 Rod	1 - 3..... 16.76	4 - 6..... 14.68	7 - 15..... 12.59

ASSEMBLIES —

4931 (2902)	1 - 2..... 96.52	3 - 4..... 84.45	5 - 9..... 60.31
5725 (2839)	1 - 210.23	2 - 4..... 178.06	5 - 9..... 165.20
7434-1	1 - 259.68	2 - 177.88	3 - 6..... 137.04

SINTERED ALNICO II MAGNETS — Poles Ground

	Price Per Hundred Magnets		
2036	1 - 99..... $14.60	100 - 249..... $13.50	250 - 499..... $13.00
2037	1 - 99..... 13.00	100 - 249..... 11.98	250 - 499..... 11.57
2037A	1 - 99..... 15.60	100 - 249..... 14.39	250 - 499..... 13.88
2077	1 - 99..... 13.20	100 - 249..... 12.20	250 - 499..... 11.77
2815	1 - 99..... 19.30	100 - 249..... 17.70	250 - 499..... 17.14
2826	1 - 99..... $14.25	100 - 249..... $13.17	250 - 499..... $12.71
2895	1 - 99..... 33.10	100 - 249..... 30.30	250 - 499..... 29.20
3241	1 - 99..... 15.00	100 - 249..... 13.84	250 - 499..... 13.36
7532	1 - 99..... 9.90	100 - 249..... 9.20	250 - 499..... 8.95
7559 (Alnico V)	1 - 99..... 29.00	100 - 249..... 26.66	250 - 499..... 25.64
7828	1 - 99..... 46.00	100 - 249..... 42.00	250 - 499..... 40.55

SINTERED ALNICO II MAGNETS — No Ground Surfaces

	Price Per Hundred Magnets		
2036	1 - 99..... $11.60	100 - 249..... $10.74	250 - 499..... $10.38
2037	1 - 99..... 10.00	100 - 249..... 9.25	250 - 499..... 8.95
2037A	1 - 99..... 12.60	100 - 249..... 11.65	250 - 499..... 11.26
2077	1 - 99..... 10.20	100 - 249..... 9.50	250 - 499..... 9.14
2815	1 - 99..... 16.30	100 - 249..... 15.05	250 - 499..... 14.51
2895	1 - 99..... 30.10	100 - 249..... 27.50	250 - 499..... 26.57
3241	1 - 99..... 12.00	100 - 249..... 11.10	250 - 499..... 10.73
7453	1 - 99..... 8.60	100 - 249..... 8.00	250 - 499..... 7.72
7539	1 - 99..... 28.00	100 - 249..... 25.56	250 - 499..... 24.60
7559 (Alnico V)	1 - 99..... 26.00	100 - 249..... 23.90	250 - 499..... 23.02
7828	1 - 99..... 43.00	100 - 249..... 39.28	250 - 499..... 37.93

Form 91 5M 12-55

THE ARNOLD ENGINEERING COMPANY
SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION
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