REWINDING OF POWER TRANSFORMERS

When we buy an old radio, we all know what needs to be done. All capacitors should be replaced, along with out of tolerance resistors, low emission valves, bare wiring, etc. At the same time, we should be trying as much as possible to leave it in its original appearance. All of this is relatively easy to do.

The problem is when we find a burnt power transformer. Years ago, the simplest thing was to remove the transformer and take it to a specialist to rewind it. Unfortunately, many of these people are now either deceased or retired. In some cases, we can find the same transformer model. But in other cases, it is impossible to find a suitable replacement. There is also the solution of replacing a transformer with another that has the same technical characteristics. But in these cases, it is necessary to proceed to make new holes in the chassis, considerably varying its original appearance.

I personally have come across blown transformers from ATWATER KENT and JACKSON BELL. Interestingly, I have to say, that I have never come across damaged power transformers from PHILCO.

Why not rewind them ourselves? Is it that difficult? The answer is no. It is much simpler than it seems. Of course, you have to have a minimally good winder. It is impossible to do it manually. In many of these transformers, each winding may have several thousand turns.

I will approach the subject from a practical point of view. In any case, in another article I can propose the demonstration of the formulas that I am going to detail below.

When we come across a burnt-out transformer, the core of the transformer is generally not damaged. Therefore, we remove all the windings and we are left with only the core.

The formulas that we will use are three:

$$P=V.I$$
 $P=S^2$ $N=42/S$

Where P is the power in watts, V voltage in volts, I intensity in amperes, S area in cm² and N number of turns per volt.

Very important:

The power of a transformer depends strictly on the surface of the core. The voltages of each winding strictly depend on the number of turns. Finally, the amperages that each winding can withstand depends on the thickness of the copper cables. In the latter case we need the attached table.

We will explain the issue with an example.

In my case, I found the totally burned transformer of the model 62 "SUNRISE", the first series of the JACKSON BELL.

We can find the schematic at:

http://www.nostalgiaair.org/PagesByModel/669/M0009669.pdf

This radio has 6 tubes: 4 type 24, 1 type 45 and one type 80.

Your transformer has 5 windings - the primary and 4 secondaries.

1.- Characteristics of the valves.

80
$$I_f = 2 A V_f = 5 V$$

24
$$I_f = 1,75 \text{ A}$$
 $V_f = 2,5 \text{ V}$

45
$$I_f = 1.5 A$$
 $V_f = 2.5 V$

2.- Windings.

80 secondary: 5 volts, 2 amps

45 secondary: 2.5 volts, 1.5 amps

24 secondary: 2.5 volts, 7 amps

3.- Core surface. See figure 1.

X = 3.2cm Y = 3.2cm

Therefore, the core surface: **S = 10.24 cm²**

4.- Maximum power.

$$P = S^2 = (10.24)^2 = 104$$
 watts

5.- Number of turns per volt.

$$N = 42/S = 42/10.24 = 4.10$$
 turns per volt

6.- Gauges.

PRIMARY: 230 volts (voltage we have in Europe)

I = P/V = 104/230 = 0.45 amps therefore, according to the table, a 26 gauge corresponds to it

SECONDARY:

HT Secondary: 700 volts center tapped

$$I = P/V = 104/(350+350) = 0.148 \text{ amps}$$
 ====> 31 gauge

7.- Total number of turns of each winding.

PRIMARY: 230 volts x 4.10 turns/volt = 943 turns

SECONDARY HT (CENTRAL TAP): 700 volts \times 4.10 turns/volt = 2,870 turns (at turn 1,435 the central tap must be removed)

SECONDARY 80: 5 volts x 4.10 turns/volt = 20.5 turns

SECONDARY 45 (CENTRAL TAP): 2.5 volts x 4.10 turns/volt = 10.25 turns (at turn 5.125 the central tap must be removed)

SECONDARY 24 (CENTRAL TAP): 2.5 volts x 4.10 turns/volt = 10.25 turns (at turn 5.125 the central tap must be removed)

WINDING CONSTRUCTION NOTES:

1.- To wind, we will have to acquire a reel, which fits perfectly in the core.

What winding should we start with? Theoretically, it is the same, but in practice we always have to start winding with the thinnest wire. Why? By using the thinnest gauge wire for the initial winding, the turns are closer together in each pass which prevents the next winding from having any turns between the winding that is below it.

Therefore, in our case we will start winding the HT, followed by the primary, then the 45, the 80, and finally the 24 secondary.

- 2.- Between each winding you have to use insulating tape or fish paper.
- 3.- The center taps do NOT have to be cut and soldered. At the halfway point you have to take the wire out and then put it back into the coil without cutting. See figure 2.
- 4.- Once the windings are made, we will assemble the core. The metal plates must be mounted alternately thus avoiding, as far as possible, Eddy currents. See figure 3.
- 5.- When we look at the gauges, in the event that we do not have an appropriate cable for the corresponding intensity, we will always choose the next thickest cable from the table. Never the thinnest.
- 6.- Once the transformer is assembled, the voltages of the secondaries must be checked before reassembling it inside the radio, to avoid possible errors in the windings and seriously damaging other components of the device.

FINAL NOTE: One of the most important formulas in transformers is the following:

N1/N2 = V1/V2 = I2/I1

In our case, we can verify that:

943/2870 = 230/700 = 0.148/0.45 = 0.328

When I checked the tensions, they gave the exact result. This is not difficult to achieve. But I insist, you must buy a good winder.

fig. 1

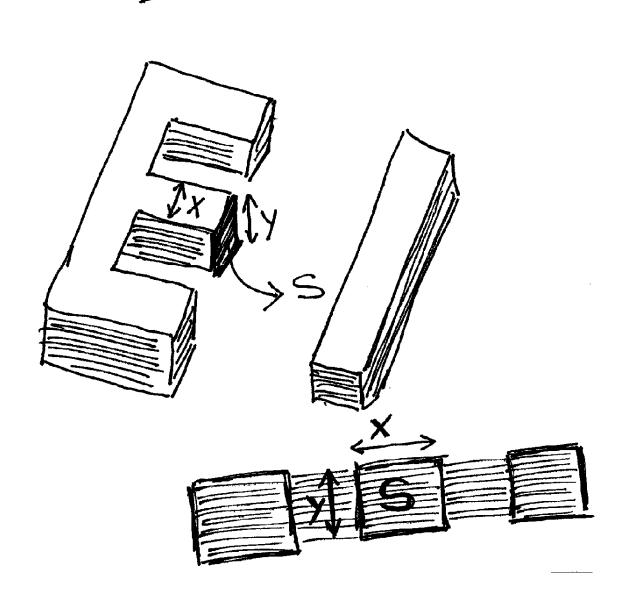


fig. 2

TOMA CENTIZAL 2.

fis.3

TABLA DE EQUIVALENCIAS DE GROSORES AWG

AMG	Dia-mils	TPI	Dia-mm	Circ-mils	Ohms/Rft	Ft/Ohm	Ft/1b	Olms/Lb	Lb/Rft	*Amps	Ma apulos
0000	459.99	2.1740	11.684	211592	0.0490	20402	1.5613	0.0001	640.48	282.12	423.18
000	409.63	2.4412	10.405	167800	0.0618	16180	1.9688	0.0001	507.93	223.73	335.60
00	364.79	2.7413	9.2657	133072	0.0779	12831	2.4826	0.0002	402.80	177.43	256.14
ANG	Dia-mils	TPI	Dia-ma	Circ mils	Ohms/Rft	Ft/Ohm	Ft/Ib	Ohms/Lb	Lb/Rft	*Ащра	НажАпра
0	324.85	3,0763	8.2513	105531	0.0983	10175	3.1305	0.0003	319.44	140.71	211.06
1	289.29	3.4567	7.3480	83690	0.1239	8069.5	3.9475	0.0005	253.33	111,59	167.38
2	257.62	3.8917	6.5436	66369	0.1563	6399.4	4.9777	0.0003	200.90	88.492	132.74
3	229.42	4.3588	5.8272	52633	0.1970	5075.0	6.2767	0.0012	159.32	70.177	105.27
4	204.30	4.8947	5.1893	41740	0.2485	4024.7	7.9148	0.0020	126.35	55.653	83.486
5	181.94	5.4964	4.6212	33191	0.3133	3191.7	9.9804	0.0031	100.20	44.135	66.203
6	162.02	6.1721	4.1153	26251	0.3951	2531.1	12.585	0.0050	79.460	35.001	52.501
7	144.28	6.9308	3.6648	20818	0.4982	2007.3	15.869	0.0079	63.014	27.757	41.635
8	128.49	7.7828	3.2636	16509	0.6282	1591.8	20.011	0.0126	49.973	22.012	33.018
9	114.42	8.7396	2.9063	13092	0.7921	1262.4	25.233	0.0200	39.630	17.456	26.165
ang	Dia-mils	TPI	Dia-mm	Circ-mils	Ohms/Eft	Ft/Chm	Ft/Hb	Chms/Lb	Lb/Rft	*Аверз	MaxAmps
10	101.90	9.8140	2.5881	10383	0.9989	1001.1	31.819	0.0318	31.426	13,844	20.765
11	90.741	11.020	2.3048	8233.9	1.2596	793.93	40,122	0.0505	24.924	10.978	16,468
12	80.807	12.375	2.0525	6529.8	1.5883	629.61	50,593	0.0804	19.765	8.7064	13.060
13	71.961	13,896	1.8278	5178.3	2.0028	499.31	63.797	0.1278	15.675	6.9045	16.357
14	64.083	15.605	1.6277	4106.6	2.5255	395.97	80.447	0.2031	12.431	5.4755	8.2132
15	57.067	17.523	1.4495	3256.7	3.1845	314.02	101.44	0.3230	9.8579	4.3423	6.5134
16	30.820	19.677	1.2908	2582.7	4.0156	249.03	127.91	0.5136	7.8177	3.4436	5.1654
17	45.257	22.096	1.1495	2048.2	5.0636	197.49	161.30	0.8167	6.1997	2.7309	4,0963
18	40.302	24.813	1.0237	1624.3	6.3851	156.62	203.39	1.2986	4.9166	2.1657	3.2485
19	35.890	27.863	0.9116	1288.1	8.0514	124.20	256.47	2.0648	3.8991	1.7175	2.5762
AW	Dia-mils	TPI	Dia-mm	Circ-mils	Ohms/Rft	Ft/Ohm	Ft/Lb	Chus/Lb	Lb/Rft	*Авфа	ИсхАпра
AWG 20	Dia-mils	TPI 31.288	Dia-mm 0.8118	Circ-mils	Ohms/Rft	Ft/Ohm 98.496	Ft/Lb 323.41	Chms/Lb 3.2832	lb/Rft 3.0921	•	MaxAmps 2.0430
										*Amps 1.3620 1.0801	_
20	31.961	31.288	0.8118	1021.5	10.153 12.802	98.496	323.41	3.2832	3.0921	1.3620	2.0430
20 21	31.961 28.462	31.288 35.134	0.8118 0.7229	1021.5 810.10	10.153	98.496 78.111	323.41 407.81	3.2832 5.2205	3.0921 2.4521	1.3620 1.0801	2.0430 1.6202
20 21 22	31.961 28.462 25.346	31.288 35.134 39.453	0.8118 0.7229 0.6438	1021.5 810.10 642.44	10.153 12.802 16.143	98.496 78.111 61.945	323.41 407.81 514.23	3.2832 5.2205 8.3009	3.0921 2.4521 1.9446	1.3620 1.0801 0.8566	2.0430 1.6202 1.2849
20 21 22 23	31.961 28.462 25.346 22.572	31.288 35.134 39.453 44.304	0.8118 0.7229 0.6438 0.5733	1021.5 810.10 642.44 509.48	10.153 12.802 16.143 20.356	98.496 78.111 61.945 49.125	323.41 407.81 514.23 648.44	3.2832 5.2205 8.3009 13.199	3.0921 2.4521 1.9446 1.5422	1.3620 1.0801 0.8566 0.6793	2.0430 1.6202 1.2849 1.0190
20 21 22 23 24	31.961 28.462 25.346 22.572 20.101	31.288 35.134 39.453 44.304 49.750	0.8118 0.7229 0.6438 0.5733 0.5106	1021.5 810.10 642.44 509.48 404.03	10.153 12.802 16.143 20.356 25.669	98.496 78.111 61.945 49.125 38.958	323.41 407.81 514.23 648.44 817.66	3.2832 5.2205 8.3009 13.199 20.987	3.0921 2.4521 1.9446 1.5422 1.2230	1.3620 1.0801 0.8566 0.6793 0.5387	2.0430 1.6202 1.2849 1.0190 0.8081
20 21 22 23 24 25	31.961 28.462 25.346 22.572 20.101 17.900	31.288 35.134 39.453 44.304 49.750 55.866	0.8118 0.7229 0.6438 0.5733 0.5106	1021.5 810.10 642.44 509.48 404.03 320.41	10.153 12.802 16.143 20.356 25.669 32.368	98.496 78.111 61.945 49.125 38.958 38.895	323.41 407.81 514.23 648.44 817.66 1031.1	3.2832 5.2205 8.3009 13.199 20.987 33.371	3.0921 2.4521 1.9446 1.5422 1.2230	1.3620 1.0801 0.8566 0.6793 0.5387	2.0430 1.6202 1.2849 1.0190 0.8081 0.5408
20 21 22 23 24 25 26 27	31.961 28.462 25.346 22.572 20.101 17.900 15.940	31.288 35.134 39.453 44.304 49.750 55.866 62.733	0.8118 0.7229 0.6438 0.5733 0.5106 0.4547 0.4049	1021.5 810.10 642.44 509.48 404.03 320.41 254.10	10.153 12.802 16.143 20.356 25.669 32.368 40.815	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371	3.0921 2.4521 1.9446 1.5422 1.2230 0.9699 0.7692 0.6100	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687	2.0430 1.6202 1.2649 1.0190 0.8081 0.5408 0.5082
20 21 22 23 24 25 26	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445	0.8118 0.7229 0.6438 0.5733 0.5106 0.4547 0.4049	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467	98.496 78.111 61.945 49.125 38.958 30.895 24.501	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061	3.0921 2.4521 1.9446 1.5422 1.2230 0.9699 0.7692	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272	2.0430 1.6202 1.2649 1.0190 0.8081 0.5408 0.5082
20 21 22 23 24 25 26 27 28	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105	0.8118 0.7229 0.6438 0.5733 0.5106 0.4547 8.4049 0.3606 0.3211	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430 15.409	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15	3.0921 2.4521 1.9446 1.5422 1.2230 0.9699 0.7692 0.6100 0.4837	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131	2.0430 1.6202 1.2849 1.0190 0.8081 0.5408 0.5082 0.4030
20 21 22 23 24 25 26 27 28 29	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.195 12.681 11.257	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830	0.8118 0.7229 0.6438 0.5733 0.5106 0.4547 8.4049 0.3606 0.3211 0.2859	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835	98.496 78:111 61.945 49.125 38.958 30.895 24.501 19.501 19.502 Pt/Ohm	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.8	3.2832 5.2205 8.3009 13.199 20.987 33.371 52.061 84.371 134.15 213.31	3.0921 2.4521 1.9446 1.5422 0.2699 0.7699 0.6100 0.4837 0.3836	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690	2.0430 1.6202 1.2849 1.0190 0.8091 0.5408 0.5082 0.4030 0.3196 0.2535
20 21 22 23 24 25 26 27 28 29	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641 11.257	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830	0.8118 0.7229 0.6438 0.5733 0.5106 0.4547 0.4049 0.3606 0.3211 0.2859	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.31 159.80 126.73	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835	98.496 78.111 61.945 49.125 49.125 38.958 38.895 24.501 19.430 12.220 Pt/Ohm	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.8	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31	3.0921 2.4521 1.9446 1.5422 1.2230 0.7692 0.7692 0.6100 0.4837 0.3836	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131	2.0430 1.6202 1.2849 1.0190 0.8081 0.5408 0.5082 0.4030 0.3196 0.2535
20 21 22 23 24 25 27 28 29	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641 11.257 Dia-mils 10.025 8.9276	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830	0.6118 0.7229 0.6438 0.5733 0.5106 0.4547 0.3606 0.3211 0.2859	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835 Ohms/Kft 103.19 130.12	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430 13.409 12.220 Pt/Ohm 9.6906 7.6650	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.0	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31	3.0921 2.4521 1.9446 1.54230 0.9699 0.7692 0.6100 0.4837 0.3836	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690	2.0430 1.6202 1.2649 1.0190 0.8081 0.5082 0.4030 0.3196 0.2535
20 21 22 22 23 24 25 26 27 28 29	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.195 12.681 11.257 Dia-mils 10.025 8.9276 7.9503	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830 TPI 99.750 112.01 125.78	0.8118 0.7229 0.6438 0.5733 0.51.06 0.4547 8.4049 0.3606 0.3211 0.2859	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73 Cizc-mile 100.50 79.702 63.207	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835 Ohms/Kft 103.19 130.12 164.08	98.496 78:111 61.945 49.125 38.958 30.895 24.501 19.430 15.409 12.220 Pt/Ohm P.6850 6.0945	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.8 Ft/Lb 3287.1 4145.0	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31 Ohmo/Lib 339.18 539.32 857.55	3.0921 2.4521 1.9446 1.5422 0.2699 0.76100 0.4837 0.3836 Lb/REt 0.3042 0.2413 0.1913	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690	2.0430 1.6202 1.2849 1.0190 0.8081 0.5082 0.4030 0.3196 0.2535 MaxAmps 0.2010 0.1594 0.1264
20 21 22 23 24 25 26 27 28 29 AWG 30 31 32 33	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641 11.257 Dia-mils 10.025 8.9276 7.9503 7.0799	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830 TPI 99.750 112.61 125.78	0.6118 0.7229 0.6438 0.5733 0.5106 0.4547 0.4049 0.3606 0.3211 0.2859 Dia-mm	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73 Cizc_mils 100.50 79.702 63.207 50.125	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835 Ohms/Kft 103.19 130.12 164.08 206.90	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430 15.409 12.220 Pt/Ohm 9.6906 7.6850 6.0945 4.8332	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.0 Ft/Lb 3287.1 4145.0 5226.7 6590.8	3.2832 5.2205 8.3009 13.199 20.987 33.371 134.15 213.31 0hmc/lb 339.18 539.32 857.32	3.0921 2.4521 1.9446 1.5422 1.2230 0.7692 0.7692 0.6100 0.4837 0.3836 Lb/REt 0.3042 0.2413 0.1913 0.1517	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690 *Amps	2.0430 1.6202 1.2849 1.0190 0.8081 0.5082 0.4030 0.1196 0.2535 MaxAmps
20 21 22 23 24 25 26 27 28 29 AWG 30 31 32 33 34	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641 11.257 Dia-mils 10.025 8.9276 7.9503 7.0799 6.3048	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830 TPI 99.750 112.61 125.78 141.24 158.61	0.6118 0.7229 0.6438 0.5733 0.5106 0.4547 0.3606 0.3211 0.2859 Dia-max 0.2546 0.2268 0.2019 0.1798	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73 Cize_mils 100.50 79.702 63.207 50.125 39.751	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835 Ohms/Kft 103.19 130.12 164.08 206.90 260.90	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430 13.409 12.220 Pt/Ohm 9.6906 7.6650 6.0945 4.8332	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.0 Pt/Ib 3287.1 4145.0 5226.7 6590.8	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31 Ohmo/Lib 339.18 539.32 857.55 1363.6	3.0921 2.4521 1.9446 1.54230 0.9699 0.7692 0.6100 0.4837 0.3836 Lb/REt 0.3042 0.2413 0.1913 0.1517 0.1203	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690	2.0430 1.6202 1.2849 1.0190 0.8081 0.5082 0.4030 0.3196 0.2535 MaxAmps 0.2010 0.1594 0.1264 0.1003
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.195 12.661 11.257 Dia-mils 10.025 8.9276 7.9503 7.0799 6.3048 5.6146	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830 TPI 99.750 112.01 125.78 141.24 158.61	0.8118 0.7229 0.6438 0.5733 0.5106 0.4547 6.4049 0.3666 0.3211 0.2859 Dia-mm 0.2258 0.2019 0.1798 0.1601 0.1426	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73 Circ-mils 100.50 79.702 63.207 50.125 39.751 31.524	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835 Ohms/Kft 103.19 130.12 164.08 206.90 260.90 328.99	98.496 78:111 61.945 49.125 38.958 30.895 24.501 19.430 15.409 12.220 Pt/Ohm 9.6806 7.6850 6.0945 4.8332 3.8396	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 2067.3 2606.9 Ft/Lb 3287.1 4145.0 5226.7 6590.8 8310.8	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31 0hmc/Lib 339.18 539.32 857.55 1363.6 2168.1 3447.5	3.0921 2.4521 1.9446 1.5422 0.2699 0.7699 0.6100 0.4837 0.3836 Lb/REt 0.3042 0.2413 0.1913 0.1517 0.1905	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690 *Amps	2.0430 1.6202 1.2849 1.0190 0.8081 0.5082 0.4030 0.1196 0.2535 MaxAmps
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641 11.257 Dia-mils 10.025 8.9276 7.9503 7.0799 6.3048 5.6146 5.0000	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830 TPI 99.750 112.61 125.78 141.24 158.61 178.11	0.6118 0.7229 0.6438 0.5733 0.5106 0.4547 0.4049 0.3606 0.3211 0.2859 Dia-mm 0.2546 0.2268 0.2019 0.1798 0.1601 0.1426	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.31 159.80 126.73 Cizc_mile 100.50 79.702 63.207 50.125 39.751 31.524 23.000	10.153 12.802 16.143 20.356 32.368 40.815 51.467 64.898 81.835 Ohms/Kft 103.19 130.12 164.08 206.90 260.90 328.99	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430 13.409 12.220 Pt/Ohm 9.6906 7.6650 6.0945 4.8332	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.8 Ft/Lb 3287.1 4145.0 5226.7 6590.8 8310.8 10480	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31 Ohmo/Lib 339.18 539.32 857.55 1363.6	3.0921 2.4521 1.9446 1.54230 0.9699 0.7692 0.6100 0.4837 0.3836 Lb/REt 0.3042 0.2413 0.1913 0.1517 0.1203	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690 *Ampus 0.1043 0.0843 0.0843 0.0530	2.0430 1.6202 1.2849 1.0190 0.8081 0.5082 0.4030 0.3196 0.2535 MaxAmps 0.2010 0.1594 0.1264 0.1003
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641 11.257 Dia-mils 10.025 8.9276 7.9503 7.0799 6.3048 5.6146 5.0000 4.4526	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830 TPI 99.750 112.61 125.78 141.24 158.61 178.11 200.00	0.6118 0.7229 0.6438 0.5733 0.5106 0.4547 0.3606 0.3211 0.2859 Dia-ma 0.2546 0.2268 0.2019 0.1798 0.1601 0.1426 0.1270	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73 Cire-mils 100.50 79.702 63.207 50.125 39.751 31.524 25.000 19.826	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835 Ohms/Kft 103.19 130.12 164.08 206.90 328.99 414.85 523.11	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430 13.409 12.220 Pt/Ohm 9.6906 7.6650 6.0945 4.8322 3.0396 2.4105 1.9116	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.0 Pt/Ib 3287.1 4145.0 5226.7 6590.8 10480 13215 16663	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31 0hmc/Lb 339.18 539.32 857.55 1363.6 2168.1 3447.5 5481.7 8716.2	3.0921 2.4521 1.9446 1.5422 0.2699 0.7699 0.6100 0.4837 0.3836 Lb/REt 0.3042 0.2413 0.1913 0.1517 0.1905	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690 *Ampus 0.1063 0.0843 0.0668 0.0530 0.0420	2.0430 1.6202 1.2849 1.0190 0.8081 0.5082 0.4030 0.3196 0.2535 MaxAmps 0.2010 0.1594 0.1003 0.0795 0.0795
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641 11.257 Dia-mils 10.025 8.9276 7.9503 7.0799 6.3048 5.6146 5.0000 4.4526 3.9552	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830 TPI 99.750 112.61 125.78 141.24 158.61 178.11 200.00 224.59 252.20	0.8118 0.7229 0.6438 0.5733 0.5106 0.4547 0.4049 0.3606 0.5211 0.2859 Dia-mm 0.2546 0.2268 0.2019 0.1798 0.1601 0.1426 0.1270 6.1131 0.1007	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73 Circ mile 100.50 79.702 63.207 50.125 39.751 31.524 25.000 19.826 15.723	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835 Ohws/Kft 103.19 130.12 164.08 206.90 260.90 328.99 414.85 523.11 659.63	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430 15.409 12.220 Pt/Ohm 9.6850 6.0945 4.8332 3.8396 2.4105 1.5160	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.9 Pt/Lb 3287.1 4145.0 5226.7 6590.8 8310.8 810.8 13215 16663 21012	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31 0hms/Lib 339.18 539.32 857.55 1363.6 2168.1 3447.5 5481.7 8716.2 13859	3.0921 2.4521 1.9446 1.5422 1.2230 0.9699 0.7692 0.6100 0.4837 0.3836 Lb/KEt 0.3042 0.2413 0.1913 0.1517 0.1903 0.0954	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690 *Amps 0.1063 0.0843 0.0668 0.0530 0.0420 0.0333	2.0430 1.6202 1.2849 1.0190 0.8081 0.5082 0.4030 0.3196 0.2535 MaxAmps 0.2010 0.1594 0.1264 0.1003 0.0795 0.0630 0.0500
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641 11.257 Dia-mils 10.025 8.9276 7.9503 7.0799 6.3048 5.6146 5.0000 4.4526	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830 TPI 99.750 112.61 125.78 141.24 158.61 178.11 200.00	0.6118 0.7229 0.6438 0.5733 0.5106 0.4547 0.3606 0.3211 0.2859 Dia-ma 0.2546 0.2268 0.2019 0.1798 0.1601 0.1426 0.1270	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73 Cire-mils 100.50 79.702 63.207 50.125 39.751 31.524 25.000 19.826	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835 Ohms/Kft 103.19 130.12 164.08 206.90 328.99 414.85 523.11	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430 13.409 12.220 Pt/Ohm 9.6906 7.6650 6.0945 4.8322 3.0396 2.4105 1.9116	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.0 Pt/Ib 3287.1 4145.0 5226.7 6590.8 10480 13215 16663	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31 0hmc/Lb 339.18 539.32 857.55 1363.6 2168.1 3447.5 5481.7 8716.2	3.0921 2.4521 1.9446 1.54230 0.9699 0.7692 0.6100 0.4837 0.3836 Lb/Rft 0.3042 0.2413 0.1913 0.1913 0.1913 0.0954 0.0757	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690 *Ampus 0.1063 0.0843 0.0668 0.05420 0.0333 0.0264 0.0210	2.0430 1.6202 1.2849 1.0190 0.8081 0.5082 0.4030 0.3196 0.2535 MaxAmps 0.2010 0.1594 0.1064 0.1064 0.0795 0.0630 0.0500 0.0397
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38	31.961 28.462 25.346 22.572 20.101 17.900 15.940 14.193 12.641 11.257 Dia-mils 10.025 8.9276 7.9503 7.0799 6.3048 5.6146 5.0000 4.4526 3.9552	31.288 35.134 39.453 44.304 49.750 55.866 62.733 70.445 79.105 88.830 TPI 99.750 112.61 125.78 141.24 158.61 178.11 200.00 224.59 252.20	0.8118 0.7229 0.6438 0.5733 0.5106 0.4547 0.4049 0.3606 0.5211 0.2859 Dia-mm 0.2546 0.2268 0.2019 0.1798 0.1601 0.1426 0.1270 6.1131 0.1007	1021.5 810.10 642.44 509.48 404.03 320.41 254.10 201.51 159.80 126.73 Circ mile 100.50 79.702 63.207 50.125 39.751 31.524 25.000 19.826 15.723	10.153 12.802 16.143 20.356 25.669 32.368 40.815 51.467 64.898 81.835 Ohms/Kft 103.19 130.12 164.08 206.90 328.99 414.85 523.11 659.63 831.78	98.496 78.111 61.945 49.125 38.958 30.895 24.501 19.430 15.409 12.220 Pt/Ohm 9.6850 6.0945 4.8332 3.8396 2.4105 1.5160	323.41 407.81 514.23 648.44 817.66 1031.1 1300.1 1639.4 2067.3 2606.9 Pt/Lb 3287.1 4145.0 5226.7 6590.8 8310.8 810.8 13215 16663 21012	3.2832 5.2205 8.3009 13.199 20.987 33.371 53.061 84.371 134.15 213.31 0hms/Lib 339.18 539.32 857.55 1363.6 2168.1 3447.5 5481.7 8716.2 13859	3.0921 2.4521 1.9446 1.5422 0.9699 0.7699 0.6100 0.4837 0.3836 Lb/REt 0.3042 0.2413 0.1913 0.1517 0.3954 0.0757 0.0600	1.3620 1.0801 0.8566 0.6793 0.5387 0.4272 0.3388 0.2687 0.2131 0.1690 *Amps 0.1063 0.0843 0.0668 0.0530 0.0420 0.0333 0.0264	2.0430 1.6202 1.2849 1.0190 0.8081 0.5082 0.4030 0.3196 0.2535 MaxAmps 0.2010 0.1594 0.1003 0.0795 0.0630 0.0397 0.0397