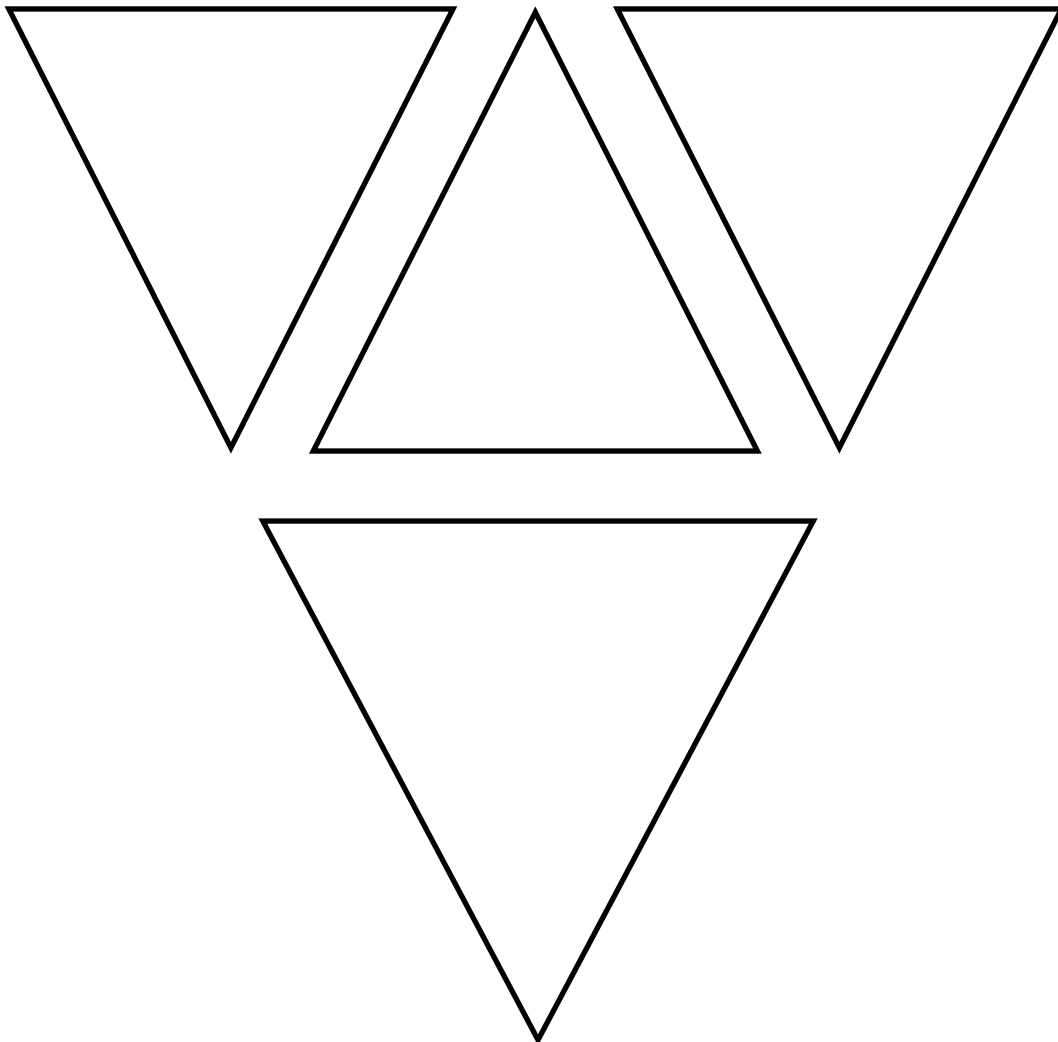


# **Magnet Wire General Engineering Data**

**Bare and Film Insulated  
Copper and Aluminum**



**ALCATEL**

CABLE

# Magnet Wire General Engineering Data

## Bare and Film Insulated Copper and Aluminum

### Forward

This booklet contains engineering data for bare and film insulated conductors (copper and aluminum). It is to be used in conjunction with the individual Alcatel Magnet Wire Inc. product sheets.

Alcatel Magnet Wire Inc. has combined established abilities in magnet wire engineering and production with large scale manufacturing facilities to provide a source of outstanding copper and aluminum magnet wires.

The data presented in this booklet is consistent with NEMA MW 1000 specifications and is applicable for all film and insulation types. The data is given to help in the application and design choices of copper and aluminum magnet wire.

All information contained herein is believed to be reliable and accurate. Note that it may not be all inclusive nor entirely suitable to all local codes and practices; and therefore they should first be confirmed by the user.

The information found in this guide is given and accepted at the user's risk and Alcatel Magnet Wire Inc. assumes no responsibility for results obtained or damage inherent from use of the information in whole or in part.

It should also be noted that metric units, given in this catalogue, are approximate equivalents to those of the English system of measures, and thus are given as information only.

### Table of Contents

<b>Forward/Table of Contents</b>	1
<b>Bare Wire Data</b>	
Comparison, AWG and IEC R-40	2, 3
Annealed Copper	4, 5
Annealed Aluminum	6, 7
<b>Film Insulated Dimensions</b>	
AWG Sizes, Copper	8, 9
Half AWG Sizes, Copper	10, 11
AWG Sizes, Aluminum	12, 13
Half AWG Sizes, Aluminum	14, 15
<b>Recommended Winding Tensions</b>	
Copper and Aluminum	16
<b>Winding Space Factor Chart</b>	17
<b>Physical Constants at 20°C</b>	18
<b>Formula for Calculating Weights and Resistance at 20°C</b>	19
<b>Square Wire Data</b>	
Annealed Copper	20
Annealed Aluminum	21
<b>Square and Rectangular Wire Data</b>	
Copper and Aluminum	22
<b>Resistance Variation with Temperature</b>	23
<b>Factors for Converting</b>	
Copper Resistance to 20°C	24
Aluminum Resistance to 20°C	25
<b>Variations in Conductor Resistance</b>	
due to Diameter Tolerance	26
<b>Conversion Chart</b>	27

## Comparison between AWG and IEC R-40 Series Bare Wire Diameters

AWG SIZE	AWG BARE WIRE NOMINAL DIAMETER		NOM. DIA. R-40 SERIES millimeters	NOM.** AWG AREA millimeters <sup>2</sup>	NOM. R-40 SERIES AREA millimeters <sup>2</sup>	% Δ †		AWG SIZE
	inches	millimeters*				NOM. DIA. R-40 to AWG	NOM. AREA R-40 to AWG	
4	0.2043	5.189	5.000	21.149	19.635	-3.6	-7.2	4
4.5	0.1928	4.897	4.750	18.835	17.721	-3.0	-5.9	4.5
5	0.1819	4.620	4.500	16.766	15.904	-2.6	-5.1	5
5.5	0.1717	4.361	4.250	14.938	14.186	-2.5	-5.0	5.5
6	0.1620	4.115	4.000	13.298	12.566	-2.8	-5.5	6
6.5	0.1529	3.884	3.750	11.846	11.045	-3.4	-6.8	6.5
7	0.1443	3.665	3.550	10.551	9.898	-3.1	-6.2	7
7.5	0.1362	3.459	3.350	9.400	8.814	-3.2	-6.2	7.5
8	0.1285	3.264	3.150	8.367	7.793	-3.5	-6.9	8
8.5	0.1213	3.081	3.000	7.456	7.069	-2.6	-5.2	8.5
9	0.1144	2.906	2.800	6.631	6.158	-3.6	-7.1	9
9.5	0.1080	2.743	2.650	5.910	5.515	-3.4	-6.7	9.5
10	0.1019	2.588	2.500	5.261	4.909	-3.4	-6.7	10
10.5	0.0962	2.443	2.360	4.689	4.374	-3.4	-6.7	10.5
11	0.0907	2.304	2.240	4.168	3.941	-2.8	-5.5	11
11.5	0.0856	2.174	2.120	3.713	3.530	-2.5	-4.9	11.5
12	0.0808	2.052	2.000	3.308	3.142	-2.5	-5.0	12
12.5	0.0763	1.938	1.900	2.950	2.835	-2.0	-3.9	12.5
13	0.0720	1.829	1.800	2.627	2.545	-1.6	-3.1	13
13.5	0.0679	1.725	1.700	2.336	2.270	-1.4	-2.8	13.5
14	0.0641	1.628	1.600	2.082	2.011	-1.7	-3.4	14
14.5	0.0605	1.537	1.500	1.855	1.767	-2.4	-4.7	14.5
15	0.0571	1.450	1.400	1.652	1.539	-3.5	-6.8	15
15.5	0.0539	1.369	1.320	1.472	1.368	-3.6	-7.0	15.5
16	0.0508	1.290	1.250	1.308	1.227	-3.1	-6.2	16
16.5	0.0480	1.219	1.180	1.167	1.094	-3.2	-6.3	16.5
17	0.0453	1.151	1.120	1.040	0.985	-2.7	-5.3	17
17.5	0.0427	1.085	1.060	0.924	0.882	-2.3	-4.5	17.5
18	0.0403	1.024	1.000	0.823	0.785	-2.3	-4.6	18
18.5	0.0380	0.965	0.950	0.732	0.709	-1.6	-3.1	18.5
19	0.0359	0.912	0.900	0.653	0.636	-1.3	-2.6	19
19.5	0.0339	0.861	0.850	0.582	0.567	-1.3	-2.6	19.5
20	0.0320	0.813	0.800	0.519	0.503	-1.6	-3.1	20
20.5	0.0302	0.767	0.750	0.462	0.442	-2.2	-4.4	20.5
21	0.0285	0.724	0.710	0.412	0.396	-1.9	-3.8	21
21.5	0.0269	0.683	0.670	0.367	0.353	-1.9	-3.8	21.5
22	0.0253	0.643	0.630	0.324	0.312	-2.0	-3.9	22
22.5	0.0239	0.607	0.600	0.289	0.283	-1.2	-2.3	22.5
23	0.0226	0.574	0.560	0.259	0.246	-2.4	-4.8	23
23.5	0.0213	0.541	0.530	0.230	0.221	-2.0	-4.0	23.5
24	0.0201	0.511	0.500	0.205	0.196	-2.1	-4.1	24
24.5	0.0190	0.483	0.475	0.183	0.177	-1.6	-3.1	24.5
25	0.0179	0.455	0.450	0.162	0.159	-1.0	-2.0	25
25.5	0.0169	0.429	0.425	0.145	0.142	-1.0	-2.0	25.5

## Comparison between AWG and IEC R-40 Series Bare Wire Diameters (cont'd)

AWG SIZE	AWG BARE WIRE NOMINAL DIAMETER		NOM. DIA. R-40 SERIES millimeters	NOM.** AWG AREA millimeters <sup>2</sup>	NOM. R-40 SERIES AREA millimeters <sup>2</sup>	%Δ †		AWG SIZE
	inches	millimeters*				NOM. DIA. R-40 to AWG	NOM. AREA R-40 to AWG	
26	0.0159	0.404	0.400	0.128	0.126	-1.0	-1.9	26
26.5	0.0150	0.381	0.375	0.114	0.110	-1.6	-3.1	26.5
27	0.0142	0.361	0.355	0.102	0.0990	-1.6	-3.1	27
27.5	0.0134	0.340	0.335	0.0910	0.0881	-1.6	-3.1	27.5
28	0.0126	0.320	0.315	0.0804	0.0779	-1.6	-3.1	28
28.5	0.0119	0.302	0.300	0.0718	0.0707	-0.7	-1.5	28.5
29	0.0113	0.287	0.280	0.0647	0.0616	-2.4	-4.8	29
29.5	0.0106	0.269	0.265	0.0569	0.0552	-1.6	-3.1	29.5
30	0.0100	0.254	0.250	0.0507	0.0491	-1.6	-3.1	30
30.5	0.0095	0.241	0.236	0.0457	0.0437	-2.2	-4.3	30.5
31	0.0089	0.226	0.224	0.0401	0.0394	-0.9	-1.8	31
31.5	0.0084	0.213	0.212	0.0358	0.0353	-0.6	-1.3	31.5
32	0.0080	0.203	0.200	0.0324	0.0314	-1.6	-3.1	32
32.5	0.0075	0.191	0.190	0.0285	0.0284	-0.3	-0.5	32.5
33	0.0071	0.180	0.180	0.0255	0.0254	-0.2	-0.4	33
33.5	0.0067	0.170	0.170	0.0227	0.0227	-0.1	-0.2	33.5
34	0.0063	0.160	0.160	0.0201	0.0201	0.0	0.0	34
34.5	0.0059	0.150	0.150	0.0176	0.0177	0.1	0.2	34.5
35	0.0056	0.142	0.140	0.0159	0.0154	-1.6	-3.1	35
35.5	0.0053	0.135	0.132	0.0142	0.0137	-1.9	-3.9	35.5
36	0.0050	0.127	0.125	0.0127	0.0123	-1.6	-3.1	36
36.5	0.0047	0.119	0.118	0.0112	0.0109	-1.2	-2.3	36.5
37	0.0045	0.114	0.112	0.0103	0.00985	-2.0	-4.0	37
37.5	0.0042	0.107	0.106	0.00894	0.00882	-0.6	-1.3	37.5
38	0.0040	0.102	0.100	0.00811	0.00785	-1.6	-3.1	38
38.5	0.0037	0.094	0.095	0.00694	0.00709	1.1	2.2	38.5
39	0.0035	0.089	0.090	0.00621	0.00636	1.2	2.5	39
39.5	0.0033	0.084	0.085	0.00552	0.00567	1.4	2.8	39.5
40	0.0031	0.079	0.080	0.00487	0.00503	1.6	3.2	40
40.5	0.0030	0.076	0.075	0.00456	0.00442	-1.6	-3.1	40.5
41	0.0028	0.071	0.071	0.00397	0.00396	-0.2	-0.3	41
41.5	0.0026	0.066	0.067	0.00343	0.00353	1.5	2.9	41.5
42	0.0025	0.064	0.063	0.00317	0.00312	-0.8	-1.6	42
42.5	0.0024	0.061	0.060	0.00292	0.00283	-1.6	-3.1	42.5
43	0.0022	0.056	0.056	0.00245	0.00246	0.2	0.4	43
43.5	0.0021	0.053	0.053	0.00223	0.00221	-0.6	-1.3	43.5
44	0.0020	0.051	0.050	0.00203	0.00196	-1.6	-3.1	44
44.5	0.0019	0.048	0.0475	0.00183	0.00177	-1.6	-3.1	44.5

\* These diameters are rounded numbers calculated from the inch value.

\*\* The nominal areas of AWG wires have been calculated in square inches and then converted to square millimeters.

† The differences in diameter and area have been calculated from values more precise than those shown in the table.

# Bare Wire Data/Annealed Copper – AWG Sizes

AWG SIZE	BARE WIRE DIAMETER						NOMINAL AREA			RESISTANCE AT 20°C						PHYSICAL DATA FOR NOMINAL DIAMETER				AWG SIZE
	Minimum		Nominal		Maximum		cir. mils	sq. mils	sq. mm	Min. Dia.		Nom. Dia.		Max. Dia.		lbs/1000ft	kg/km	ft/lb	m/kg	
	in	mm	in	mm	in	mm				ohms/1000ft	ohms/km	ohms/1000ft	ohms/km	ohms/1000ft	ohms/km					
2	.2550	6.477	.2576	6.543	.2602	6.609	66360	52120	33.62	.1595	.5233	.1563	.5128	.1532	.5026	200.9	298.9	4.979	3.346	2
3	.2271	5.768	.2294	5.827	.2317	5.885	52620	41330	26.66	.2011	.6598	.1971	.6466	.1932	.6338	159.3	237.0	6.278	4.219	3
4	.2023	5.138	.2043	5.189	.2053	5.215	41740	32780	21.15	.2534	.8314	.2485	.8152	.2461	.8073	126.3	188.0	7.915	5.320	4
5	.1801	4.575	.1819	4.620	.1828	4.643	33090	25990	16.77	.3198	1.049	.3135	1.028	.3104	1.018	100.2	149.0	9.985	6.711	5
6	.1604	4.074	.1620	4.115	.1628	4.135	26240	20610	13.30	.4031	1.323	.3952	1.297	.3913	1.284	79.44	118.2	12.59	8.460	6
7	.1429	3.630	.1443	3.665	.1450	3.683	20820	16350	10.55	.5079	1.666	.4981	1.634	.4933	1.618	63.03	93.78	15.87	10.66	7
8	.1272	3.231	.1285	3.264	.1292	3.282	16510	12970	8.367	.6410	2.103	.6281	2.061	.6213	2.038	49.98	74.37	20.01	13.45	8
9	.1133	2.878	.1144	2.906	.1150	2.921	13090	10280	6.631	.8080	2.651	.7925	2.600	.7842	2.573	39.61	58.94	25.24	16.97	9
10	.1009	2.563	.1019	2.588	.1024	2.601	10380	8155	5.261	1.019	3.342	.9988	3.277	.9891	3.245	31.43	46.77	31.82	21.38	10
11	.0898	2.281	.0907	2.304	.0912	2.316	8226	6461	4.168	1.286	4.220	1.261	4.136	1.247	4.091	24.90	37.05	40.16	26.99	11
12	.0800	2.032	.0808	2.052	.0812	2.062	6528	5127	3.308	1.621	5.317	1.589	5.212	1.573	5.161	19.76	29.40	50.60	34.01	12
13	.0713	1.811	.0720	1.829	.0724	1.839	5183	4071	2.627	2.040	6.693	2.001	6.564	1.979	6.492	15.69	23.35	63.73	42.83	13
14	.0635	1.613	.0641	1.628	.0644	1.636	4108	3227	2.082	2.572	8.439	2.524	8.282	2.501	8.205	12.44	18.51	80.41	54.04	14
15	.0565	1.435	.0571	1.450	.0574	1.458	3260	2560	1.652	3.249	10.66	3.181	10.44	3.148	10.33	9.869	14.68	101.3	68.10	15
16	.0503	1.278	.0508	1.290	.0511	1.298	2580	2026	1.308	4.099	13.45	4.019	13.19	3.972	13.03	7.811	11.62	128.0	86.04	16
17	.0448	1.138	.0453	1.151	.0455	1.156	2052	1611	1.040	5.168	16.95	5.054	16.58	5.010	16.44	6.211	9.242	161.0	108.2	17
18	.0399	1.013	.0403	1.024	.0405	1.029	1624	1275	.8229	6.515	21.37	6.386	20.95	6.323	20.75	4.916	7.314	203.4	136.7	18
19	.0355	.902	.0359	.912	.0361	.917	1288	1012	.6530	8.230	27.00	8.047	26.40	7.959	26.11	3.901	5.804	256.3	172.3	19
20	.0317	.805	.0320	.813	.0322	.818	1024	804.2	.5189	10.32	33.86	10.13	33.23	10.00	32.82	3.100	4.612	322.6	216.8	20
21	.0282	.716	.0285	.724	.0286	.726	812.3	637.9	.4116	13.04	42.79	12.77	41.89	12.68	41.60	2.459	3.658	406.7	273.4	21
22	.0250	.635	.0253	.643	.0254	.645	640.1	502.7	.3243	16.59	54.44	16.20	53.16	16.08	52.74	1.937	2.883	516.1	346.9	22
23	.0224	.569	.0226	.574	.0227	.577	510.8	401.1	.2588	20.67	67.82	20.31	66.62	20.13	66.04	1.546	2.300	646.8	434.7	23
24	.0199	.505	.0201	.511	.0202	.513	404.0	317.3	.2047	26.19	85.93	25.67	84.22	25.42	83.39	1.223	1.820	817.7	549.6	24
25	.0177	.450	.0179	.455	.0180	.457	320.4	251.6	.1624	33.11	108.6	32.37	106.2	32.01	105.0	.9698	1.443	1031	693.0	25
26	.0157	.399	.0159	.404	.0160	.406	252.8	198.6	.1281	42.08	138.0	41.03	134.6	40.51	132.9	.7652	1.139	1306	878.3	26
27	.0141	.358	.0142	.361	.0143	.363	201.6	158.4	.1022	52.17	171.2	51.44	168.8	50.72	166.4	.6103	.9081	1638	1101	27
28	.0125	.317	.0126	.320	.0127	.323	158.8	124.7	.0804	66.38	217.8	65.33	214.3	64.30	211.0	.4806	.7150	2080	1398	28
29	.0112	.284	.0113	.287	.0114	.290	127.7	100.3	.0647	82.68	271.3	81.23	266.5	79.81	261.8	.3865	.5751	2587	1738	29
30	.0099	.251	.0100	.254	.0101	.257	100.0	78.54	.0507	105.8	347.2	103.7	340.3	101.7	333.6	.3027	.4504	3303	2220	30
31	.0088	.224	.0089	.226	.0090	.229	79.21	62.21	.0401	133.9	439.4	130.9	429.6	128.0	420.1	.2398	.3567	4170	2803	31
32	.0079	.201	.0080	.203	.0081	.206	64.00	50.27	.0324	166.2	545.2	162.1	531.7	158.1	518.6	.1937	.2882	5162	3469	32
33	.0070	.178	.0071	.180	.0072	.183	50.41	39.59	.0255	211.7	694.4	205.7	675.0	200.1	656.4	.1526	.2270	6553	4404	33
34	.0062	.157	.0063	.160	.0064	.163	39.69	31.17	.0201	269.8	885.2	261.3	857.3	253.2	830.7	.1201	.1788	8323	5594	34
35	.0055	.140	.0056	.142	.0057	.145	31.36	24.63	.0159	342.9	1124	330.7	1085	319.2	1047	.0949	.1412	10530	7080	35
36	.0049	.124	.0050	.127	.0051	.130	25.00	19.63	.0127	432.0	1417	414.9	1361	398.8	1308	.0757	.1126	13210	8881	36
37	.0044	.112	.0045	.114	.0046	.117	20.25	15.90	.0103	535.7	1757	512.2	1680	490.2	1608	.0613	.0912	16310	10960	37
38	.0039	.099	.0040	.102	.0041	.104	16.00	12.57	.0081	681.9	2237	648.2	2126	617.0	2024	.0484	.0721	20650	13880	38
39	.0034	.086	.0035	.089	.0036	.091	12.25	9.621	.0062	897.2	2943	846.7	2777	800.3	2625	.0371	.0552	26970	18130	39
40	.0030	.076	.0031	.079	.0032	.081	9.610	7.548	.0049	1152	3780	1079	3540	1012	3322	.0291	.0433	34380	23100	40
41	.0027	.069	.0028	.071	.0029	.074	7.840	6.157	.0040	1422	4667	1322	4340	1233	4046	.0237	.0353	42140	28320	41
42	.0024	.061	.0025	.064	.0026	.066	6.250	4.909	.0032	1800	5907	1659	5444	1534	5033	.0189	.0281	52860	35530	42
43	.0021	.053	.0022	.056	.0023	.058	4.840	3.801	.0025	2351	7715	2142	7030	1960	6432	.0147	.0218	68260	45880	43
44	.0019	.048	.0020	.051	.0021	.053	4.000	3.142	.0020	2773	9425	2592	8506	2351	7715	.0121	.0180	82590	55510	44

# Bare Wire Data/Annealed Copper – Half AWG Sizes

AWG SIZE	BARE WIRE DIAMETER						NOMINAL AREA			RESISTANCE AT 20°C						PHYSICAL DATA FOR NOMINAL DIAMETER				AWG SIZE
	Minimum		Nominal		Maximum		cir. mils	sq. mils	sq. mm	Min. Dia.		Nom. Dia.		Max. Dia.		lbs/1000 ft	kg/km	ft/lb	m/kg	
	in	mm	in	mm	in	mm				ohms/1000ft	ohms/km	ohms/1000ft	ohms/km	ohms/1000ft	ohms/km					
2.5	.2406	6.111	.2431	6.175	.2455	6.236	59100	46410	29.94	.1792	.5878	.1755	.5758	.1721	.5646	178.9	266.2	5.590	3.757	2.5
3.5	.2144	5.446	.2165	5.499	.2176	5.527	46870	36810	23.75	.2256	.7402	.2213	.7260	.2190	.7186	141.9	211.1	7.048	4.737	3.5
4.5	.1908	4.846	.1928	4.897	.1938	4.923	37170	29190	18.84	.2849	.9347	.2790	.9145	.2761	.9060	112.5	167.4	8.888	5.973	4.5
5.5	.1700	4.318	.1717	4.361	.1726	4.384	29480	23150	14.94	.3589	1.177	.3518	1.154	.3481	1.142	89.24	132.8	11.21	7.532	5.5
6.5	.1514	3.846	.1529	3.884	.1537	3.904	23380	18360	11.85	.4525	1.484	.4436	1.456	.4390	1.440	70.76	105.3	14.13	9.498	6.5
7.5	.1348	3.424	.1362	3.459	.1368	3.475	18550	14570	9.400	.5708	1.873	.5591	1.834	.5542	1.818	56.15	83.55	17.81	11.97	7.5
8.5	.1200	3.048	.1212	3.078	.1218	3.094	14690	11540	7.443	.7203	2.363	.7061	2.316	.6991	2.294	44.46	66.16	22.49	15.12	8.5
9.5	.1069	2.715	.1080	2.743	.1085	2.756	11660	9160	5.910	.9076	2.978	.8892	2.917	.8810	2.890	35.31	52.53	28.32	19.04	9.5
10.5	.0952	2.418	.0962	2.443	.0966	2.454	9254	7268	4.689	1.144	3.755	1.121	3.677	1.111	3.646	28.01	41.68	35.70	23.99	10.5
11.5	.0848	2.154	.0856	2.174	.0860	2.184	7327	5754	3.713	1.442	4.732	1.415	4.644	1.402	4.601	22.18	33.00	45.09	30.30	11.5
12.5	.0755	1.918	.0763	1.938	.0767	1.948	5821	4572	2.950	1.820	5.969	1.782	5.845	1.763	5.784	17.62	26.22	56.75	38.14	12.5
13.5	.0673	1.709	.0679	1.725	.0682	1.732	4610	3620	2.336	2.290	7.513	2.250	7.381	2.230	7.316	13.96	20.76	71.66	48.16	13.5
14.5	.0599	1.521	.0605	1.537	.0608	1.544	3660	2874	1.855	2.891	9.484	2.834	9.296	2.806	9.205	11.08	16.48	90.26	60.66	14.5
15.5	.0533	1.354	.0539	1.369	.0542	1.377	2905	2281	1.472	3.651	11.98	3.570	11.71	3.531	11.58	8.794	13.08	113.7	76.43	15.5
16.5	.0475	1.206	.0480	1.219	.0482	1.224	2304	1809	1.167	4.597	15.08	4.502	14.77	4.464	14.65	6.974	10.38	143.4	96.37	16.5
17.5	.0423	1.074	.0427	1.085	.0429	1.090	1823	1431	.9239	5.797	19.02	5.688	18.66	5.636	18.49	5.519	8.212	181.2	121.8	17.5
18.5	.0376	.955	.0380	.965	.0383	.973	1444	1134	.7317	7.336	24.07	7.183	23.56	7.070	23.20	4.371	6.503	228.8	153.8	18.5
19.5	.0336	.853	.0339	.861	.0341	.866	1149	902.6	.5823	9.187	30.14	9.025	29.61	8.919	29.26	3.479	5.176	287.5	193.2	19.5
20.5	.0299	.759	.0302	.767	.0303	.770	912.0	716.3	.4621	11.60	38.06	11.37	37.31	11.30	37.06	2.761	4.108	362.2	243.5	20.5
21.5	.0266	.676	.0268	.681	.0270	.686	718.2	564.1	.3639	14.66	48.09	14.44	47.38	14.23	46.68	2.174	3.235	460.0	309.1	21.5
22.5	.0237	.602	.0239	.607	.0241	.612	571.2	448.6	.2894	18.47	60.58	18.16	59.57	17.86	58.59	1.729	2.573	578.4	388.7	22.5
23.5	.0211	.536	.0213	.541	.0214	.544	453.7	356.3	.2299	23.30	76.43	22.86	75.00	22.65	74.30	1.373	2.043	728.2	489.4	23.5
24.5	.0188	.478	.0190	.483	.0191	.485	361.0	283.5	.1829	29.34	96.27	28.73	94.26	28.43	93.27	1.093	1.626	915.2	615.1	24.5
25.5	.0167	.424	.0169	.429	.0170	.432	285.6	224.3	.1447	37.19	122.0	36.31	119.1	35.89	117.7	.8645	1.286	1156	777.4	25.5
26.5	.0149	.378	.0150	.381	.0151	.384	225.0	176.7	.1140	46.72	153.3	46.10	151.2	45.49	149.2	.6811	1.103	1468	986.8	26.5
27.5	.0133	.338	.0134	.340	.0135	.343	179.6	141.0	.0910	58.63	192.4	57.76	189.5	56.91	186.7	.5435	.8087	1839	1236	27.5
28.5	.0118	.300	.0119	.302	.0120	.305	141.6	111.2	.0718	74.49	244.4	73.24	240.3	72.03	236.3	.4286	.6378	2332	1567	28.5
29.5	.0105	.267	.0106	.269	.0107	.272	112.4	88.25	.0569	94.07	308.6	92.31	302.8	90.59	297.2	.3401	.5060	2940	1976	29.5
30.5	.0093	.236	.0094	.239	.0095	.241	88.36	69.40	.0448	119.9	393.4	117.4	385.1	114.9	377.0	.2675	.3980	3738	2512	30.5
31.5	.0083	.211	.0084	.213	.0085	.216	70.56	55.42	.0358	150.6	493.9	147.0	482.2	143.6	471.0	.2136	.3178	4682	3146	31.5
32.5	.0074	.188	.0075	.190	.0076	.193	56.25	44.18	.0285	189.4	621.4	184.4	604.9	179.6	589.1	.1703	.2533	5873	3947	32.5
33.5	.0066	.168	.0067	.170	.0068	.173	44.89	35.26	.0227	238.1	781.2	231.0	758.0	224.3	735.9	.1359	.2022	7359	4946	33.5
34.5	.0058	.147	.0059	.150	.0060	.152	34.81	27.34	.0176	308.3	1011	298.0	977.5	288.1	945.2	.1054	.1568	9490	6378	34.5
35.5	.0052	.132	.0053	.135	.0054	.137	28.09	22.06	.0142	383.6	1258	369.2	1211	355.7	1166	.0850	.1265	11760	7904	35.5
36.5	.0047	.119	.0048	.122	.0049	.124	23.04	18.10	.0117	469.5	1540	450.2	1476	432.0	1417	.0697	.1038	14340	9637	36.5

# Bare Wire Data/Annealed Aluminum – AWG Sizes

AWG SIZE	BARE WIRE DIAMETER						NOMINAL AREA			RESISTANCE AT 20°C						PHYSICAL DATA FOR NOMINAL DIAMETER				AWG SIZE
	Minimum		Nominal		Maximum		cir. mils	sq. mils	sq. mm	Min. Dia.		Nom. Dia.		Max. Dia.		lbs/1000 ft	kg/km	ft/lb	m/kg	
	in	mm	in	mm	in	mm				ohms/1000ft	ohms/km	ohms/1000ft	ohms/km	ohms/1000ft	ohms/km					
1/0	.3217	8.171	.3249	8.252	.3281	8.334	105600	82910	53.49	.1622	.5320	.1590	.5216	.1559	.5115	97.17	144.6	10.29	6.917	1/0
1	.2864	7.275	.2893	7.348	.2922	7.422	83690	65730	42.41	.2046	.6712	.2005	.6579	.1966	.6449	77.04	114.6	12.98	8.724	1
2	.2550	6.477	.2576	6.543	.2602	6.609	66360	52120	33.62	.2581	.8467	.2529	.8297	.2479	.8132	61.08	90.88	16.37	11.00	2
3	.2271	5.768	.2294	5.827	.2317	5.885	52620	41330	26.66	.3254	1.068	.3189	1.046	.3126	1.026	48.44	72.07	20.65	13.87	3
4	.2023	5.138	.2043	5.189	.2053	5.215	41740	32780	21.15	.4101	1.345	.4021	1.319	.3982	1.306	38.42	57.16	26.03	17.49	4
5	.1801	4.575	.1819	4.620	.1828	4.643	33090	25990	16.77	.5174	1.697	.5072	1.664	.5022	1.648	30.46	45.32	32.84	22.07	5
6	.1604	4.074	.1620	4.115	.1628	4.135	26240	20610	13.30	.6523	2.140	.6395	2.098	.6332	2.077	24.16	35.94	41.40	27.82	6
7	.1429	3.630	.1443	3.665	.1450	3.683	20820	16350	10.55	.8218	2.696	.8060	2.644	.7982	2.619	19.17	28.52	52.18	35.07	7
8	.1272	3.231	.1285	3.264	.1292	3.282	16510	12970	8.367	1.037	3.403	1.016	3.334	1.005	3.298	15.20	22.61	65.80	44.22	8
9	.1133	2.878	.1144	2.906	.1150	2.921	13090	10280	6.631	1.307	4.289	1.282	4.207	1.269	4.163	12.05	17.92	83.02	55.79	9
10	.1009	2.563	.1019	2.588	.1024	2.601	10380	8155	5.261	1.648	5.408	1.616	5.302	1.600	5.251	9.558	14.22	104.6	70.32	10
11	.0898	2.281	.0907	2.304	.0912	2.316	8226	6461	4.168	2.081	6.828	2.040	6.693	2.018	6.620	7.572	11.27	132.1	88.76	11
12	.0800	2.032	.0808	2.052	.0812	2.062	6528	5127	3.308	2.622	8.603	2.571	8.433	2.545	8.351	6.009	8.941	166.4	111.8	12
13	.0713	1.811	.0720	1.829	.0724	1.839	5183	4071	2.627	3.301	10.83	3.237	10.62	3.202	10.50	4.772	7.100	209.6	140.8	13
14	.0635	1.613	.0641	1.628	.0644	1.636	4108	3227	2.082	4.162	13.65	4.084	13.40	4.046	13.28	3.782	5.627	264.4	177.7	14
15	.0565	1.435	.0571	1.450	.0574	1.458	3260	2560	1.652	5.257	17.25	5.147	16.89	5.094	16.71	3.001	4.465	333.3	223.9	15
16	.0503	1.278	.0508	1.290	.0511	1.298	2580	2026	1.308	6.633	21.76	6.503	21.34	6.427	21.09	2.375	3.534	421.0	282.9	16
17	.0448	1.138	.0453	1.151	.0455	1.156	2052	1611	1.040	8.362	27.43	8.178	26.83	8.106	26.60	1.889	2.810	529.5	355.8	17
18	.0399	1.013	.0403	1.024	.0405	1.029	1624	1275	.8229	10.54	34.58	10.33	33.90	10.23	33.57	1.495	2.224	669.0	449.6	18
19	.0355	.902	.0359	.912	.0361	.917	1288	1012	.6530	13.32	43.69	13.02	42.72	12.88	42.25	1.186	1.765	843.1	566.5	19
20	.0317	.805	.0320	.813	.0322	.818	1024	804.2	.5189	16.70	54.79	16.39	53.77	16.19	53.10	.9426	1.402	1061	713.0	20
21	.0282	.716	.0285	.724	.0286	.726	812.3	637.9	.4116	21.10	69.24	20.66	67.79	20.52	67.31	.7477	1.112	1337	898.9	21
22	.0250	.635	.0253	.643	.0254	.645	640.1	502.7	.3243	26.85	88.09	26.22	86.02	26.01	85.34	.5892	.8766	1697	1140	22
23	.0224	.569	.0226	.574	.0227	.577	510.8	401.1	.2588	33.45	109.7	32.86	107.8	32.57	106.9	.4701	.6995	2127	1429	23
24	.0199	.505	.0201	.511	.0202	.513	404.0	317.3	.2047	42.38	139.0	41.54	136.3	41.13	134.9	.3719	.5533	2689	1807	24
25	.0177	.450	.0179	.455	.0180	.457	320.4	251.6	.1624	53.57	175.7	52.38	171.8	51.80	169.9	.2949	.4388	3391	2278	25
26	.0157	.399	.0159	.404	.0160	.406	252.8	198.6	.1281	68.08	223.4	66.38	217.8	65.56	215.1	.2327	.3462	4297	2888	26
27	.0141	.358	.0142	.361	.0143	.363	201.6	158.4	.1022	84.41	276.9	83.23	273.1	82.07	269.2	.1856	.2762	5388	3621	27
28	.0125	.317	.0126	.320	.0127	.323	158.8	124.7	.0804	107.4	352.4	105.7	346.8	104.0	341.4	.1461	.2174	6843	4599	28
29	.0112	.284	.0113	.287	.0114	.290	127.7	100.3	.0647	133.8	438.9	131.4	431.2	129.1	423.7	.1175	.1749	8509	5718	29
30	.0099	.251	.0100	.254	.0101	.257	100.0	78.54	.0507	171.2	561.8	167.8	550.6	164.5	539.7	.0920	.1370	10870	7301	30

# Bare Wire Data/Annealed Aluminum – Half AWG Sizes

AWG SIZE	BARE WIRE DIAMETER						NOMINAL AREA			RESISTANCE AT 20°C						PHYSICAL DATA FOR NOMINAL DIAMETER				AWG SIZE
	Minimum		Nominal		Maximum		cir. mils	sq. mils	sq. mm	Min. Dia.		Nom. Dia.		Max. Dia.		lbs/1000 ft	kg/km	ft/lb	m/kg	
	in	mm	in	mm	in	mm				ohms/1000ft	ohms/km	ohms/1000ft	ohms/km	ohms/1000ft	ohms/km					
1/0.5	.3035	7.709	.3066	7.788	.3096	7.864	94000	73830	47.63	.1822	.5977	.1785	.5857	.1751	.5744	86.53	128.7	11.56	7.767	1/0.5
1.5	.2701	6.861	.2730	6.934	.2759	7.008	74530	58530	37.76	.2300	.7547	.2252	.7388	.2205	.7233	68.60	102.1	14.58	9.797	1.5
2.5	.2406	6.111	.2431	6.175	.2455	6.236	59100	46410	29.94	.2899	.9511	.2840	.9317	.2784	.9135	54.40	80.94	18.39	12.36	2.5
3.5	.2144	5.446	.2165	5.499	.2176	5.527	46870	36810	23.75	.3651	1.198	.3580	1.175	.3544	1.163	43.14	64.19	23.18	15.58	3.5
4.5	.1908	4.846	.1928	4.897	.1938	4.923	37170	29190	18.84	.4610	1.512	.4515	1.481	.4468	1.466	34.22	50.91	29.23	19.64	4.5
5.5	.1700	4.318	.1717	4.361	.1726	4.384	29480	23150	14.94	.5807	1.905	.5693	1.868	.5633	1.848	27.14	40.38	36.86	24.77	5.5
6.5	.1514	3.846	.1529	3.884	.1537	3.904	23380	18360	11.85	.7321	2.402	.7178	2.355	.7104	2.331	21.52	32.02	46.48	31.23	6.5
7.5	.1348	3.424	.1362	3.459	.1368	3.475	18550	14570	9.400	.9236	3.030	.9047	2.968	.8968	2.942	17.08	25.41	58.57	39.36	7.5
8.5	.1200	3.048	.1212	3.078	.1218	3.094	14690	11540	7.443	1.165	3.824	1.142	3.748	1.131	3.711	13.52	20.12	73.97	49.71	8.5
9.5	.1069	2.715	.1080	2.743	.1085	2.756	11660	9160	5.910	1.469	4.818	1.439	4.720	1.426	4.677	10.74	15.97	93.15	62.60	9.5
10.5	.0952	2.418	.0962	2.443	.0966	2.454	9254	7268	4.689	1.852	6.075	1.813	5.949	1.798	5.900	8.519	12.67	117.4	78.90	10.5
11.5	.0848	2.154	.0856	2.174	.0860	2.184	7327	5754	3.713	2.334	7.657	2.290	7.514	2.269	7.444	6.745	10.04	148.3	99.65	11.5
12.5	.0755	1.918	.0763	1.938	.0767	1.948	5821	4572	2.950	2.944	9.659	2.883	9.458	2.853	9.359	5.359	7.973	186.6	125.4	12.5
13.5	.0673	1.709	.0679	1.725	.0682	1.732	4610	3620	2.336	3.705	12.16	3.640	11.94	3.608	11.84	4.244	6.314	235.7	158.4	13.5
14.5	.0599	1.521	.0605	1.537	.0608	1.544	3660	2874	1.855	4.677	15.35	4.585	15.04	4.540	14.89	3.369	5.013	296.8	199.5	14.5
15.5	.0533	1.354	.0539	1.369	.0542	1.377	2905	2281	1.472	5.907	19.38	5.777	18.95	5.713	18.74	2.674	3.979	374.0	251.3	15.5
16.5	.0475	1.206	.0480	1.219	.0482	1.224	2304	1809	1.167	7.438	24.40	7.284	23.90	7.224	23.70	2.121	3.155	471.6	316.9	16.5
17.5	.0423	1.074	.0427	1.085	.0429	1.090	1823	1431	.9239	9.379	30.77	9.204	30.20	9.119	29.92	1.678	2.497	595.9	400.5	17.5
18.5	.0376	.955	.0380	.965	.0383	.973	1444	1134	.7317	11.87	38.94	11.62	39.13	11.44	37.53	1.329	1.978	752.5	505.6	18.5
19.5	.0336	.853	.0339	.861	.0341	.866	1149	902.6	.5823	14.87	48.77	14.60	47.91	14.43	47.35	1.058	1.574	945.5	635.4	19.5
20.5	.0299	.759	.0302	.767	.0303	.770	912.0	716.3	.4621	18.77	61.59	18.40	60.37	18.28	59.97	.8395	1.249	1191	800.6	20.5
21.5	.0266	.676	.0268	.681	.0270	.686	718.2	564.1	.3639	23.72	77.82	23.37	76.66	23.02	75.53	.6611	.9837	1512	1016	21.5
22.5	.0237	.602	.0239	.607	.0241	.612	571.2	448.6	.2894	29.88	98.02	29.38	96.39	28.89	94.80	.5258	.7832	1902	1278	22.5
23.5	.0211	.536	.0213	.541	.0214	.544	453.7	356.3	.2299	37.69	123.7	36.99	121.4	36.65	120.2	.4176	.6214	2394	1609	23.5
24.5	.0188	.478	.0190	.483	.0191	.485	361.0	283.5	.1829	47.48	155.8	46.49	152.5	46.00	150.9	.3323	.4944	3009	2022	24.5
25.5	.0167	.424	.0169	.429	.0170	.432	285.6	224.3	.1447	60.17	197.4	58.76	192.8	58.07	190.5	.2629	.3912	3804	2556	25.5
26.5	.0149	.378	.0150	.381	.0151	.384	225.0	176.7	.1140	75.59	248.0	74.59	244.7	73.60	241.5	.2071	.3082	4829	3245	26.5
27.5	.0133	.338	.0134	.340	.0135	.343	179.6	141.0	.0910	94.87	311.3	93.46	306.6	92.08	302.1	.1653	.2459	6051	4066	27.5
28.5	.0118	.300	.0119	.302	.0120	.305	141.6	111.2	.0718	120.5	395.4	118.5	388.8	116.5	382.4	.1303	.1939	7672	5156	28.5
29.5	.0105	.267	.0106	.269	.0107	.272	112.4	88.25	.0569	152.2	499.4	149.4	490.0	146.6	480.9	.1034	.1539	9670	6498	29.5



# Film Insulated Data – Copper – AWG Sizes

AWG SIZE	LIGHT BUILD								SINGLE BUILD								AWG SIZE
	OVERALL DIAMETER						NOMINAL WEIGHT *		OVERALL DIAMETER						NOMINAL WEIGHT *		
	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	
	in	mm	in	mm	in	mm			in	mm	in	mm	in	mm			
4																	4
5																	5
6																	6
7																	7
8																	8
9																	9
10																	10
11																	11
12																	12
13																	13
14									.0651	1.654	.0658	1.671	.0666	1.692	12.5	18.6	14
15									.0580	1.473	.0587	1.491	.0594	1.509	9.95	14.8	15
16	.0515	1.308	.0521	1.323	.0527	1.399	7.86	11.7	.0517	1.313	.0524	1.331	.0531	1.349	7.88	11.7	16
17	.0460	1.168	.0465	1.181	.0471	1.196	6.26	9.31	.0462	1.173	.0468	1.189	.0475	1.206	6.27	9.33	17
18	.0410	1.041	.0415	1.054	.0420	1.067	4.95	7.37	.0412	1.046	.0418	1.062	.0424	1.077	4.97	7.39	18
19	.0365	.927	.0370	.940	.0376	.955	3.93	5.85	.0367	.932	.0373	.947	.0379	.963	3.94	5.86	19
20	.0327	.831	.0331	.841	.0334	.848	3.12	4.64	.0329	.836	.0334	.848	.0339	.861	3.14	4.67	20
21	.0291	.739	.0294	.747	.0297	.754	2.48	3.69	.0293	.739	.0298	.747	.0303	.754	2.49	3.70	21
22	.0259	.658	.0263	.668	.0265	.673	1.95	2.90	.0261	.663	.0265	.673	.0270	.686	1.97	2.93	22
23	.0232	.589	.0235	.597	.0237	.602	1.56	2.32	.0234	.594	.0238	.605	.0243	.617	1.57	2.34	23
24	.0207	.526	.0210	.533	.0212	.538	1.23	1.83	.0209	.531	.0213	.541	.0217	.551	1.24	1.84	24
25	.0184	.467	.0188	.478	.0190	.483	.983	1.46	.0186	.472	.0190	.483	.0194	.493	.988	1.47	25
26	.0164	.417	.0167	.424	.0169	.429	.776	1.15	.0166	.422	.0169	.429	.0173	.439	.780	1.16	26
27	.0147	.373	.0149	.379	.0151	.384	.619	.921	.0149	.378	.0152	.386	.0156	.396	.624	.928	27
28	.0131	.333	.0133	.338	.0135	.343	.488	.726	.0133	.338	.0136	.345	.0140	.356	.491	.731	28
29	.0117	.297	.0119	.302	.0121	.307	.392	.538	.0119	.302	.0122	.310	.0126	.320	.396	.589	29
30	.0104	.264	.0105	.267	.0107	.272	.307	.457	.0106	.269	.0109	.277	.0112	.284	.310	.461	30
31	.0093	.236	.0094	.239	.0096	.244	.244	.363	.0094	.239	.0097	.246	.0100	.254	.246	.366	31
32	.0084	.213	.0085	.216	.0087	.221	.197	.293	.0085	.216	.0088	.224	.0091	.231	.199	.296	32
33	.0074	.188	.0075	.191	.0077	.196	.155	.231	.0075	.190	.0078	.198	.0081	.206	.158	.235	33
34	.0066	.168	.0067	.170	.0069	.175	.122	.182	.0067	.170	.0069	.175	.0072	.183	.125	.186	34
35	.0058	.147	.0059	.150	.0061	.155	.096	.143	.0059	.150	.0061	.155	.0064	.163	.098	.146	35
36	.0052	.132	.0053	.135	.0055	.140	.077	.115	.0053	.135	.0055	.140	.0058	.147	.079	.118	36
37	.0046	.117	.0047	.119	.0049	.124	.062	.092	.0047	.119	.0049	.124	.0052	.132	.064	.095	37
38	.0041	.104	.0042	.107	.0044	.112	.049	.073	.0042	.107	.0044	.107	.0047	.119	.050	.074	38
39	.0036	.091	.0037	.094	.0039	.099	.038	.057	.0036	.091	.0038	.097	.0041	.104	.039	.058	39
40	.0032	.081	.0033	.084	.0035	.089	.029	.043	.0032	.081	.0034	.086	.0037	.094	.031	.046	40
41	.0028	.071	.0029	.074	.0031	.079	.024	.036	.0029	.074	.0031	.079	.0033	.084	.025	.037	41
42	.0025	.064	.0026	.066	.0028	.071	.019	.028	.0026	.066	.0028	.071	.0030	.076	.020	.030	42
43	.0022	.056	.0023	.058	.0025	.064	.015	.022	.0023	.058	.0024	.061	.0026	.066	.015	.022	43
44	.0020	.051	.0021	.053	.0023	.058	.012	.018	.0020	.051	.0022	.056	.0024	.061	.012	.018	44

\* Nominal Weight, see page 19

# Film Insulated Data – Copper – AWG Sizes

AWG SIZE	HEAVY BUILD								TRIPLE BUILD								AWG SIZE
	OVERALL DIAMETER						NOMINAL WEIGHT *		OVERALL DIAMETER						NOMINAL WEIGHT *		
	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	
	in	mm	in	mm	in	mm			in	mm	in	mm	in	mm			
4	.2060	5.232	.2079	5.281	.2098	5.329	127	189									4
5	.1837	4.666	.1854	4.709	.1872	4.755	101	150									5
6	.1639	4.163	.1655	4.204	.1671	4.244	79.8	119									6
7	.1463	3.716	.1477	3.752	.1491	3.787	63.4	94.3									7
8	.1305	3.315	.1318	3.348	.1332	3.383	50.4	75.0									8
9	.1165	2.959	.1177	2.990	.1189	3.020	40.0	59.5									9
10	.1040	2.642	.1050	2.667	.1061	2.695	31.8	47.3									10
11	.0928	2.357	.0938	2.383	.0948	2.408	25.2	37.5									11
12	.0829	2.106	.0838	2.129	.0847	2.151	20.0	29.8									12
13	.0741	1.882	.0749	1.902	.0757	1.923	15.9	23.7									13
14	.0667	1.694	.0674	1.712	.0682	1.732	12.6	18.7	.0683	1.735	.0690	1.753	.0700	1.778	12.7	18.9	14
15	.0595	1.511	.0602	1.529	.0609	1.547	10.0	14.9	.0610	1.549	.0618	1.570	.0627	1.593	10.1	15.0	15
16	.0532	1.351	.0538	1.367	.0545	1.384	7.96	11.8	.0546	1.387	.0554	1.407	.0562	1.427	8.00	11.9	16
17	.0476	1.209	.0482	1.224	.0488	1.240	6.34	9.43	.0489	1.242	.0496	1.260	.0504	1.280	6.38	9.49	17
18	.0425	1.080	.0431	1.095	.0437	1.110	5.02	7.47	.0438	1.113	.0445	1.130	.0452	1.148	5.06	7.53	18
19	.0380	.965	.0385	.978	.0391	.993	3.99	5.94	.0392	.996	.0399	1.013	.0406	1.031	4.03	6.00	19
20	.0340	.864	.0345	.876	.0351	.892	3.18	4.73	.0352	.894	.0358	.909	.0364	.925	3.20	4.76	20
21	.0304	.772	.0309	.785	.0314	.798	2.53	3.76	.0315	.800	.0320	.813	.0326	.828	2.55	3.79	21
22	.0271	.688	.0276	.701	.0281	.714	1.99	2.96	.0282	.716	.0287	.729	.0293	.744	2.01	2.99	22
23	.0244	.620	.0248	.630	.0253	.643	1.59	2.37	.0254	.645	.0259	.658	.0264	.671	1.61	2.40	23
24	.0218	.554	.0222	.564	.0227	.577	1.26	1.87	.0228	.579	.0233	.592	.0238	.605	1.28	1.90	24
25	.0195	.495	.0199	.505	.0203	.516	1.00	1.49	.0204	.518	.0209	.531	.0214	.544	1.02	1.52	25
26	.0174	.442	.0178	.452	.0182	.462	.794	1.18	.0183	.465	.0188	.478	.0193	.490	.808	1.20	26
27	.0157	.399	.0160	.406	.0164	.417	.634	.943	.0165	.419	.0169	.429	.0173	.439	.646	.961	27
28	.0141	.358	.0144	.366	.0147	.373	.501	.745	.0148	.376	.0152	.386	.0156	.396	.511	.760	28
29	.0127	.323	.0130	.330	.0133	.338	.403	.600	.0134	.340	.0138	.351	.0142	.361	.413	.614	29
30	.0113	.287	.0116	.295	.0119	.302	.317	.472	.0120	.305	.0124	.315	.0128	.325	.325	.484	30
31	.0101	.257	.0104	.264	.0108	.274	.253	.376									31
32	.0091	.231	.0094	.239	.0098	.249	.204	.304									32
33	.0081	.206	.0084	.213	.0088	.224	.162	.241									33
34	.0072	.183	.0075	.191	.0078	.198	.127	.189									34
35	.0064	.163	.0067	.170	.0070	.178	.101	.150									35
36	.0057	.145	.0060	.152	.0063	.160	.080	.119									36
37	.0052	.132	.0055	.140	.0057	.145	.065	.097									37
38	.0046	.117	.0048	.122	.0051	.130	.052	.077									38
39	.0040	.102	.0042	.107	.0045	.114	.040	.060									39
40	.0036	.091	.0038	.097	.0040	.102	.032	.048									40
41	.0032	.081	.0034	.086	.0036	.091	.025	.037									41
42	.0028	.071	.0030	.076	.0032	.081	.020	.030									42
43	.0025	.064	.0027	.069	.0029	.074	.016	.024									43
44	.0023	.058	.0025	.064	.0027	.069	.013	.019									44

\* Nominal Weight, see page 19

# Film Insulated Data – Copper – Half AWG Sizes

AWG SIZE	LIGHT BUILD								SINGLE BUILD								AWG SIZE
	OVERALL DIAMETER						NOMINAL WEIGHT *		OVERALL DIAMETER						NOMINAL WEIGHT *		
	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	
	in	mm	in	mm	in	mm			in	mm	in	mm	in	mm			
4.5																	4.5
5.5																	5.5
6.5																	6.5
7.5																	7.5
8.5																	8.5
9.5																	9.5
10.5																	10.5
11.5																	11.5
12.5																	12.5
13.5																	13.5
14.5									.0615	1.56	.0622	1.580	.0630	1.600	11.1	16.5	14.5
15.5									.0548	1.39	.0555	1.410	.0562	1.427	8.91	13.3	15.5
16.5	.0487	1.237	.0492	1.250	.0496	1.260	7.02	10.4	.0489	1.24	.0496	1.260	.0502	1.275	7.07	10.5	16.5
17.5	.0435	1.105	.0439	1.115	.0443	1.125	5.51	8.20	.0437	1.11	.0442	1.123	.0449	1.140	5.61	8.35	17.5
18.5	.0387	.983	.0391	.993	.0396	1.006	4.43	65.9	.0389	.988	.0395	1.003	.0402	1.021	4.43	6.59	18.5
19.5	.0346	.879	.0350	.889	.0354	.899	3.51	5.22	.0348	.884	.0353	.897	.0359	.912	3.54	5.27	19.5
20.5	.0309	.785	.0312	.792	.0315	.800	2.79	4.15	.0311	.790	.0316	.803	.0320	.813	2.81	4.18	20.5
21.5	.0275	.699	.0278	.706	.0281	.714	2.19	3.26	.0277	.704	.0282	.716	.0287	.729	2.22	3.30	21.5
22.5	.0246	.625	.0249	.632	.0252	.640	1.75	2.60	.0248	.630	.0252	.640	.0257	.653	1.76	2.62	22.5
23.5	.0219	.556	.0221	.561	.0224	.569	1.39	2.07	.0221	.561	.0225	.572	.0230	.584	1.41	2.10	23.5
24.5	.0196	.498	.0198	.503	.0211	.536	1.11	1.65	.0198	.503	.0202	.513	.0206	.523	1.11	1.65	24.5
25.5	.0174	.442	.0177	.450	.0180	.457	.857	1.28	.0176	.447	.0180	.457	.0184	.467	.885	1.32	25.5
26.5	.0156	.396	.0158	.401	.0160	.406	.693	1.03	.0158	.401	.0161	.409	.0164	.417	.697	1.04	26.5
27.5	.0139	.353	.0141	.358	.0143	.363	.552	.821	.0141	.358	.0144	.366	.0148	.376	.557	.829	27.5
28.5	.0124	.315	.0126	.320	.0128	.325	.439	.653	.0126	.320	.0129	.328	.0133	.338	.442	.658	28.5
29.5	.0110	.279	.0112	.284	.0114	.290	.344	.512	.0112	.284	.0115	.292	.0119	.302	.348	.518	29.5
30.5	.0098	.249	.0099	.251	.0101	.257	.272	.405	.0100	.254	.0103	.262	.0106	.269	.275	.409	30.5
31.5	.0088	.224	.0089	.226	.0091	.231	.218	.324	.0089	.226	.0092	.234	.0095	.241	.221	.329	31.5
32.5	.0079	.201	.0080	.203	.0082	.208	.173	.257	.0080	.203	.0083	.211	.0086	.218	.175	.260	32.5
33.5	.0070	.178	.0071	.180	.0073	.185	.138	.205	.0071	.180	.0074	.188	.0077	.196	.141	.210	33.5
34.5	.0062	.157	.0063	.160	.0065	.165	.107	.159	.0063	.160	.0065	.165	.0068	.173	.110	.164	34.5
35.5	.0055	.140	.0056	.142	.0058	.147	.086	.128	.0056	.142	.0058	.147	.0061	.155	.088	.131	35.5
36.5	.0050	.127	.0051	.130	.0053	.135	.070	.104	.0051	.130	.0053	.135	.0056	.142	.073	.109	36.5
37.5	.0043	.109	.0045	.114	.0046	.117	.053	.079	.0044	.112	.0046	.117	.0049	.124	.056	.083	37.5
38.5	.0038	.097	.0039	.099	.0041	.104	.043	.064	.0039	.099	.0041	.104	.0044	.112	.044	.065	38.5
39.5	.0034	.086	.0035	.089	.0037	.094	.034	.051	.0034	.086	.0036	.091	.0039	.099	.035	.052	39.5

\* Nominal Weight, see page 19

# Film Insulated Data – Copper – Half AWG Sizes

AWG SIZE	HEAVY BUILD								TRIPLE BUILD								AWG SIZE
	OVERALL DIAMETER						NOMINAL WEIGHT *		OVERALL DIAMETER						NOMINAL WEIGHT *		
	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	
	in	mm	in	mm	in	mm			in	mm	in	mm	in	mm			
4.5	.1945	4.940	.1964	4.989	.1983	5.037	113	168									4.5
5.5	.1736	4.409	.1756	4.460	.1770	4.496	89.8	134									5.5
6.5	.1549	3.934	.1564	3.973	.1580	4.013	71.1	106									6.5
7.5	.1382	3.510	.1396	3.546	.1409	3.579	56.5	84.1									7.5
8.5	.1233	3.132	.1255	3.188	.1258	3.195	44.5	66.2									8.5
9.5	.1101	2.797	.1113	2.827	.1124	2.855	35.7	53.1									9.5
10.5	.0983	2.497	.0993	2.522	.1003	2.548	28.4	42.3									10.5
11.5	.0878	2.230	.0887	2.253	.0896	2.276	22.5	33.5									11.5
12.5	.0784	1.991	.0793	2.014	.0802	2.037	18.0	26.8									12.5
13.5	.0701	1.781	.0708	1.798	.0715	1.816	14.2	21.1									13.5
14.5	.0631	1.603	.0638	1.621	.0646	1.641	11.4	17.0	.0647	1.643	.0655	1.664	.0664	1.687	11.7	17.4	14.5
15.5	.0563	1.430	.0570	1.448	.0577	1.466	8.99	13.4	.0578	1.468	.0586	1.488	.0595	1.511	9.21	13.7	15.5
16.5	.0504	1.280	.0510	1.295	.0516	1.311	7.15	10.6	.0518	1.316	.0526	1.336	.0534	1.356	7.34	10.9	16.5
17.5	.0451	1.146	.0456	1.158	.0462	1.173	5.68	8.45	.0464	1.179	.0471	1.196	.0478	1.214	5.85	8.70	17.5
18.5	.0402	1.021	.0408	1.036	.0415	1.054	4.49	6.68	.0415	1.054	.0422	1.072	.0429	1.090	4.63	6.89	18.5
19.5	.0361	.917	.0365	.927	.0371	.942	3.59	5.34	.0373	.947	.0379	.963	.0386	.980	3.72	5.53	19.5
20.5	.0322	.818	.0327	.831	.0332	.843	2.86	4.26	.0334	.848	.0340	.864	.0346	.879	2.96	4.40	20.5
21.5	.0288	.732	.0293	.744	.0297	.754	2.26	3.36	.0299	.759	.0304	.772	.0310	.787	2.35	3.50	21.5
22.5	.0258	.655	.0262	.665	.0268	.681	1.79	2.66	.0269	.683	.0274	.696	.0279	.709	1.87	2.78	22.5
23.5	.0231	.587	.0235	.597	.0240	.610	1.43	2.13	.0241	.612	.0246	.625	.0251	.638	1.50	2.23	23.5
24.5	.0207	.526	.0211	.536	.0216	.549	1.14	1.70	.0217	.551	.0222	.564	.0227	.557	1.18	1.76	24.5
25.5	.0185	.470	.0189	.480	.0193	.490	.903	1.34	.0194	.493	.0199	.505	.0204	.518	.942	1.40	25.5
26.5	.0166	.422	.0169	.429	.0173	.439	.711	1.06	.0175	.445	.0179	.455	.0184	.467	.749	1.11	26.5
27.5	.0149	.378	.0152	.386	.0156	.396	.569	.847	.0157	.399	.0161	.409	.0165	.419	.605	.900	27.5
28.5	.0134	.340	.0137	.348	.0140	.356	.452	.673	.0141	.358	.0145	.368	.0149	.378	.482	.717	28.5
29.5	.0120	.305	.0123	.312	.0126	.320	.355	.528	.0127	.323	.0131	.333	.0135	.343	.381	.567	29.5
30.5	.0107	.272	.0110	.279	.0113	.287	.282	.420									30.5
31.5	.0096	.244	.0099	.251	.0103	.262	.227	.388									31.5
32.5	.0086	.218	.0089	.226	.0093	.236	.180	.268									32.5
33.5	.0077	.196	.0080	.203	.0084	.213	.145	.216									33.5
34.5	.0068	.173	.0071	.180	.0074	.188	.112	.167									34.5
35.5	.0061	.155	.0063	.160	.0067	.170	.091	.135									35.5
36.5	.0055	.140	.0058	.147	.0061	.155	.074	.110									36.5
37.5	.0049	.124	.0051	.130	.0054	.137	.057	.085									37.5
38.5	.0043	.109	.0045	.114	.0048	.122	.046	.068									38.5
39.5	.0038	.097	.0040	.102	.0043	.109	.036	.054									39.5

\* Nominal Weight, see page 19

# Film Insulated Data – Aluminum – AWG Sizes

AWG SIZE	LIGHT BUILD								SINGLE BUILD								AWG SIZE
	OVERALL DIAMETER						NOMINAL WEIGHT *		OVERALL DIAMETER						NOMINAL WEIGHT *		
	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	
in	mm	in	mm	in	mm	in			mm	in	mm	in	mm	in			mm
4																	4
5																	5
6																	6
7																	7
8																	8
9																	9
10																	10
11																	11
12																	12
13																	13
14									.0651	1.654	.0658	1.671	.0666	1.692	3.83	5.70	14
15									.0580	1.473	.0587	1.491	.0594	1.509	3.08	4.58	15
16									.0517	1.313	.0524	1.331	.0531	1.349	2.45	3.65	16
17									.0462	1.173	.0468	1.189	.0475	1.206	1.94	2.89	17
18									.0412	1.046	.0418	1.062	.0424	1.077	1.56	2.32	18
19									.0367	.932	.0373	.947	.0379	.963	1.24	1.84	19
20									.0329	.836	.0334	.848	.0339	.861	.973	1.45	20
21									.0293	.739	.0298	.747	.0303	.754	.771	1.15	21
22									.0261	.663	.0265	.673	.0270	.686	.617	.918	22
23									.0234	.594	.0238	.605	.0243	.617	.490	.729	23
24									.0209	.531	.0213	.541	.0217	.551	.389	.579	24
25									.0186	.472	.0190	.483	.0194	.493	.303	.451	25
26									.0166	.422	.0169	.429	.0173	.439	.209	.311	26
27									.0149	.378	.0152	.386	.0156	.396	.200	.298	27
28									.0133	.338	.0136	.345	.0140	.356	.160	.238	28
29									.0119	.302	.0122	.310	.0126	.320	.130	.193	29
30															.101	.150	30

\* Nominal Weight, see page 19

# Film Insulated Data – Aluminum – AWG Sizes

AWG SIZE	HEAVY BUILD								TRIPLE BUILD								AWG SIZE
	OVERALL DIAMETER						NOMINAL WEIGHT *		OVERALL DIAMETER						NOMINAL WEIGHT *		
	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	
	in	mm	in	mm	in	mm			in	mm	in	mm	in	mm			
4	.2060	5.232	.2079	5.281	.2098	5.329	39.1	58.2									4
5	.1837	4.666	.1854	4.709	.1872	4.755	31.1	46.3									5
6	.1639	4.163	.1655	4.204	.1671	4.244	24.5	36.5									6
7	.1463	3.716	.1477	3.752	.1491	3.787	19.5	29.0									7
8	.1305	3.315	.1318	3.348	.1332	3.383	15.6	23.2									8
9	.1165	2.959	.1177	2.990	.1189	3.020	12.4	18.4									9
10	.1040	2.642	.1050	2.667	.1061	2.695	9.80	14.6									10
11	.0928	2.357	.0938	2.383	.0948	2.408	7.85	11.7									11
12	.0829	2.106	.0838	2.129	.0847	2.151	6.23	9.27									12
13	.0741	1.882	.0749	1.902	.0757	1.923	4.98	7.41									13
14	.0667	1.694	.0674	1.712	.0682	1.732	3.90	5.80	.0683	1.735	.0690	1.753	.0700	1.778	4.08	6.07	14
15	.0595	1.511	.0602	1.529	.0609	1.547	3.14	4.67	.0610	1.549	.0618	1.570	.0627	1.593	3.21	4.78	15
16	.0532	1.351	.0538	1.367	.0545	1.384	2.51	3.73	.0546	1.387	.0554	1.407	.0562	1.427	2.56	3.81	16
17	.0476	1.209	.0482	1.224	.0488	1.240	2.00	2.98	.0489	1.242	.0496	1.260	.0504	1.280	2.06	3.07	17
18	.0425	1.080	.0431	1.095	.0437	1.110	1.61	2.40	.0438	1.113	.0445	1.130	.0452	1.148	1.63	2.43	18
19	.0380	.965	.0385	.978	.0391	.993	1.28	1.90	.0392	.996	.0399	1.013	.0406	1.031	1.32	1.96	19
20	.0340	.864	.0345	.876	.0351	.892	1.00	1.50	.0352	.894	.0358	.909	.0364	.925	1.04	1.55	20
21	.0304	.772	.0309	.785	.0314	.798	.798	1.19	.0315	.800	.0320	.813	.0326	.828	.837	1.25	21
22	.0271	.688	.0276	.701	.0281	.714	.640	.952	.0282	.716	.0287	.729	.0293	.744	.664	.988	22
23	.0244	.620	.0248	.630	.0253	.643	.515	.766	.0254	.645	.0259	.658	.0264	.671	.523	.778	23
24	.0218	.554	.0222	.564	.0227	.577	.408	.607	.0228	.579	.0233	.592	.0238	.605	.424	.631	24
25	.0195	.495	.0199	.505	.0203	.516	.330	.491	.0204	.518	.0209	.531	.0214	.544	.346	.515	25
26	.0174	.442	.0178	.452	.0182	.462	.267	.397	.0183	.465	.0188	.478	.0193	.490	.275	.409	26
27	.0157	.399	.0160	.406	.0164	.417	.209	.311	.0165	.419	.0169	.429	.0173	.439	.221	.329	27
28	.0141	.358	.0144	.366	.0147	.373	.169	.251	.0148	.376	.0152	.386	.0156	.396	.176	.262	28
29	.0127	.323	.0130	.330	.0133	.338	.133	.198	.0134	.340	.0138	.351	.0142	.361	.143	.213	29
30	.0113	.287	.0116	.295	.0119	.302	.108	.161	.0120	.305	.0124	.315	.0128	.325	.114	.170	30

\* Nominal Weight, see page 19

# Film Insulated Data – Aluminum – Half AWG Sizes

AWG SIZE	LIGHT BUILD								SINGLE BUILD								AWG SIZE
	OVERALL DIAMETER						NOMINAL WEIGHT *		OVERALL DIAMETER						NOMINAL WEIGHT *		
	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	
	in	mm	in	mm	in	mm			in	mm	in	mm	in	mm			
4.5																4.5	
5.5																5.5	
6.5																6.5	
7.5																7.5	
8.5																8.5	
9.5																9.5	
10.5																10.5	
11.5																11.5	
12.5																12.5	
13.5																13.5	
14.5									.0615	1.56	.0622	1.580	.0630	1.600	3.52	5.24	14.5
15.5									.0548	1.39	.0555	1.410	.0562	1.427	2.77	4.12	15.5
16.5									.0489	1.24	.0496	1.260	.0502	1.275	2.20	3.27	16.5
17.5									.0437	1.11	.0442	1.123	.0449	1.140	1.75	2.60	17.5
18.5									.0389	.988	.0395	1.003	.0402	1.021	1.38	2.05	18.5
19.5									.0348	.884	.0353	.897	.0359	.912	1.11	1.65	19.5
20.5									.0311	.790	.0316	.803	.0320	.813	.882	1.31	20.5
21.5									.0277	.704	.0282	.716	.0287	.729	.700	1.04	21.5
22.5									.0248	.630	.0252	.640	.0257	.653	.558	.830	22.5
23.5									.0221	.561	.0225	.572	.0230	.584	.443	.659	23.5
24.5									.0198	.503	.0202	.513	.0206	.523	.352	.524	24.5
25.5									.0176	.447	.0180	.457	.0184	.467	.282	.420	25.5
26.5									.0158	.401	.0161	.409	.0164	.417	.222	.330	26.5
27.5									.0141	.358	.0144	.366	.0148	.376	.179	.266	27.5
28.5									.0126	.320	.0129	.328	.0133	.338	.141	.210	28.5
29.5									.0112	.284	.0115	.292	.0119	.302	.112	.167	29.5

\* Nominal Weight, see page 19

# Film Insulated Data – Aluminum – Half AWG Sizes

AWG SIZE	HEAVY BUILD								TRIPLE BUILD								AWG SIZE
	OVERALL DIAMETER						NOMINAL WEIGHT *		OVERALL DIAMETER						NOMINAL WEIGHT *		
	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	Minimum		Nominal		Maximum		lbs/ 1000 ft	kg/km	
	in	mm	in	mm	in	mm			in	mm	in	mm	in	mm			
4.5	0.1945	4.94	0.1964	4.989	0.1983	5.037	34.9	51.9									4.5
5.5	0.1736	4.409	0.1756	4.46	0.177	4.496	27.7	41.2									5.5
6.5	0.1549	3.934	0.1564	0.3973	0.158	4.013	21.9	32.6									6.5
7.5	0.1382	3.51	0.1396	0.3546	0.1409	3.579	17.5	26.0									7.5
8.5	0.1233	3.132	0.1255	3.188	0.1258	3.195	13.8	20.5									8.5
9.5	0.1101	2.797	0.1113	2.827	0.1124	2.855	11.1	16.5									9.5
10.5	0.0983	2.497	0.0993	2.522	0.1003	2.548	8.9	13.2									10.5
11.5	0.0878	2.23	0.0887	2.253	0.0896	2.276	7.03	10.5									11.5
12.5	0.0784	1.991	0.0793	2.014	0.0802	2.037	5.6	8.33									12.5
13.5	0.0701	1.781	0.0708	1.798	0.0715	1.816	4.47	6.65									13.5
14.5	0.0631	1.603	0.0638	1.621	0.0646	1.641	3.58	5.33	0.0647	1.643	0.0655	1.664	0.0664	1.687	3.68	5.48	14.5
15.5	0.0563	1.43	0.057	1.448	0.0577	1.466	2.84	4.23	0.0578	1.468	0.0586	1.488	0.0595	1.511	2.9	4.31	15.5
16.5	0.0504	1.28	0.051	1.295	0.0516	1.311	2.28	3.39	0.0518	1.316	0.0526	1.336	0.0534	1.356	2.32	3.45	16.5
17.5	0.0451	1.146	0.0456	1.158	0.0462	1.173	1.82	2.71	0.0464	1.179	0.0471	1.196	0.0478	1.214	1.86	2.77	17.5
18.5	0.0402	1.021	0.0408	1.036	0.0415	1.054	1.44	2.14	0.0415	1.054	0.0422	1.072	0.0429	1.09	1.48	2.20	18.5
19.5	0.0361	0.917	0.0365	0.927	0.0371	0.942	1.15	1.71	0.0373	0.947	0.0379	0.963	0.0386	0.98	1.19	1.77	19.5
20.5	0.0322	0.818	0.0327	0.831	0.0332	0.843	0.925	1.38	0.0334	0.848	0.034	0.864	0.0346	0.879	0.945	1.41	20.5
21.5	0.0288	0.732	0.0293	0.744	0.0297	0.754	0.737	1.10	0.0299	0.759	0.0304	0.772	0.031	0.787	0.757	1.13	21.5
22.5	0.0258	0.655	0.0262	0.665	0.0268	0.681	0.58	0.863	0.0269	0.683	0.0274	0.696	0.0279	0.709	0.606	0.902	22.5
23.5	0.0231	0.587	0.0235	0.587	0.024	0.61	0.463	0.689	0.0241	0.612	0.0246	0.625	0.0251	0.638	0.486	0.723	23.5
24.5	0.0207	0.526	0.0211	0.526	0.0216	0.549	0.373	0.555	0.0217	0.551	0.0222	0.564	0.0227	0.577	0.375	0.558	24.5
25.5	0.0185	0.47	0.0189	0.47	0.0193	0.49	0.3	0.446	0.0194	0.493	0.0199	0.505	0.0204	0.518	0.303	0.451	25.5
26.5	0.0166	0.422	0.0169	0.422	0.0173	0.439	0.236	0.351	0.0175	0.445	0.0179	0.455	0.0184	0.467	0.245	0.365	26.5
27.5	0.0149	0.378	0.0152	0.378	0.0156	0.396	0.191	0.284	0.0157	0.399	0.0161	0.409	0.0165	0.419	0.201	0.299	27.5
28.5	0.0134	0.34	0.0137	0.34	0.014	0.356	0.151	0.225	0.0141	0.358	0.0145	0.368	0.0149	0.378	0.161	0.240	28.5
29.5	0.012	0.305	0.0123	0.305	0.0126	0.32	0.119	0.177	0.0127	0.323	0.0131	0.333	0.0135	0.343	0.129	0.192	29.5

\* Nominal Weight, see page 19



## Recommended Winding Tensions – Copper and Aluminum

AWG SIZE	NOMINAL DIAMETER		COPPER		ALUMINUM		AWG SIZE
	inches	millimeters	8500 PSI	598 kg/cm <sup>2</sup>	5500 PSI	387 kg/cm <sup>2</sup>	
4	.2043	5.189	278 lbs	126 kg	180 lbs	81.6 kg	4
5	.1819	4.620	221 lbs	100 kg	143 lbs	64.8 kg	5
6	.1620	4.115	175 lbs	79.4 kg	113 lbs	51.2 kg	6
7	.1443	3.665	139 lbs	63.0 kg	90.0 lbs	40.8 kg	7
8	.1285	3.264	110 lbs	49.9 kg	71.4 lbs	32.4 kg	8
9	.1144	2.906	87.2 lbs	39.5 kg	56.4 lbs	25.6 kg	9
10	.1019	2.588	73.7 lbs	33.4 kg	44.8 lbs	20.3 kg	10
11	.0907	2.304	54.9 lbs	24.9 kg	35.5 lbs	16.1 kg	11
12	.0808	2.052	43.8 lbs	19.9 kg	28.3 lbs	12.8 kg	12
13	.0720	1.829	34.5 lbs	15.6 kg	22.3 lbs	10.1 kg	13
14	.0641	1.628	27.5 lbs	12.5 kg	17.8 lbs	8.07 kg	14
15	.0571	1.450	21.8 lbs	9.99 kg	14.1 lbs	6.53 kg	15
16	.0508	1.290	17.3 lbs	7.85 kg	11.2 lbs	5.08 kg	16
17	.0453	1.151	13.8 lbs	6.26 kg	8.90 lbs	4.04 kg	17
18	.0403	1.024	10.9 lbs	4.94 kg	7.05 lbs	3.20 kg	18
19	.0359	.912	8.58 lbs	3.89 kg	5.55 lbs	2.52 kg	19
20	.0320	.813	6.83 lbs	3.10 kg	4.42 lbs	2.00 kg	20
21	.0285	.724	5.43 lbs	2.46 kg	3.51 lbs	1.59 kg	21
22	.0253	.643	4.28 lbs	1.94 kg	2.77 lbs	1.26 kg	22
23	.0226	.574	3.40 lbs	1.54 kg	2.20 lbs	.998 kg	23
24	.0201	.511	2.71 lbs	1.23 kg	1.75 lbs	.794 kg	24
25	.0179	.455	2.15 lbs	.975 kg	1.39 lbs	.630 kg	25
26	.0159	.404	1.70 lbs	.771 kg	1.10 lbs	.499 kg	26
27	.0142	.361	1.35 lbs	.612 kg	13.9 oz	.394 kg	27
28	.0126	.320	1.07 lbs	.485 kg	11.0 oz	.312 kg	28
29	.0113	.287	13.6 oz	.385 kg	6.88 oz	.195 kg	29
30	.0100	.254	10.7 oz	.303 kg			30
31	.0089	.226	8.45 oz	.240 kg			31
32	.0080	.203	6.83 oz	.194 kg			32
33	.0071	.180	5.38 oz	.152 kg			33
34	.0063	.160	4.24 oz	.120 kg			34
35	.0056	.142	3.35 oz	95.0 g			35
36	.0050	.127	2.67 oz	75.7 g			36
37	.0045	.114	2.16 oz	61.2 g			37
38	.0040	.102	1.71 oz	48.5 g			38
39	.0035	.089	1.30 oz	36.9 g			39
40	.0031	.079	1.03 oz	29.2 g			40
41	.0028	.071	.837 oz	23.7 g			41
42	.0025	.064	.667 oz	18.9 g			42
43	.0022	.056	.517 oz	14.7 g			43
44	.0020	.051	.427 oz	12.1 g			44

# Winding Space Factor Chart

## Winding Space Factors (basis – square lay)

Chart expresses percentage of cross sectional area occupied by bare conductor.

## Physical Constants at 20°C

Property	Annealed Copper	Annealed Aluminum
Volume electrical conductivity minimum percent I.A.C.S	100.0	61.8
Density lb/in <sup>3</sup> kg/m <sup>3</sup>	0.32117 8888.4	0.09765 272.05
Weight resistivity ohm-circular mil/ft ohm-mm <sup>2</sup> /m	10.371 17.2417x10 <sup>-3</sup>	16.782 27.898x10 <sup>-3</sup>
Volume resistivity micro-ohm-inch micro-ohm-mm	0.67881 17.2417	1.0928 27.7574
Temperature coefficient of resistance ohm/°C	0.00393	0.00410
Specific heat cal/gm/°C	0.092	0.214
Coefficient of thermal conductivity cal/sec/cm <sup>2</sup> /cm/°C	0.934	0.57
Coefficient of linear expansion/°C	0.0000168	0.0000238

## Formula for Calculating Weights and Resistances at 20°C

		Copper	Aluminum
Weight	lb/1000 ft	$3854 \times A$	$1172 \times A$
	kg/km	$8.8897 \times a$	$2.7034 \times a$
Length	ft/lb	$\frac{0.25947}{A}$	$\frac{0.85336}{A}$
	m/kg	$\frac{112.5066}{a}$	$\frac{370.0184}{a}$
Resistance	ohm/1000 ft	$\frac{8.145 \times 10^{-3}}{A}$	$\frac{13.1806 \times 10^{-3}}{A}$
	ohm/km	$\frac{17.2417}{a}$	$\frac{27.7474}{a}$
	ohm/lb	$\frac{2.1135 \times 10^{-6}}{A^2}$	$\frac{11.212 \times 10^{-6}}{A^2}$
	ohm/kg	$\frac{1.93975}{a^2}$	$\frac{10.2903}{a^2}$

A = nominal cross sectional area of wire in square inches.  
a = nominal cross sectional area of wire in square millimeters.

# Square Wire Data – Annealed Copper

## Square AWG Sizes

AWG SIZE	DIMENSIONS						NOMINAL AREA			NOMINAL RESISTANCE AT 20°C				PHYSICAL DATA FOR NOMINAL DIMENSIONS				AWG SIZE
	Minimum		Nominal		Maximum		cir mils	sq. in	sq. mm	ohms/1000 ft	ohms/km	ohms/lb	ohms/kg	lbs/1000 ft	kg/km	ft/lb	m/kg	
	in	mm	in	mm	in	mm												
2	.2550	6.477	.2576	6.543	.2602	6.609	82738	.064984	41.925	.1254	.4113	.0005005	.001104	250.4	372.6	3.993	2.684	2
3	.2271	5.768	.2294	5.827	.2317	5.885	65252	.051249	33.064	.1589	.5215	.0008046	.001774	197.5	293.9	5.063	3.403	3
4	.2023	5.138	.2043	5.189	.2053	5.215	51393	.040364	26.042	.2018	.6621	.001297	.002860	155.6	231.4	6.428	4.320	4
5	.1801	4.575	.1819	4.620	.1828	4.643	40380	.031714	20.461	.2568	.8427	.002101	.004633	122.2	181.8	8.182	5.499	5
6	.1604	4.074	.1620	4.115	.1628	4.135	32295	.025364	16.364	.3212	1.054	.003285	.007243	97.75	145.4	10.23	6.876	6
7	.1429	3.630	.1443	3.665	.1450	3.683	25391	.019942	12.866	.4085	1.340	.005315	.01172	76.86	114.4	13.01	8.744	7
8	.1272	3.231	.1285	3.264	.1292	3.282	19904	.015633	10.086	.5211	1.710	.008648	.01907	60.25	89.65	16.60	11.16	8
9	.1133	2.878	.1144	2.906	.1150	2.921	15294	.012012	8.069	.6781	2.225	.01465	.03230	46.29	68.87	21.60	14.52	9
10	.1009	2.563	.1019	2.588	.1024	2.601	12481	.009803	6.325	.8309	2.726	.02199	.04849	37.78	56.21	26.47	17.79	10
11	.0898	2.281	.0907	2.304	.0912	2.317	10366	.008141	5.086	1.001	3.283	.03189	.07032	31.38	46.69	31.87	21.42	11
12	.0800	2.032	.0808	2.052	.0812	2.062	7857	.006185	3.990	1.317	4.321	.05525	.1218	23.84	35.47	41.95	28.19	12
13	.0713	1.811	.0720	1.829	.0724	1.839	6320	.004964	3.203	1.641	5.384	.08577	.1891	19.13	28.46	52.27	35.13	13
14	.0635	1.613	.0641	1.628	.0644	1.636	4951	.003889	2.509	2.095	6.873	.1398	.3083	14.99	22.30	66.72	44.84	14

## Bare Wire Characteristics for all Square and Rectangular Copper Products (corner radii)

SPECIFIED THICKNESS		CORNER RADIUS				AREA REDUCTION				WEIGHT REDUCTION			
Inches	Millimeters	Inches		Millimeters		sq. mils		sq. millimeters		lbs/1000 ft		kg/km	
		Width under .189"	to 751"	Width under 4.801mm	to 19.075mm	Width under .189"	to .751"	Width under 4.801mm	to 19.075mm	Width under .189"	to .751"	Width under 4.801mm	to 19.075mm
.439-.226	11.15-5.740		.040		1.016		1373		.8858		5.29		7.871
.225-.166	5.715-4.216	.040	.040	1.016	1.016	1373	1373	.8858	.8858	5.29	5.29	7.871	7.871
.165-.126	4.191-3.200	.032	.032	.813	.813	879	879	.5671	.5671	3.39	3.39	5.044	5.044
.125-.096	3.175-2.438	.026	.032	.660	.813	580	879	.3742	.5671	2.24	3.39	3.333	5.044
.095-.061	2.413-1.549	.020	.032	.508	.813	343	879	.2213	.5671	1.32	3.39	1.964	5.044
Under .061	Under 1.549	Round Edge	Round Edge	Round Edge	Round Edge	(a)	(a)	(b)	(b)				

Based on ASTM Specification B48-68

(a) = Rounded edge area reduction in square mils is  $214600 T^2$ , where T is wire thickness in inches.

(b) = Rounded edge area reduction in square millimeters is  $.2146 t^2$ , where t is wire thickness in millimeters.

# Square Wire Data – Annealed Aluminum

## Square AWG Sizes

AWG SIZE	DIMENSIONS						NOMINAL AREA			NOMINAL RESISTANCE AT 20°C				PHYSICAL DATA FOR NOMINAL DIMENSIONS				AWG SIZE
	Minimum		Nominal		Maximum		cir mils	sq. in	sq. mm	ohms/ 1000 ft	ohms/ km	ohms/ lb	ohms/ kg	lbs/ 1000 ft	kg/ km	ft/ lb	m/ kg	
	in	mm	in	mm	in	mm												
1/0	.3217	8.171	.3249	8.252	.3281	8.334	132655	.104187	67.217	.1265	.4128	.001033	.002278	122.11	181.71	8.191	5.505	1/0
1	.2864	7.275	.2893	7.348	.2922	7.422	104814	.082321	53.110	.1601	.5225	.001655	.003648	96.48	143.58	10.37	6.967	1
2	.2550	6.477	.2576	6.543	.2602	6.609	82738	.064984	41.925	.2022	.6633	.002655	.005854	76.16	113.3	13.13	8.825	2
3	.2271	5.768	.2294	5.827	.2317	5.885	65252	.051249	33.064	.2564	.8411	.004269	.009413	60.06	89.37	16.65	11.19	3
4	.2023	5.138	.2043	5.189	.2053	5.215	51393	.040364	26.042	.3255	1.068	.006882	.01517	47.31	70.39	21.14	14.21	4
5	.1801	4.575	.1819	4.620	.1828	4.643	40380	.031714	20.461	.4143	1.359	.01115	.02458	37.17	55.30	26.90	18.08	5
6	.1604	4.074	.1620	4.115	.1628	4.135	32295	.025364	16.364	.5180	1.700	.01743	.03843	29.73	44.23	33.64	22.61	6
7	.1429	3.630	.1443	3.665	.1450	3.683	25391	.019942	12.866	.6589	2.162	.02819	.06217	23.37	34.78	42.79	28.76	7
8	.1272	3.231	.1285	3.264	.1292	3.282	19904	.015633	10.086	.8405	2.757	.04588	.1012	18.32	27.26	54.58	36.68	8
9	.1133	2.878	.1144	2.906	.1150	2.921	15294	.012012	8.069	1.094	3.589	.07771	.1713	14.08	20.95	71.03	47.74	9
10	.1009	2.563	.1019	2.588	.1024	2.601	12481	.009803	6.325	1.340	4.397	.1167	.2573	11.49	17.09	87.04	58.50	10
11	.0898	2.281	.0907	2.304	.0912	2.317	10366	.008141	5.086	1.614	5.295	.1692	.3730	9.541	14.20	104.8	70.44	11
12	.0800	2.032	.0808	2.052	.0812	2.062	7857	.006185	3.990	2.124	6.970	.2931	.6463	7.249	10.79	137.9	92.72	12
13	.0713	1.811	.0720	1.829	.0724	1.839	6320	.004964	3.203	2.647	8.684	.4550	1.003	5.818	8.656	171.9	115.5	13
14	.0635	1.613	.0641	1.628	.0644	1.636	4951	.003889	2.509	3.379	11.084	.7413	1.635	4.558	6.782	219.4	147.5	14

## Bare Wire Characteristics for all Square and Rectangular Aluminum Products (corner radii)

SPECIFIED THICKNESS		CORNER RADIUS				AREA REDUCTION				WEIGHT REDUCTION			
Inches	Millimeters	Inches		Millimeters		sq. mils		sq. millimeters		lbs/1000 ft		kg/km	
		Width under .189"	.189" to .751"	Width under 4.801mm	4.801mm to 19.075mm	Width under .189"	.189" to .751"	Width under 4.801mm	4.801mm to 19.075mm	Width under .189"	.189" to .751"	Width under 4.801mm	4.801mm to 19.075mm
.439-.226	11.15-5.740		.040		1.016		1373		.8858		1.61		2.396
.225-.166	5.715-4.216	.040	.040	1.016	1.016	1373	1373	.8858	.8858	1.61	1.61	2.396	2.396
.165-.126	4.191-3.200	.032	.032	.813	.813	879	879	.5671	.5671	1.03	1.03	1.533	1.533
.125-.096	3.175-2.438	.026	.032	.660	.813	580	879	.3742	.5671	0.68	1.03	1.012	1.533
.095-.061	2.413-1.549	.020	.032	.508	.813	343	879	.2213	.5671	0.40	1.03	0.595	1.533
Under .061	Under 1.549	Round Edge	Round Edge	Round Edge	Round Edge	(a)	(a)	(b)	(b)				

Based on ASTM Specification B324-69

(a) = Rounded edge area reduction in square mils is  $214600 T^2$ , where T is wire thickness in inches.

(b) = Rounded edge area reduction in square millimeters is  $.2146 t^2$ , where t is wire thickness in millimeters.

# Square and Rectangular Wire Data – Copper and Aluminum

## Rectangular Bare Standards

### Maximum Permissible Variation in Rectangular Wire – Thickness

SPECIFIED THICKNESS		THICKNESS, PLUS AND MINUS			
<i>Inches</i>	<i>Millimeters</i>	<i>1.000 to .501 inches in width</i>	<i>.500 inches and under in width</i>	<i>25.4 to 12.73 millimeters in width</i>	<i>12.7 millimeters and under</i>
.500 to .301	12.70 to 7.65	1%	.003 inches	1%	.08 mm
.300 to .101	7.62 to 2.57	1%	1%	1%	1%
.100 and under	2.54 and under	.001 inches	.001 inches	.03 mm	.03 mm

### Maximum Permissible Variation in Rectangular Wire – Width

SPECIFIED WIDTH		WIDTH, PLUS AND MINUS
<i>Inches</i>	<i>Millimeters</i>	
.500 and over	12.73 and over	1 % but not to exceed .016 inches (.4 mm)
.500 to .301	12.70 to 7.65	.003 inches (.08 mm)
.300 to .101	7.62 to 2.57	1 %
.100 and under	2.54 and under	.001 inches (.03 mm)

Based on ASTM Specification B48-68 (CU) B324-69 (AL)

### Additions for Film Covered Rectangular and Square Wire

Rectangular Wire	Inches	Millimeters
Single Thickness	.0015-.0025	.038-.064
Single Width	.0015-.0025	.038-.064
Heavy Thickness	.0030-.0050	.076-.127
Heavy Width	.0025-.0045	.064-.114
Extra Heavy Thickness	.005-.007	.127-.178
Extra Heavy Width	.004-.006	.102-.152
Square Wire	Above thickness limits apply.	

Dimensions shown above are consistent with NEMA MW 1000.

**Note:** Maximum addition may be exceeded provided the overall dimension of the insulated wire does not exceed the sum of the maximum bare wire dimension plus the maximum addition of the film insulation.

# Resistance Variation with Temperature

The resistance of a conductor varies with temperature as follows:

$$R_t = R_{t_1} (1 + \alpha_{t_1} (t - t_1))$$

where:

$R_t$  is the resistance at any temperature  $t$ ,  $R_{t_1}$  is the known resistance at the stated temperature  $t_1$ .

$\alpha_{t_1}$  is the temperature coefficient of resistance at the stated temperature.

Because it is most practical to measure resistance at room temperature, it is convenient to choose 20°C as the stated temperature  $t_1$ . The formula thus becomes:

$$R_t = R_{20} (1 + \alpha_{20} (t - 20))$$

The temperature coefficient of resistance varies with conductivity  $n$ , as well as temperature.

$$\alpha_{t_1} = \frac{1}{(1/n\alpha) + (t_1 - 20)}$$

Where  $\alpha$  is the temperature coefficient of resistance for the given conductivity,  $n$ , at 20°C.

Conductor	$\alpha$	$n$ (I.A.C.S)
Copper	0.00393	100%
Aluminum	0.00660	61.8%

For a temperature of 20°C the coefficient becomes:

$$\begin{aligned} \alpha_{20} &= .00393 \text{ for Copper} \\ &= .00408 \text{ for Aluminum} \end{aligned}$$

Thus the resistance formula for copper becomes:

$$\begin{aligned} R_t &= R_{20} (1 + .00393 (t - 20)) \\ &= \frac{234.5 + t}{254.5} \times R_{20} \end{aligned}$$

For aluminum

$$\begin{aligned} R_t &= R_{20} (1 + .00408 (t - 20)) \\ &= \frac{245.1 + t}{245.1} \times R_{20} \end{aligned}$$

Thus conversion of resistances at operating temperatures to resistance at 20°C is achieved by multiplying by the inverses of the factors.

That is:

$$R_{20} = \frac{254}{234.5 + t} \times R_t \text{ for CU}$$

$$R_{20} = \frac{245.1}{225.1 + t} \times R_t \text{ for AL}$$

These factors for converting resistance to 20°C are listed from 0 to 250°C in the following tables on the next two pages.



## Factors for Converting Copper Resistance to 20°C

°C	Factor	°C	Factor	°C	Factor	°C	Factor	°C	Factor
0	1.0853								
1	1.0807	51	.8914	101	.7586	151	.6602	201	.5844
2	1.0761	52	.8883	102	.7563	152	.6585	202	.5830
3	1.0716	53	.8852	103	.7541	153	.6568	203	.5817
4	1.0671	54	.8821	104	.7518	154	.6551	204	.5804
5	1.0626	55	.8791	105	.7496	155	.6534	205	.5791
6	1.0582	56	.8761	106	.7474	156	.6517	206	.5778
7	1.0538	57	.8731	107	.7452	157	.6501	207	.5764
8	1.0495	58	.8701	108	.7431	158	.6484	208	.5751
9	1.0452	59	.8671	109	.7409	159	.6468	209	.5738
10	1.0409	60	.8642	110	.7388	160	.6451	210	.5726
11	1.0367	61	.8613	111	.7366	161	.6435	211	.5713
12	1.0325	62	.8583	112	.7345	162	.6419	212	.5700
13	1.0283	63	.8555	113	.7324	163	.6403	213	.5687
14	1.0241	64	.8526	114	.7303	164	.6386	214	.5674
15	1.0200	65	.8497	115	.7282	165	.6370	215	.5662
16	1.0160	66	.8469	116	.7261	166	.6355	216	.5649
17	1.0119	67	.8441	117	.7240	167	.6339	217	.5637
18	1.0079	68	.8413	118	.7220	168	.6323	218	.5624
19	1.0039	69	.8386	119	.7199	169	.6307	219	.5612
20	1.0000	70	.8358	120	.7179	170	.6292	220	.5600
21	.9961	71	.8331	121	.7159	171	.6276	221	.5587
22	.9922	72	.8303	122	.7139	172	.6261	222	.5575
23	.9883	73	.8276	123	.7119	173	.6245	223	.5563
24	.9845	74	.8250	124	.7099	174	.6230	224	.5551
25	.9807	75	.8223	125	.7079	175	.6215	225	.5539
26	.9770	76	.8196	126	.7060	176	.6200	226	.5527
27	.9732	77	.8170	127	.7040	177	.6185	227	.5515
28	.9695	78	.8144	128	.7021	178	.6170	228	.5503
29	.9658	79	.8118	129	.7001	179	.6155	229	.5491
30	.9622	80	.8092	130	.6982	180	.6140	230	.5479
31	.9586	81	.8067	131	.6963	181	.6125	231	.5467
32	.9550	82	.8041	132	.6944	182	.6110	232	.5456
33	.9514	83	.8016	133	.6925	183	.6096	233	.5444
34	.9479	84	.7991	134	.6906	184	.6081	234	.5432
35	.9443	85	.7966	135	.6888	185	.6067	235	.5421
36	.9409	86	.7941	136	.6869	186	.6052	236	.5409
37	.9374	87	.7916	137	.6851	187	.6038	237	.5398
38	.9339	88	.7891	138	.6832	188	.6024	238	.5386
39	.9305	89	.7867	139	.6814	189	.6009	239	.5375
40	.9271	90	.7843	140	.6796	190	.5995	240	.5364
41	.9238	91	.7819	141	.6778	191	.5981	241	.5352
42	.9204	92	.7795	142	.6760	192	.5967	242	.5341
43	.9171	93	.7771	143	.6742	193	.5953	243	.5330
44	.9138	94	.7747	144	.6724	194	.5939	244	.5319
45	.9106	95	.7724	145	.6706	195	.5925	245	.5308
46	.9073	96	.7700	146	.6689	196	.5912	246	.5297
47	.9041	97	.7677	147	.6671	197	.5898	247	.5286
48	.9009	98	.7654	148	.6654	198	.5884	248	.5275
49	.8977	99	.7631	149	.6636	199	.5871	249	.5264
50	.8946	100	.7608	150	.6619	200	.5857	250	.5253

## Factors for Converting Aluminum Resistance to 20°C

°C	Factor	°C	Factor	°C	Factor	°C	Factor	°C	Factor
0	1.0889								
1	1.0840	51	.8877	101	.7516	151	.6517	201	.5752
2	1.0793	52	.8845	102	.7493	152	.6500	202	.5739
3	1.0745	53	.8813	103	.7470	153	.6482	203	.5725
4	1.0698	54	.8782	104	.7448	154	.6465	204	.5712
5	1.0652	55	.8750	105	.7425	155	.6448	205	.5699
6	1.0606	56	.8719	106	.7403	156	.6431	206	.5685
7	1.0560	57	.8688	107	.7380	157	.6415	207	.5672
8	1.0515	58	.8658	108	.7358	158	.6398	208	.5659
9	1.0470	59	.8627	109	.7336	159	.6381	209	.5646
10	1.0425	60	.8597	110	.7314	160	.6365	210	.5633
11	1.0381	61	.8567	111	.7292	161	.6348	211	.5620
12	1.0337	62	.8537	112	.7271	162	.6332	212	.5607
13	1.0294	63	.8507	113	.7249	163	.6315	213	.5595
14	1.0251	64	.8478	114	.7228	164	.6299	214	.5582
15	1.0208	65	.8449	115	.7207	165	.6283	215	.5569
16	1.0166	66	.8420	116	.7186	166	.6267	216	.5557
17	1.0124	67	.8391	117	.7165	167	.6251	217	.5544
18	1.0082	68	.8362	118	.7144	168	.6235	218	.5531
19	1.0041	69	.8334	119	.7123	169	.6219	219	.5519
20	1.0000	70	.8306	120	.7102	170	.6203	220	.5507
21	.9959	71	.8278	121	.7082	171	.6188	221	.5494
22	.9919	72	.8250	122	.7061	172	.6172	222	.5482
23	.9879	73	.8222	123	.7041	173	.6157	223	.5470
24	.9839	74	.8195	124	.7021	174	.6141	224	.5458
25	.9800	75	.8167	125	.7001	175	.6126	225	.5445
26	.9761	76	.8140	126	.6981	176	.6111	226	.5433
27	.9722	77	.8113	127	.6961	177	.6095	227	.5421
28	.9684	78	.8086	128	.6941	178	.6080	228	.5409
29	.9646	79	.8060	129	.6922	179	.6065	229	.5397
30	.9608	80	.8033	130	.6902	180	.6050	230	.5386
31	.9570	81	.8007	131	.6883	181	.6035	231	.5374
32	.9533	82	.7981	132	.6864	182	.6021	232	.5362
33	.9496	83	.7955	133	.6844	183	.6006	233	.5350
34	.9460	84	.7929	134	.6825	184	.5991	234	.5339
35	.9423	85	.7904	135	.6806	185	.5977	235	.5327
36	.9387	86	.7878	136	.6788	186	.5962	236	.5316
37	.9351	87	.7853	137	.6769	187	.5948	237	.5304
38	.9316	88	.7828	138	.6750	188	.5933	238	.5293
39	.9281	89	.7803	139	.6732	189	.5919	239	.5281
40	.9246	90	.7778	140	.6713	190	.5905	240	.5270
41	.9211	91	.7754	141	.6695	191	.5890	241	.5259
42	.9176	92	.7729	142	.6677	192	.5876	242	.5247
43	.9142	93	.7705	143	.6658	193	.5862	243	.5236
44	.9108	94	.7681	144	.6640	194	.5848	244	.5225
45	.9074	95	.7657	145	.6623	195	.5834	245	.5214
46	.9041	96	.7633	146	.6605	196	.5820	246	.5203
47	.9008	97	.7609	147	.6587	197	.5807	247	.5192
48	.8975	98	.7586	148	.6569	198	.5793	248	.5181
49	.8942	99	.7562	149	.6552	199	.5779	249	.5170
50	.8909	100	.7539	150	.6534	200	.5766	250	.5159

# Variations in Conductor Resistance Due to Diameter Tolerance

The resistance of a given length of wire is inversely proportional to its cross-sectional area, and thus for round wire the square of its diameter:

Resistance	Copper	Aluminum
ohm/1000 ft	$\frac{8.1454 \times 10^{-3}}{A} = \frac{10.371 \times 10^{-3}}{D^2}$	$\frac{13.1806 \times 10^{-3}}{A} = \frac{16.782 \times 10^{-3}}{D^2}$
ohm/km	$\frac{17.2417}{a} = \frac{21.9519}{d^2}$	$\frac{27.7474}{a} = \frac{35.3291}{d^2}$

where: D is the diameter in inches  
 d is the diameter in millimeters  
 A is the cross-sectional area in square inches  
 a is the cross-sectional area in square millimeters

It is easily seen that the resistance will reach its maximum when the wire approaches its minimum diameter.

The wire diameter corresponding to any resistance measurement is given by the following formulae:

Units	Copper	Aluminum
Inches	$D = \frac{0.1019}{R}$	$D = \frac{0.1295}{R}$
Millimeters	$d = \frac{4.685}{r}$	$d = \frac{5.944}{r}$

where: R is the resistance in ohms/in  
 r is the resistance in ohms/km

# Wire and Cable Metric Calculations

## Dimensions

### Length

mils x 0.0254 = mm (millimetres)  
 inches x 25.4 = mm  
 feet x 0.3048 = m (metres)  
 miles x 1.609344 = km (kilometres)

### Area

circular mils x 0.0005067 = mm<sup>2</sup>  
 (square millimetres)  
 sq. in x 645.16 = mm<sup>2</sup>  
 sq. ft. x 0.092903 = m<sup>2</sup>  
 (square metres)  
 sq. yd. x 0.836127 = m<sup>2</sup>  
 sq. mi. x 2.58999 = km<sup>2</sup>  
 (square kilometres)

### Volume

cu. in. x 16.387 = cm<sup>3</sup>  
 (cubic centimetres)  
 cu. ft. x 0.028317 = m<sup>3</sup>  
 (cubic metres)  
 gallons x 4.54609 = L (litres)  
 U.S. gal. x 3.7854 = L (litres)

## Mass

pounds x 0.45359 = kg (kilograms)  
 tons (2000 lb) x 0.907185 = t  
 (metric tonnes)

### Mass per unit length

lb/1000 ft. x 1.48816 = kg/km  
 (kilograms per kilometre)  
 lb/mi x 0.28185 = kg/km

### Solid wire weight

mm<sup>2</sup> x 8.89 = kg/km (for copper)  
 mm<sup>2</sup> x 2.70 = kg/km (for aluminum)  
 mm<sup>2</sup> x 7.83 = kg/km (for steel)

## Temperature Conversion

°F to °C: °C = (°F minus 32) x <sup>5</sup>/<sub>9</sub>  
 °C to °F: °F = (°C x <sup>9</sup>/<sub>5</sub>) plus 32

## Force or Tension

pounds (force) x 4.448 = N  
 (newtons)  
 mass (in kg) x 9.8066 = N  
 (weight at or near sea level)

### Force per unit area

(stress, pressure, tensile strength, etc.)  
 lbf/in<sup>2</sup> = (psi) x 6.895 = kPa  
 (kilopascals)  
 lbf/in<sup>2</sup> x 0.006895 = MPa  
 (megapascals)  
 N/mm<sup>2</sup> = MPa

### Note

Kilopascals are used generally for fluid pressures. Megapascals are used generally for stresses in materials, i.e. for tensile stress, modulus of elasticity, etc. **SI Prefixes**

## SI Prefixes

Multiplying factor	Prefix	Symbol
1 000 000 000 000 = 10 <sup>12</sup>	tera	T
1 000 000 000 = 10 <sup>9</sup>	giga	G
1 000 000 = 10 <sup>6</sup>	mega	M
1 000 = 10 <sup>3</sup>	kilo	k
100 = 10 <sup>2</sup>	hecto	h
10 = 10 <sup>1</sup>	deca	da
0.1 = 10 <sup>-1</sup>	deci	d
0.01 = 10 <sup>-2</sup>	centi	c
0.001 = 10 <sup>-3</sup>	milli	m
0.000 001 = 10 <sup>-6</sup>	micro	μ
0.000 000 001 = 10 <sup>-9</sup>	nano	n
0.000 000 000 001 = 10 <sup>-12</sup>	pico	p
0.000 000 000 000 001 = 10 <sup>-15</sup>	femto	f
0.000 000 000 000 000 001 = 10 <sup>-18</sup>	atto	a

## NOTICE

Alcatel Magnet Wire Inc. has endeavoured to ensure the accuracy of the data in this publication, however we cannot be liable for the consequences of errors or omissions. All data is subject to change without notice. The installer and/or user assumes all liability for the consequences of the installation and/or use of any of our products in contravention of any applicable law, regulation or code.

### **Corporate Offices**

Alcatel Canada Wire Inc.  
140 Allstate Parkway  
Markham, Ontario  
Canada  
L3R 0Z7

Telephone (905) 944-4300  
Fax (905) 944-4340

### **Customer Sales and Service**

Toll Free  
Canada (except Québec)  
(800) 265-8072  
Québec  
(800) 361-4534  
United States of America  
(800) 265-6702

Facsimile  
(519) 426-2458

Alcatel Scanwire Corporation  
914 Stiles Drive  
Addison, Illinois  
60101, USA

Telephone (708) 628-8440  
Facsimile (708) 628-8960

### **Manufacturing Locations**

LaGrange, Kentucky  
Simcoe, Ontario  
Montréal, Québec

