

Round and Square Conductor AWG Standards

American Wire Gauge (AWG) standards allow industry professionals in North America to determine which wire gauge is best suited for particular commercial or residential applications. In addition to wire gauge, other properties like diameter, area, resistance (ohms), current capacity (amps), and frequency (Hz) help in selecting the appropriate wire for the application.

Please consult the following resources when planning and developing your project.

What Are AWG Standards?

AWG is the standard for sizing single-strand, round, solid wires in North America. The size of the electrical wire depends on its current-carrying capacity and electrical resistance. As the wire gauge number increases, the diameter of the wire decreases.

The largest wire gauge is 0000 AWG, which has a 0.46-inch (11.7 mm) diameter, while the smallest wire gauge is 40 AWG, with a 0.0032-inch (0.08128 mm) diameter. Wire diameter and cross-section standards for wire sizes do not include the insulation coating.

Analyzing Design in Accordance With AWG Standards and Conductor Properties

“Wire gauge” refers to the way the electrical wire is made and its electrical resistance. When analyzing a design for a wiring project, consider the following four aspects.

Conductor Shape and Dimensions

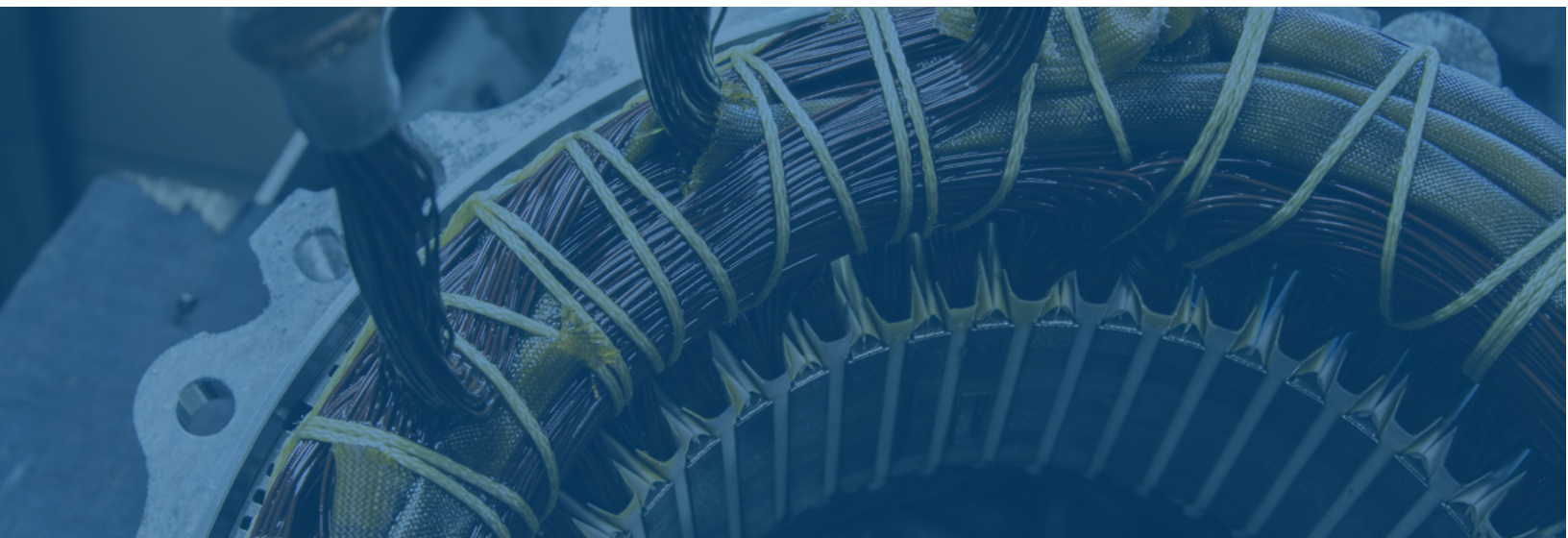
Consider the properties of round vs. square wire conductors. For example, square wires have a volumetric occupancy ratio that is 27% higher than that of round conductors. At the same time, square conductors have 15-20% lower DCR, which translates to a decrease in power.

Resistance Factors

Electrical resistance obstructs the flow of the current. A wire's length, thickness, material, and temperature affect its electrical resistance. The wire gauge number reveals both the size and level of electrical resistance. Thicker wires, for example, contain more electrons, so they have lower electrical resistance. Thinner wires have more resistance because they carry fewer electrons.

Weight

The wire's weight also influences its application and function.



General Properties of Copper/ Aluminum Conductor Material

Copper and aluminum are low-resistance conductors that provide superior conductivity and resist corrosion. To determine which one to use for your project, consider its physical and electrical properties.

Physical Properties

Copper

Aluminum

Density at 68 °F	0.3212 pounds/inch ³	0.09765 pounds/inch ³
Thermal capacity at 68 °F	0.0921 BTU/pound/°F	0.214 BTU/pound/°F
Thermal conductivity at 68 °F	1.15 BTU/foot ² /sec/°F/inch	0.66 BTU/foot ² /sec/°F/inch
Thermal coefficient of expansion, linear change in length at 32 °F	16.9 x 10 ⁻⁶	23.8 x 10 ⁻⁶
Melting point	1,980 °F	1,220 °F
Tensile characteristics, annealed, at 68 °F: Ultimate strength, Yield strength	36,000-40,000 pounds/inch ² 9,000-12,000 pounds/inch ²	9,000-14,000 pounds/inch ² 4,000-7,000 pounds/inch ²

Electrical Properties

IACS volume conductivity at 68 °F	100%	61.8%
Volume resistivity at 68 °F	10.371 (ohm) x (circular mil)/foot	16.782 (ohm) x (circular mil)/foot
Weight resistivity at 68 °F	875.2 (ohm) x (pound)/mile ²	430.59 (ohm) x (pound)/mile ²
Thermal coefficient of resistance at 68 °F Change in unit resistance at 68 °F	0.00393	0.00408

For more details about copper and aluminum conductors, consult the [Essex Handbook](#).

General Conductor Resources

AWG determines the amount of electrical current the wire can safely conduct and its resistance. See the [Essex Handbook](#) for more general information about conductor properties.

[Essex Handbook](#)

Round Conductor Resources

According to AWG, round copper conductors range from size 4 to 46. They're measured according to single build diameter, heavy build diameter, and triple build diameter.

Round Conductor AWG Standards

For more details about round conductor AWG standards, download the [AWG Round Copper Conductor chart](#).

[AWG Round Copper Conductor Chart](#)

American Wire Gauge, Round Copper Conductor

AWG Size

Single Build Diameter (Inches)

Heavy Build Diameter (Inches)

Triple Build Diameter (Inches)

Ohms/1000 ft

	Min.	Nom.	Max.	Ft./Lb.	Min.	Nom.	Max.	Ft./Lb.	Min.	Nom.	Max.	Ft./Lb.	
4	0.2042	0.2073	0.2093	7.908	0.206	0.2084	0.2098	7.9	0.2072	0.2095	0.2117	7.892	0.2534
5	0.182	0.1848	0.1867	9.942	0.1837	0.1859	0.1872	9.9	0.1849	0.1869	0.189	9.858	0.3197
6	0.1622	0.1648	0.1665	12.545	0.1639	0.1659	0.1671	12.5	0.1651	0.1679	0.1688	12.455	0.4031
7	0.1446	0.1469	0.1485	15.81	0.1463	0.1481	0.1491	15.75	0.1475	0.1492	0.1508	15.69	0.5079
8	0.1288	0.1306	0.1324	19.93	0.1305	0.1322	0.1332	19.85	0.1317	0.1333	0.1348	19.77	0.641
9	0.1149	0.1165	0.1181	25.12	0.1165	0.1177	0.1189	25	0.1177	0.1191	0.1205	24.88	0.8079
10	0.1024	0.1039	0.1054	31.66	0.104	0.1051	0.1061	31.5	0.1052	0.1064	0.1076	31.34	1.019
11	0.0913	0.0927	0.0941	39.6	0.0928	0.0938	0.0948	39	0.094	0.0952	0.0963	38.4	1.286
12	0.0814	0.0827	0.084	50.25	0.0829	0.0838	0.0847	49.9	0.084	0.0851	0.0861	49.55	1.62
13	0.0727	0.0739	0.075	63.3	0.0741	0.0749	0.0757	62.9	0.0752	0.0762	0.0771	62.5	2.04
14	0.0651	0.0659	0.0666	79.94	0.0667	0.0675	0.0682	79.18	0.0683	0.0692	0.07	78.42	2.572
15	0.058	0.0587	0.0594	100.4	0.0595	0.0602	0.0609	99.7	0.061	0.0619	0.0627	99	3.249
16	0.0517	0.0524	0.0531	126.8	0.0532	0.0539	0.0545	125.6	0.0546	0.0554	0.0562	124.4	4.099
17	0.0462	0.0469	0.0475	159.4	0.0476	0.0482	0.0488	157.7	0.0489	0.0497	0.0504	156	5.167
18	0.0412	0.0418	0.0424	201.1	0.0425	0.0431	0.0437	199.2	0.0438	0.0445	0.0452	197.3	6.514
19	0.0367	0.0373	0.0379	253.2	0.038	0.0386	0.0391	250.6	0.0392	0.0399	0.0406	248	8.229
20	0.0329	0.0334	0.0339	318.4	0.034	0.0346	0.0351	314.5	0.0352	0.0358	0.0364	310.6	10.32
21	0.0293	0.0298	0.0303	400.6	0.0304	0.0309	0.0314	395.3	0.0315	0.0321	0.0326	390	13.04
22	0.0261	0.0266	0.027	507.1	0.0271	0.0276	0.0281	502.5	0.0282	0.0288	0.0293	497.9	16.59
23	0.0234	0.0239	0.0243	633.7	0.0244	0.0249	0.0253	625	0.0254	0.0259	0.0264	616.3	20.67
24	0.0209	0.0213	0.0217	804.5	0.0218	0.0223	0.0227	790.5	0.0228	0.0233	0.0238	776.5	26.19
25	0.0186	0.019	0.0194	1010	0.0195	0.0199	0.0203	992.1	0.0204	0.0209	0.0214	974.2	33.1
26	0.0166	0.017	0.0173	1279	0.0174	0.0178	0.0182	1254	0.0183	0.0188	0.0193	1229	42.07
27	0.0149	0.0153	0.0156	1600	0.0157	0.0161	0.0164	1571	0.0165	0.0169	0.0173	1542	52.17
28	0.0133	0.0137	0.014	2028	0.0141	0.0144	0.0147	1987	0.0148	0.0152	0.0156	1946	66.37
29	0.0119	0.0123	0.0126	2513	0.0127	0.013	0.0133	2463	0.0134	0.0138	0.0142	2413	82.68
30	0.0106	0.0109	0.0112	3208	0.0113	0.0116	0.0119	3136	0.012	0.0124	0.0128	3064	105.8
31	0.0094	0.0097	0.01	4052	0.0101	0.0105	0.0108	3948	0.0108	0.011	0.0114	3844	133.9
32	0.0085	0.0088	0.0091	4995	0.0091	0.0095	0.0098	4873	0.0097	0.0101	0.0103	4751	166.2
33	0.0075	0.0078	0.0081	6337	0.0081	0.0085	0.0088	6161	0.0086	0.009	0.0092	5985	211.7

AWG Size	Single Build Diameter (Inches)				Heavy Build Diameter (Inches)				Triple Build Diameter (Inches)				Ohms/1000 ft
	Min.	Nom.	Max.	Ft./Lb.	Min.	Nom.	Max.	Ft./Lb.	Min.	Nom.	Max.	Ft./Lb.	
34	0.0067	0.007	0.0072	8055	0.0072	0.0075	0.0078	7837	0.0077	0.008	0.0082	7619	269.8
35	0.0059	0.0062	0.0064	10250	0.0064	0.0067	0.007	9891	0.0068	0.0071	0.0074	9532	342.8
36	0.0053	0.0056	0.0058	12800	0.0057	0.006	0.0063	12380	0.0061	0.0064	0.0067	11960	431.9
37	0.0047	0.005	0.0052	15750	0.0052	0.0055	0.0057	15290	0.0056	0.0059	0.006	14830	355.7
38	0.0042	0.0045	0.0047	20020	0.0046	0.0049	0.0051	19360	0.0049	0.0052	0.0054	18700	681.9
39	0.0036	0.0039	0.0041	26240	0.004	0.0043	0.0045	25270	0.0043	0.0046	0.0048	24300	897.1
40	0.0032	0.0035	0.0037	33330	0.0036	0.0038	0.004	31940	0.0039	0.0041	0.0043	30550	1152
41	0.0029	0.0031	0.0033	40800	0.0032	0.0034	0.0036	39340	0.0034	0.0036	0.0039	37880	1423
42	0.0026	0.0028	0.003	50940	0.0028	0.003	0.0032	49600	0.003	0.0032	0.0035	48260	1801
43	0.0023	0.0025	0.0026	66140	0.0025	0.0027	0.0029	63170	0.0027	0.0029	0.0032	60200	2352
44	0.002	0.0022	0.0024	80060	0.0023	0.0025	0.0027	76160	0.0025	0.0027	0.0029	72260	2873

NOTE: Wire sizes should be used as a reference only. Insulation build and tolerance may vary by manufacturer.

Round Conductor Properties

Round conductors have minimum and maximum recommended winding tensions. Further adjustments to tension should be made depending on the softness of the wire, type of winder, type of coil, and payoff device. Download the [Essex Handbook](#) for specifications about aluminum and copper AWG wires from 4 to 46.

Square Conductor Resources

Square conductor AWG sizes range from 0 to 14. These specifications cover bare wire, heavy build film insulated, and double dacron wires.

Square Conductor AWG Standards

For more information about square conductors, download the [Square Conductor AWG Standards chart](#).

[Square Conductor AWG Standards Chart](#)

American Wire Gauge, Square Copper Conductor

AWG Size

Bare Wire Properties

Heavy Build Film Insulated

Double Dacron

AWG Size	Bare Diameter (in.)			Area (circular mils)	Weight (lbs./1000 ft.)	Resistance @ 20° C (ohms/1000 ft.)			ohms/lb	Minimum Insulation Increase (in.)	Overall Diameter (in.)			Minimum Insulation Increase (in.)	Maximum Overall Dimension (in.)	Minimum Insulation Increase (in.)
	Min.	Nom.	Max.			Min.	Nom.	Max.			Min.	Nom.	Max.			
0	0.3217	0.3249	0.3281	104,187	401.5	0.0798	0.0766	0.0766	0.00019	0.0030	0.3247	0.3281	0.3331	0.0012	0.344	0.009
1	0.2864	0.2893	0.2922	82,321	317.3	0.1010	0.0989	0.0970	0.00031	0.0030	0.2894	0.2933	0.2972	0.0012	0.308	0.009
2	0.2550	0.2576	0.2602	64,985	250.5	0.1280	0.1253	0.1228	0.00050	0.0030	0.2580	0.2616	0.2652	0.0012	0.276	0.008
3	0.2271	0.2294	0.2317	51,251	197.5	0.1623	0.1589	0.1557	0.00080	0.0030	0.2301	0.2334	0.2367	0.0012	0.248	0.008
4	0.2030	0.2043	0.2063	40,365	155.6	0.2059	0.2018	0.1978	0.00130	0.0030	0.2053	0.2083	0.2113	0.0012	0.222	0.008
5	0.1801	0.1819	0.1837	31,715	122.2	0.2622	0.2568	0.2516	0.00210	0.0030	0.1831	0.1859	0.1887	0.0011	0.199	0.008
6	0.1604	0.1620	0.1636	25,365	97.8	0.3278	0.3211	0.3147	0.00329	0.0030	0.1634	0.1660	0.1686	0.0011	0.179	0.008
7	0.1429	0.1443	0.1457	19,943	76.9	0.4168	0.4084	0.4003	0.00531	0.0030	0.1459	0.1483	0.1507	0.0010	0.160	0.008
8	0.1272	0.1285	0.1298	15,633	60.3	0.5324	0.5210	0.5101	0.00865	0.0030	0.1302	0.1325	0.1348	0.0009	0.143	0.008
9	0.1133	0.1144	0.1155	12,507	48.2	0.6646	0.6513	0.6384	0.01351	0.0030	0.1163	0.1184	0.1205	0.0009	0.129	0.008
10	0.1009	0.1019	0.1029	9,804	37.8	0.8484	0.8309	0.8139	0.02199	0.0030	0.1039	0.1059	0.1079	0.0008	0.115	0.007
11	0.0897	0.0907	0.0917	7,883	30.4	1.0574	1.0333	1.0099	0.03401	0.0030	0.0927	0.0947	0.0967	0.0008	0.103	0.007
12	0.0798	0.0808	0.0818	6,186	23.8	1.3520	1.3169	1.2831	0.05524	0.0030	0.0828	0.0848	0.0868	0.0008	0.093	0.007
13	0.0710	0.0720	0.0730	4,964	19.1	1.6896	1.6409	1.5944	0.08577	0.0030	0.0740	0.0760	0.0780	0.0008	0.084	0.007
14	0.0631	0.0641	0.0651	3,889	15.0	2.1655	2.0946	2.0273	0.13976	0.0030	0.0661	0.0681	0.0701	0.0008	0.076	0.007

NOTE: Wire sizes should be used as a reference only. Insulation build and tolerance may vary by manufacturer.

Square Conductor Properties

Conductor properties include specifications for density, thermal capacity, melting point, ultimate strength, and yield strength. Download the [Essex Handbook](#) for detailed information about conductor properties.

AWG Conductors and Expertise From Custom Coils

Understanding wire gauge specifications is important for any electrical project. Determining the right AWG wire and whether to select round or square conductors can be difficult, but we're here to help. [Contact Custom Coils](#) if you have any questions about the AWG requirements for your project, or [request a free quote](#) to get started.

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