

## Resistance Wire for Low Temp Heating or Resistors Nickel-Copper Alloy - A90

$$I = \text{Current}$$

$$C_t = \text{Temperature factor}$$

$$p = \text{Surface load W/in}^2$$

$$\text{in}^2/\Omega = \frac{I^2 C_t}{p}$$

**Common Names:** Alloy 90, CuNi 90, Alloy 290, #95 Alloy, 90 Alloy, MWS-90, Cu-Ni 10, Cuprothal 90, HAI-90, Cu-Ni 10, Alloy 260, Alloy 95, Nickel Alloy 90

**Uses:** Alloy exhibits low resistivity and high temperature coefficient of resistance. Typical applications include voltage regulators, timing devices, temperature sensitive resistors, temperature compensating devices, motor control, heating wires and cables, precision and vitreous resistors, potentiometers, and low temperature heating applications.

### Composition

Ni	Cr	Fe	Al	Si	Mn	Cu	C	Ti	Mo	W
10%	None/Trace	None/Trace	None/Trace	None/Trace	None/Trace	90%	None/Trace	None/Trace	None/Trace	None/Trace

### Technical Data

Resistivity (Ω/cm <sup>f</sup> )	90	Resistivity (Ω/sqmf)	71
Resistivity (μΩ/cm)	14.96	Nom. Temp. Coeff. of Resistance (TCR)	0.00040
Std. Res. Tol. <.020"	3%	Std. Res. Tol. >.020"	5%
Thermal EMF vs. Cu	-0.026	Specific Heat (20°C)	0.092 cal/g
Density (g/cm <sup>3</sup> )	8.89	Density (lb/in <sup>3</sup> )	0.321
Thermal Conductivity	0.60 W/cm/°C	Coeff. of Linear Expansion (X 10 <sup>-6</sup> )	16.00 in/in/°C
Approx. Melting Point	1100°C	Max. Continuous Operating Temp.	400°C
UTS – Hard (KPSI)	75	YTS Tensile – Hard (KPSI)	
UTS – Stress Relieved (KPSI)		YTS Tensile – Stress Relieved (KPSI)	
UTS – Annealed (KPSI)	35	YTS Tensile – Annealed (KPSI)	
Magnetic Attraction	None	Emissivity – fully oxidized	
Designations/Specifications	ASTM = B267	Forms Available	Wire, Ribbon, Insul.

**Temperature Factor** – To obtain resistance at working temperature multiply by the factor C<sub>t</sub>, in the following table:

°F	68	212	392	572	752
A90 C <sub>t</sub>	1.00	1.035	1.07	1.11	1.15

### Alloy Data

Gage AWG	Diameter Inch	Resistance at 68° F Ω/ft	Resistance at 68° F Ω/lb	Weight lb/1000 ft	Surface area in <sup>2</sup> /ft	in <sup>2</sup> /Ω at 68°F
000	0.4096	0.0005	0.0011	507.6761	15.4432	28794.1597
00	0.3648	0.0007	0.0017	402.6049	13.7525	20334.9390
0	0.3249	0.0009	0.0027	319.2797	12.2470	14360.8895
1	0.2893	0.0011	0.0042	253.2000	10.9062	10141.9112
2	0.2576	0.0014	0.0068	200.7964	9.7123	7162.3950
3	0.2294	0.0017	0.0107	159.2386	8.6490	5058.2086
4	0.2043	0.0022	0.0171	126.2817	7.7022	3572.1954
5	0.1819	0.0027	0.0271	100.1458	6.8590	2522.7468
6	0.1620	0.0034	0.0432	79.4191	6.1081	1781.6079
7	0.1443	0.0043	0.0686	62.9822	5.4394	1258.2027
8	0.1285	0.0055	0.1091	49.9470	4.8439	888.5647
9	0.1144	0.0069	0.1735	39.6098	4.3136	627.5199
10	0.1019	0.0087	0.2759	31.4119	3.8414	443.1656
11	0.0907	0.0109	0.4388	24.9107	3.4209	312.9713
12	0.0808	0.0138	0.6977	19.7551	3.0464	221.0258
13	0.0720	0.0174	1.1094	15.6665	2.7129	156.0923
13.5	0.0679	0.0195	1.3989	13.9514	2.5601	131.1749
14	0.0641	0.0219	1.7640	12.4241	2.4159	110.2351
14.5	0.0605	0.0246	2.2243	11.0639	2.2798	92.6380
15	0.0571	0.0276	2.8048	9.8527	2.1514	77.8499

Gage AWG	Diameter Inch	Resistance at 68° F Ω/ft	Resistance at 68° F Ω/lb	Weight Lb/1000 ft	Surface area in <sup>2</sup> /ft	in <sup>2</sup> /Ω at 68°F
15.5	0.0539	0.0310	3.5368	8.7741	2.0302	65.4226
16	0.0508	0.0348	4.4599	7.8135	1.9159	54.9790
16.5	0.0480	0.0391	5.6238	6.9582	1.8080	46.2026
17	0.0453	0.0439	7.0915	6.1964	1.7061	38.8271
17.5	0.0427	0.0493	8.9422	5.5181	1.6100	32.6291
18	0.0403	0.0554	11.2759	4.9140	1.5194	27.4204
18.5	0.0380	0.0622	14.2187	4.3760	1.4338	23.0432
19	0.0359	0.0699	17.9295	3.8970	1.3530	19.3648
19.5	0.0339	0.0785	22.6087	3.4703	1.2768	16.2735
20	0.0320	0.0881	28.5091	3.0904	1.2049	13.6757
20.5	0.0302	0.0989	35.9494	2.7521	1.1370	11.4926
21	0.0285	0.1111	45.3314	2.4508	1.0730	9.6580
21.5	0.0269	0.1248	57.1619	2.1825	1.0126	8.1163
22	0.0253	0.1401	72.0799	1.9436	0.9555	6.8207
22.5	0.0239	0.1573	90.8912	1.7308	0.9017	5.7319
23	0.0226	0.1767	114.6119	1.5413	0.8509	4.8169
23.5	0.0213	0.1984	144.5232	1.3726	0.8030	4.0480
24	0.0201	0.2228	182.2406	1.2223	0.7578	3.4018
24.5	0.0190	0.2501	229.8015	1.0885	0.7151	2.8587
25	0.0179	0.2809	289.7747	0.9693	0.6748	2.4024
25.5	0.0169	0.3154	365.3997	0.8632	0.6368	2.0189
26	0.0159	0.3542	460.7612	0.7687	0.6009	1.6966
26.5	0.0150	0.3977	581.0100	0.6846	0.5671	1.4258
27	0.0142	0.4466	732.6411	0.6096	0.5351	1.1982
27.5	0.0134	0.5015	923.8447	0.5429	0.5050	1.0069
28	0.0126	0.5632	1164.9483	0.4835	0.4766	0.8462
29	0.0113	0.7102	1852.3457	0.3834	0.4244	0.5976
30	0.0100	0.8955	2945.3534	0.3040	0.3779	0.4220
31	0.0089	1.1292	4683.3088	0.2411	0.3366	0.2980
32	0.0080	1.4239	7446.7740	0.1912	0.2997	0.2105
33	0.0071	1.7956	11840.8684	0.1516	0.2669	0.1486
34	0.0063	2.2642	18827.7721	0.1203	0.2377	0.1050
35	0.0056	2.8551	29937.4159	0.0954	0.2117	0.0741
36	0.0050	3.6002	47602.4921	0.0756	0.1885	0.0524
37	0.0045	4.5397	75691.1440	0.0600	0.1679	0.0370
38	0.0040	5.7245	120353.9777	0.0476	0.1495	0.0261
39	0.0035	7.2185	191370.8683	0.0377	0.1331	0.0184
40	0.0031	9.1024	304292.4707	0.0299	0.1185	0.0130
41	0.0028	11.4779	483845.3655	0.0237	0.1056	0.0092
42	0.0025	14.4734	769346.4685	0.0188	0.0940	0.0065
43	0.0022	18.2506	1223312.3036	0.0149	0.0837	0.0046
44	0.0020	23.0137	1945148.3218	0.0118	0.0746	0.0032
45	0.0018	29.0197	3092915.8340	0.0094	0.0664	0.0023
46	0.0016	36.5933	4917942.8886	0.0074	0.0591	0.0016
47	0.0014	46.1433	7819857.8795	0.0059	0.0526	0.0011
48	0.0012	58.1857	12434096.6622	0.0047	0.0469	0.0008
49	0.0011	73.3710	19771044.7155	0.0037	0.0418	0.0006
50	0.0010	92.5192	31437282.4792	0.0029	0.0372	0.0004

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