

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

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

$I$  = Current  
 $C_t$  = Temperature factor  
 $p$  = Surface load W/in<sup>2</sup>

**Common Names:** Manganin 43, Manganin 130

**Uses:** The alloy is used for the manufacture of resistance standards, precision wire wound resistors, potentiometers, shunts and other electrical and electronic components. This Copper-Manganese-Nickel alloy has a very low thermal electromotive force (emf) vs. Copper, which makes it ideal for use in electrical circuits, especially DC, where a spurious thermal emf could cause malfunctioning of electronic equipment. The components in which this alloy is used normally operate at room temperature; therefore, its low temperature coefficient of resistance is controlled over a range of 15 to 35°C.

### Composition

Ni	Cr	Fe	Al	Si	Mn	Cu	C	Ti	Mo	W
4%	None/Trace	None/Trace	None/Trace	None/Trace	11%	Balance	None/Trace	None/Trace	None/Trace	None/Trace

### Technical Data

Resistivity (Ω/cm <sup>2</sup> )	290	Resistivity (Ω/sqmf)	227
Resistivity (μΩ/cm)	43	Nom. Temp. Coeff. of Resistance (TCR)	0.000015
Std. Res. Tol. <.020"	5%	Std. Res. Tol. >.020"	3%
Thermal EMF vs. Cu	<+3.0	Specific Heat (20°C)	0.098 cal/g
Density (g/cm <sup>3</sup> )	8.40	Density (lb/in <sup>3</sup> )	0.286
Thermal Conductivity	0.22 W/cm <sup>2</sup> /°C	Coeff. of Linear Expansion (X 10 <sup>-6</sup> )	18.00 in/in/°C
Approx. Melting Point	1020°C	Max. Continuous Operating Temp.	200°C
UTS – Hard (KPSI)	57	YTS Tensile – Hard (KPSI)	26
UTS – Stress Relieved (KPSI)		YTS Tensile – Stress Relieved (KPSI)	
UTS – Annealed (KPSI)	40	YTS Tensile – Annealed (KPSI)	
Magnetic Attraction	None	Emissivity – fully oxidized	
Designations/Specifications	ASTM = B267	Forms Available	Wire, Ribbon

### 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	0.0017	0.0038	452.3220	15.4432	8936.1185
00	0.3648	0.0022	0.0061	358.7071	13.7525	6310.8431
0	0.3249	0.0027	0.0097	284.4673	12.2470	4456.8278
1	0.2893	0.0035	0.0154	225.5925	10.9062	3147.4897
2	0.2576	0.0044	0.0244	178.9027	9.7123	2222.8123
3	0.2294	0.0055	0.0388	141.8761	8.6490	1569.7889
4	0.2043	0.0069	0.0617	112.5127	7.7022	1108.6124
5	0.1819	0.0088	0.0982	89.2265	6.8590	782.9214
6	0.1620	0.0110	0.1561	70.7597	6.1081	552.9128
7	0.1443	0.0139	0.2482	56.1149	5.4394	390.4767
8	0.1285	0.0176	0.3947	44.5011	4.8439	275.7615
9	0.1144	0.0221	0.6276	35.2909	4.3136	194.7476
10	0.1019	0.0279	0.9980	27.9869	3.8414	137.5341
11	0.0907	0.0352	1.5869	22.1946	3.4209	97.1290
12	0.0808	0.0444	2.5232	17.6011	3.0464	68.5942
13	0.0720	0.0560	4.0121	13.9583	2.7129	48.4424
13.5	0.0679	0.0629	5.0592	12.4302	2.5601	40.7094
14	0.0641	0.0706	6.3795	11.0694	2.4159	34.2109
14.5	0.0605	0.0793	8.0444	9.8576	2.2798	28.7497
15	0.0571	0.0890	10.1438	8.7784	2.1514	24.1603
15.5	0.0539	0.1000	12.7911	7.8174	2.0302	20.3036
16	0.0508	0.1123	16.1293	6.9616	1.9159	17.0624
16.5	0.0480	0.1261	20.3388	6.1995	1.8080	14.3387
17	0.0453	0.1416	25.6467	5.5208	1.7061	12.0498
17.5	0.0427	0.1590	32.3400	4.9164	1.6100	10.1263
18	0.0403	0.1785	40.7800	4.3782	1.5194	8.5098
18.5	0.0380	0.2005	51.4227	3.8989	1.4338	7.1513
19	0.0359	0.2251	64.8429	3.4721	1.3530	6.0098

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
19.5	0.0339	0.2528	81.7656	3.0919	1.2768	5.0504
20	0.0320	0.2839	103.1046	2.7535	1.2049	4.2442
20.5	0.0302	0.3188	130.0127	2.4520	1.1370	3.5667
21	0.0285	0.3580	163.9432	2.1836	1.0730	2.9973
21.5	0.0269	0.4020	206.7289	1.9445	1.0126	2.5189
22	0.0253	0.4514	260.6807	1.7317	0.9555	2.1168
22.5	0.0239	0.5069	328.7128	1.5421	0.9017	1.7789
23	0.0226	0.5692	414.4997	1.3733	0.8509	1.4949
23.5	0.0213	0.6392	522.6753	1.2229	0.8030	1.2563
24	0.0201	0.7178	659.0823	1.0890	0.7578	1.0557
24.5	0.0190	0.8060	831.0886	0.9698	0.7151	0.8872
25	0.0179	0.9051	1047.9849	0.8637	0.6748	0.7456
25.5	0.0169	1.0164	1321.4864	0.7691	0.6368	0.6266
26	0.0159	1.1413	1666.3660	0.6849	0.6009	0.5265
26.5	0.0150	1.2816	2101.2517	0.6099	0.5671	0.4425
27	0.0142	1.4392	2649.6333	0.5432	0.5351	0.3718
27.5	0.0134	1.6161	3341.1306	0.4837	0.5050	0.3125
28	0.0126	1.8148	4213.0940	0.4307	0.4766	0.2626
29	0.0113	2.2884	6699.1010	0.3416	0.4244	0.1855
30	0.0100	2.8856	10652.0183	0.2709	0.3779	0.1310
31	0.0089	3.6387	16937.4210	0.2148	0.3366	0.0925
32	0.0080	4.5883	26931.6314	0.1704	0.2997	0.0653
33	0.0071	5.7857	42823.0938	0.1351	0.2669	0.0461
34	0.0063	7.2957	68091.5812	0.1071	0.2377	0.0326
35	0.0056	9.1997	108270.1650	0.0850	0.2117	0.0230
36	0.0050	11.6006	172156.7985	0.0674	0.1885	0.0162
37	0.0045	14.6281	273740.8156	0.0534	0.1679	0.0115
38	0.0040	18.4457	435266.1920	0.0424	0.1495	0.0081
39	0.0035	23.2596	692102.3359	0.0336	0.1331	0.0057
40	0.0031	29.3299	1100488.9702	0.0267	0.1185	0.0040
41	0.0028	36.9844	1749851.0129	0.0211	0.1056	0.0029
42	0.0025	46.6365	2782380.0604	0.0168	0.0940	0.0020
43	0.0022	58.8076	4424170.2541	0.0133	0.0837	0.0014
44	0.0020	74.1551	7034726.3898	0.0105	0.0746	0.0010
45	0.0018	93.5080	11185685.1200	0.0084	0.0664	0.0007
46	0.0016	117.9116	17785986.9269	0.0066	0.0591	0.0005
47	0.0014	148.6840	28280907.9256	0.0053	0.0526	0.0004
48	0.0012	187.4873	44968533.7329	0.0042	0.0469	0.0003
49	0.0011	236.4175	71502974.0703	0.0033	0.0418	0.0002
50	0.0010	298.1174	113694507.6143	0.0026	0.0372	0.0001

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