

## Resistance Heating Wire Nickel-Chromium Alloy 35% Nickel / 18% Chromium - N4

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

I = Current  
C<sub>t</sub> = Temperature factor  
p = Surface load W/in<sup>2</sup>

**Common Names:** Chromel D, Nikrothal 40, N4, Chromax, HAI-NiCr 40, Tophet D, Resistohm 40, Cronifer III, 35-20 Ni-Cr, Alloy D, Nikrothal 4, MWS-610, Stablohm 610

**Uses:** Typical applications include night-storage heaters, convection heaters, heavy-duty rheostats and fan heaters. It is also used in heating cables and rope heaters in defrosting and de-icing elements, electric blankets and pads, car seats, baseboard heaters, floor heaters, resistors, etc. This Nickel-Chrome-Iron alloy has been widely used for furnace elements in the critical temperature range between 816° and 982°C in atmospheres where preferential oxidation of chromium takes place - the "Green Rot" range. N4 is also widely used as electric heating element material in domestic appliances and other electric heating equipment at operating temperatures up to 1100°C. It has good ductility after use, good corrosion resistance except in sulfur containing atmospheres and certain controlled atmospheres and excellent weldability.

### Composition

Ni	Cr	Fe	Al	Si	Mn	Cu	C	Ti	Mo	W
35%	20%	Balance	None/Trace	None/Trace	None/Trace	None/Trace	None/Trace	None/Trace	None/Trace	None/Trace

### Technical Data

Resistivity (Ω/cm <sup>2</sup> )	610	Resistivity (Ω/sqmf)	479
Resistivity (μΩ/cm)	101.41	Nom. Temp. Coeff. of Resistance (TCR)	0.00040
Std. Res. Tol. <.020"	3%	Std. Res. Tol. >.020"	5%
Thermal EMF vs. Cu		Specific Heat (20°C)	0.11 cal/g
Density (g/cm <sup>3</sup> )	7.94	Density (lb/in <sup>3</sup> )	0.287
Thermal Conductivity	0.13 W/cm/°C	Coeff. of Linear Expansion (X 10 <sup>-6</sup> )	15.60 in/in/°C
Approx. Melting Point	1390°C	Max. Continuous Operating Temp.	1100°C
UTS – Hard (KPSI)	175	YTS Tensile – Hard (KPSI)	
UTS – Stress Relieved (KPSI)	140	YTS Tensile – Stress Relieved (KPSI)	
UTS – Annealed (KPSI)	90	YTS Tensile – Annealed (KPSI)	
Magnetic Attraction	Faint	Emissivity – fully oxidized	0.88
Designations/Specifications	ASTM = B344	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	932	1112	1292	1472	1652	1832	2012
N4 C <sub>t</sub>	1.00	1.03	1.06	1.10	1.12	1.15	1.17	1.19	1.21	1.22	1.23	1.24

### 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	0.0036	0.0080	453.9035	15.4432	4248.3186
00	0.3648	0.0046	0.0127	359.9613	13.7525	3000.2369
0	0.3249	0.0058	0.0202	285.4619	12.2470	2118.8198
1	0.2893	0.0073	0.0322	226.3813	10.9062	1496.3476
2	0.2576	0.0092	0.0512	179.5283	9.7123	1056.7468
3	0.2294	0.0116	0.0814	142.3722	8.6490	746.2931
4	0.2043	0.0146	0.1294	112.9061	7.7022	527.0452
5	0.1819	0.0184	0.2058	89.5385	6.8590	372.2085
6	0.1620	0.0232	0.3272	71.0071	6.1081	262.8602
7	0.1443	0.0293	0.5203	56.3111	5.4394	185.6365
8	0.1285	0.0369	0.8274	44.6567	4.8439	131.0997
9	0.1144	0.0466	1.3156	35.4143	4.3136	92.5849
10	0.1019	0.0588	2.0919	28.0848	3.8414	65.3851
11	0.0907	0.0741	3.3263	22.2722	3.4209	46.1761
12	0.0808	0.0934	5.2890	17.6627	3.0464	32.6104
13	0.0720	0.1178	8.4098	14.0071	2.7129	23.0300
13.5	0.0679	0.1323	10.6046	12.4737	2.5601	19.3537

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
14	0.0641	0.1485	13.3722	11.1081	2.4159	16.2642
14.5	0.0605	0.1668	16.8620	9.8921	2.2798	13.6679
15	0.0571	0.1873	21.2626	8.8091	2.1514	11.4861
15.5	0.0539	0.2103	26.8117	7.8447	2.0302	9.6525
16	0.0508	0.2362	33.8090	6.9859	1.9159	8.1117
16.5	0.0480	0.2652	42.6324	6.2212	1.8080	6.8168
17	0.0453	0.2978	53.7586	5.5401	1.7061	5.7286
17.5	0.0427	0.3344	67.7884	4.9336	1.6100	4.8141
18	0.0403	0.3756	85.4798	4.3935	1.5194	4.0456
18.5	0.0380	0.4217	107.7881	3.9125	1.4338	3.3998
19	0.0359	0.4736	135.9185	3.4842	1.3530	2.8571
19.5	0.0339	0.5318	171.3904	3.1028	1.2768	2.4010
20	0.0320	0.5972	216.1196	2.7631	1.2049	2.0177
20.5	0.0302	0.6706	272.5221	2.4606	1.1370	1.6956
21	0.0285	0.7530	343.6446	2.1912	1.0730	1.4250
21.5	0.0269	0.8456	433.3284	1.9513	1.0126	1.1975
22	0.0253	0.9495	546.4178	1.7377	0.9555	1.0063
22.5	0.0239	1.0662	689.0211	1.5475	0.9017	0.8457
23	0.0226	1.1973	868.8408	1.3781	0.8509	0.7107
23.5	0.0213	1.3445	1095.5896	1.2272	0.8030	0.5972
24	0.0201	1.5098	1381.5150	1.0929	0.7578	0.5019
24.5	0.0190	1.6954	1742.0607	0.9732	0.7151	0.4218
25	0.0179	1.9038	2196.7012	0.8667	0.6748	0.3545
25.5	0.0169	2.1379	2769.9930	0.7718	0.6368	0.2979
26	0.0159	2.4007	3492.9017	0.6873	0.6009	0.2503
26.5	0.0150	2.6958	4404.4740	0.6121	0.5671	0.2104
27	0.0142	3.0272	5553.9471	0.5451	0.5351	0.1768
27.5	0.0134	3.3994	7003.4080	0.4854	0.5050	0.1486
28	0.0126	3.8172	8831.1471	0.4322	0.4766	0.1248
29	0.0113	4.8135	14042.1141	0.3428	0.4244	0.0882
30	0.0100	6.0697	22327.8999	0.2718	0.3779	0.0623
31	0.0089	7.6537	35502.8531	0.2156	0.3366	0.0440
32	0.0080	9.6512	56451.9093	0.1710	0.2997	0.0311
33	0.0071	12.1699	89762.3086	0.1356	0.2669	0.0219
34	0.0063	15.3460	142728.0699	0.1075	0.2377	0.0155
35	0.0056	19.3510	226947.1703	0.0853	0.2117	0.0109
36	0.0050	24.4012	360861.1686	0.0676	0.1885	0.0077
37	0.0045	30.7694	573793.3760	0.0536	0.1679	0.0055
38	0.0040	38.7996	912369.8168	0.0425	0.1495	0.0039
39	0.0035	48.9254	1450728.9863	0.0337	0.1331	0.0027
40	0.0031	61.6939	2306756.0464	0.0267	0.1185	0.0019
41	0.0028	77.7947	3667896.2840	0.0212	0.1056	0.0014
42	0.0025	98.0974	5832200.2323	0.0168	0.0940	0.0010
43	0.0022	123.6988	9273588.1597	0.0133	0.0837	0.0007
44	0.0020	155.9815	14745624.9666	0.0106	0.0746	0.0005
45	0.0018	196.6893	23446529.2086	0.0084	0.0664	0.0003
46	0.0016	248.0210	37281548.4713	0.0067	0.0591	0.0002
47	0.0014	312.7491	59280153.7510	0.0053	0.0526	0.0002
48	0.0012	394.3699	94259406.4044	0.0042	0.0469	0.0001
49	0.0011	497.2920	149878755.9331	0.0033	0.0418	0.0001
50	0.0010	627.0745	238317238.9571	0.0026	0.0372	0.0001

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