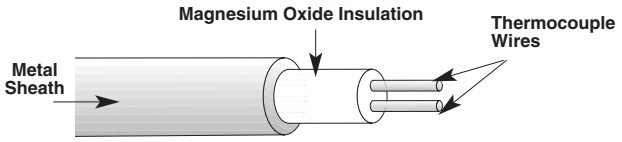
Reference Guide



Temperature Range

OMEGACLAD® is a three-part system composed of compacted MgO insulation, thermocouple wire, and metal sheath. Four factors determine the useful service temperature for OMEGACLAD® assemblies:

- **Properties of the sheath material**
- **Diameter and construction of thermocouple assembly**
- **Range for the thermocouple wire (see table of error)**
- **Maximum service temperature of insulation. In the case of MgO, this is in excess of 1650°C (3000°F).**

Sheath Material Specifications

Material	Melting Point (°C/°F)	Continuous Maximum Temp. (°C/°F)	Tensile (PSI) Strength @ 93°C (200°F)	Tensile (PSI) Strength @ 537°C (1000°F)
304 SS	1405/2560	900/1650	68,000	15,000
310 SS	1405/2560	1150/2100	75,000	27,500
316 SS	1370/2500	925/1700	75,000	23,000
321 SS	1400/2550	870/1600	70,000	17,000
Hastelloy X	1260/2300	1200/2200	55,100	35,500
Inconel*	1400/2550	1150/2100	39,000	5,000
SUPER XL	1400/2550	1204/2200	70,000	17,000

**Oxidizing, Vacuum or Inert atmosphere only*

Upper Temperature Limit in °C (°F) of Protected Bare Wire Thermocouples Vs. Wire Diameter

T/C Type	Wire Size 8 AWG 0.128"	14 AWG 0.064"	20 AWG 0.032"	24 AWG 0.020"	28 AWG 0.013"	30 AWG 0.010"	36 AWG 0.005"
J	760 (1400)	590 (1100)	480 (900)	370 (700)	370 (700)	320 (600)	315 (590)
K	1260 (2300)	1090 (2000)	980 (1800)	870 (1600)	870 (1600)	760 (1400)	590 (1100)
E	870 (1600)	650 (1200)	540 (1000)	430 (800)	430 (800)	370 (700)	320 (600)
T	370 (700)	370 (700)	260 (500)	200 (400)	200 (400)	150 (300)	
RX/SX	200 (400)	200 (400)	200 (400)	200 (400)	200 (400)	150 (300)	
N	1260 (2300)	1090 (2000)	980 (1800)	980 (1800)	980 (1800)	870 (1600)	
CX	472 (800)	472 (800)	472 (800)	472 (800)	472 (800)	400 (752)	

Common Thermocouple Junctions

Earthed

Exposed

Unearthed

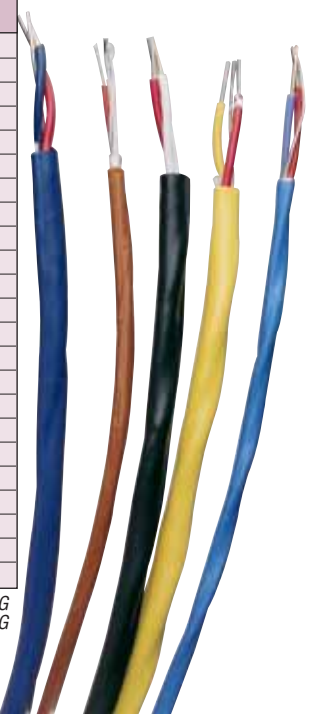
Conductor Size Equivalents

GAUGE No.	AWG inches	AWG mm	SWG inches	SWG mm	GAUGE No.	AWG inches	AWG mm	SWG inches	SWG mm
0	0.3249	8.25	0.324	8.23	23	0.0226	0.574	0.024	0.610
1	0.2893	7.35	0.300	7.62	24	0.0201	0.511	0.022	0.559
2	0.2576	6.54	0.276	7.01	25	0.0179	0.455	0.020	0.508
3	0.2294	5.83	0.252	6.40	26	0.0159	0.404	0.0180	0.457
4	0.2043	5.19	0.232	5.89	27	0.0142	0.361	0.0164	0.417
5	0.1819	4.62	0.212	5.38	28	0.0126	0.320	0.0148	0.376
6	0.1620	4.11	0.192	4.88	29	0.0113	0.287	0.0136	0.345
7	0.1443	3.67	0.176	4.47	30	0.0100	0.254	0.0124	0.315
8	0.1285	3.26	0.160	4.06	31	0.0089	0.226	0.0116	0.295
9	0.1144	2.91	0.144	3.66	32	0.0080	0.203	0.0108	0.274
10	0.1019	2.59	0.128	3.25	33	0.0071	0.180	0.0100	0.254
11	0.0907	2.30	0.116	2.95	34	0.0063	0.160	0.0092	0.234
12	0.0808	2.05	0.104	2.64	35	0.0056	0.142	0.0084	0.213
13	0.0720	1.83	0.092	2.34	36	0.0050	0.127	0.0076	0.193
14	0.0641	1.63	0.080	2.03	37	0.0045	0.114	0.0068	0.173
15	0.0571	1.45	0.072	1.83	38	0.0040	0.102	0.0060	0.152
16	0.0508	1.29	0.064	1.63	39	0.0035	0.089	0.0052	0.132
17	0.0453	1.15	0.056	1.42	40	0.0031	0.079	0.0048	0.122
18	0.0403	1.02	0.048	1.22	41	0.0028	0.071	0.0044	0.112
19	0.0359	0.912	0.040	1.02	42	0.0025	0.064	0.0040	0.102
20	0.0320	0.813	0.036	0.914	43	0.0022	0.056	0.0036	0.091
21	0.0285	0.724	0.032	0.813	44	0.0020	0.051	0.0032	0.081
22	0.0253	0.643	0.028	0.711	45	0.0018	0.046	0.0028	0.071

AWG = American Wire Gauge
SWG = (British) Standard Wire Gauge

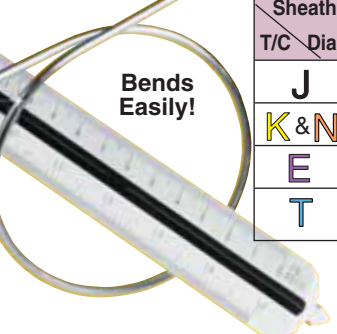
To convert from AWG to SWG: Determine wire diameter in inches (mm) from appropriate AWG To convert 30 AWG to SWG, determine that 30 AWG is 0.0100", which is equivalent to 33 SWG

Twisted Shielded Wire



Upper Temperature Limit in °C (°F) of OMEGACLAD® vs. Sheath Diameter

Sheath / T/C Dia.	0.020" 0.5 mm	0.032" 0.8 mm	0.040" 1.0 mm	0.062" 1.6 mm	0.093" 2.4 mm	0.125" 3.2 mm	0.188" 4.8 mm	0.250" 6.3 mm
J	260 (500)	260 (500)	260 (500)	440 (825)	480 (900)	520 (970)	620 (1150)	720 (1300)
K & N	700 (1290)	700 (1290)	700 (1290)	920 (1690)	1000 (1830)	1070 (1960)	1150 (2100)	1150 (2100)
E	300 (570)	300 (570)	300 (570)	510 (950)	580 (1075)	650 (1200)	730 (1350)	820 (1510)
T	260 (500)	260 (500)	260 (500)	260 (500)	260 (500)	315 (600)	370 (700)	370 (700)



Properties of Teflon® Insulation

General Properties of Neoflon and Teflon®

	Neoflon/Teflon® FEP	Neoflon/Teflon® PFA
Chemical resistance: hydrocarbons, ethylene glycol, battery acid, brake fluids, other chemicals	NO EFFECT	NO EFFECT
Resistance to weathering	NO EFFECT	NO EFFECT
Water absorption (ASTM D570)	0.1%	0.1%
Flammability (UL 83, Vertical Wire Flame Test)*	NO AFTER BURN	NO AFTER BURN
Melting point °F	518°F	590°F
Melting point °C	270°C	300°C
Upper service temperature °C (°F) 1500 to 2000 hrs. estimated 20,000 hrs. Cold bend @ -65°C 2.5 K V for 5 min.	 200°C (392°F) 177°C (350°F) PASS	 288°C (550°F) 260°C (500°F) PASS
Specific gravity	2.15	2.15

The combination of chemical and physical properties of Teflon®/Neoflon is a result of its true fluorocarbon structure. This unusual structure creates a material that has an almost universal chemical inertness; complete insolubility in all known solvents below 300°C (572°F); excellent thermal stability; and unsurpassed electrical properties including low dielectric loss, low dielectric constant, and high dielectric strength. Furthermore, Teflon®/Neoflon does not embrittle at very low temperatures.

NOW AVAILABLE IN PRE-SPOOLED LENGTHS!

Mechanical and Electrical Properties

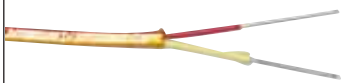
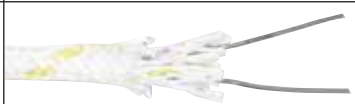
	Neoflon/Teflon® FEP	Neoflon/Teflon® PFA
Tensile strength, psi 23°C (73°F) ASTM D638	3000	4000
Elongation, % 23°C (73°F) ASTM D638	300	300
Flexural modulus, psi 23°C (73°F) ASTM D790	95,000	95,000
Flex life, MIT (7 to 9 mils) 82°C (180°F) flexes	100,000	200,000
Impact strength, ft.lb/in.: ASTM D256 Room temperature	NO BREAK	NO BREAK
-54°C (-65°F)	10	10
Coefficient of friction, 10 fpm, 100 psi	0.3	0.2
Dynamic cut-through (lb) Instron 1/16" radius blade moving at 0.2"/min. (0.0031" insulation thickness) 23°C	118	
75°C	73	
Dielectric constant, ASTM D50	2.1	2.1
Volume resistivity, Ω-cm ASTM D257	10^{18}	10^{18}
Dissipation factor, ASTM D150, 10^2 - 10^6 Hz	0.001	0.0004

Resistance vs. Wire Diameter *[Resistance in Ω per double foot @ 20°C (68°F)]*

AWG No.	Diameter inches	Diameter mm	Type K †† CHROMEGA®/ ALOMEGA®	Type J Iron/ Constantan	Type T Copper/ Constantan	Type E CHROMEGA®/ Constantan	Type S Pt/ Pt10%Rh	Type R Pt/ Pt13%Rh	Type RX/SX Copper Alloy11**	Type C† W5%Re/ W26%Re	Type CX Alloy 405/ Alloy 426	Type G† W/ W26%Re	Type D† W3%Re/ W25%Re	Type BX Copper/ Copper*
6	0.162	4.11	0.023	0.014	0.012	0.027	0.007	0.007	0.003	0.009	0.014	0.008	0.009	0.000790
8	0.128	3.25	0.037	0.022	0.019	0.044	0.011	0.011	0.004	0.015	0.023	0.012	0.015	0.001256
10	0.102	2.59	0.058	0.034	0.029	0.069	0.018	0.018	0.007	0.023	0.037	0.020	0.022	0.001998
12	0.081	2.06	0.091	0.054	0.046	0.109	0.028	0.029	0.011	0.037	0.058	0.031	0.035	0.00318
14	0.064	1.63	0.146	0.087	0.074	0.175	0.045	0.047	0.018	0.058	0.093	0.049	0.055	0.00505
16	0.051	1.30	0.230	0.137	0.117	0.276	0.071	0.073	0.028	0.092	0.146	0.078	0.088	0.00803
18	0.040	1.02	0.374	0.222	0.190	0.448	0.116	0.119	0.045	0.148	0.238	0.126	0.138	0.01277
20	0.032	0.81	0.586	0.357	0.298	0.707	0.185	0.190	0.071	0.235	0.371	0.200	0.220	0.02030
24	0.0201	0.51	1.490	0.878	0.7526	1.78	0.464	0.478	0.180	0.594	0.941	0.560	0.560	0.05134
26	0.0159	0.40	2.381	1.405	1.204	2.836	0.740	0.760	0.288	0.945	1.503	0.803	0.890	0.08162
30	0.0100	0.25	5.984	3.551	3.043	7.169	1.85	1.91	0.727	2.38	3.800	2.03	2.26	0.2064
32	0.0080	0.20	9.524	5.599	4.758	11.31	1.96	3.04	1.136	3.8	5.94	3.22	3.60	0.3282
34	0.0063	0.16	15.17	8.946	7.66	18.09	4.66	4.82	1.832	6.04	9.57	5.10	5.70	0.5218
36	0.0050	0.13	24.08	14.20	12.17	28.76	7.40	7.64	2.908	9.6	15.20	8.16	9.10	0.8296
38	0.0039	0.10	38.20	23.35	19.99	45.41	11.6	11.95	4.780	15.3	24.98	12.9	15.3	1.3192
40	0.00315	0.08	60.88	37.01	31.64	73.57	18.6	19.3	7.327	24.4	38.30	20.6	23.0	2.098
44	0.0020	0.051	149.6	88.78	76.09	179.20	74.0	76.5	18.18	60.2	95.00	51.1	56.9	5.134
50	0.0010	0.025	598.4	355.1	304.3	716.9	185	191	72.7	240	380.0	204	227	20.64
56	0.00049	0.012	2408	1420	1217	2816	740	764	302.8	1000	1583	850	945	86.38

** Increase the resistance by 19% for nickel-plated, type RTD wire*
† Not ANSI symbol
*** Maximum resistance of reviewed wire*
†† Resistivity for N is 1.324 times Type K values

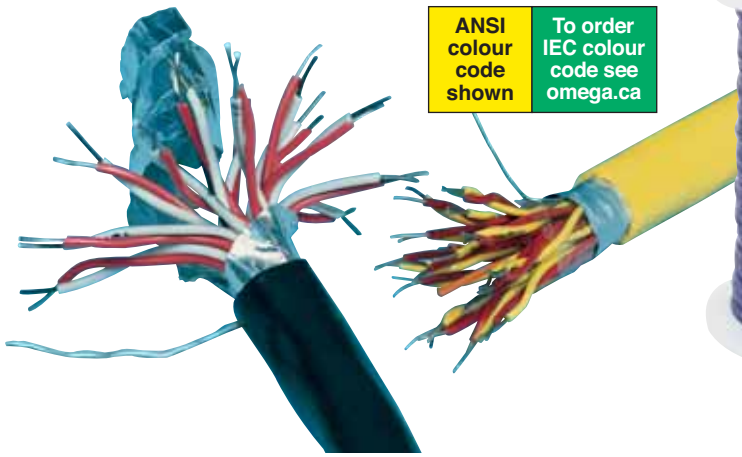
Wire Insulation Identification

Insulation Code	Insulation		Appearance of Thermocouple Grade Wire	Temperature Range, Insulation	Abrasion Resistance	Flexibility	Water Submersion
	Overall	Conductors					
PP (Extension Grade-EXPP)	Polyvinyl Chloride (PVC)	Polyvinyl Chloride (PVC)		-40 to 105°C -40 to 221°F	Good	Excellent	Good
FF (Extension Grade-EXFF)	FEP Teflon® or Neoflon	FEP Teflon® or Neoflon		-200 to 200°C -338 to 392°F	Excellent	Good	Excellent
TT (Extension Grade-EXTT)	PFA Teflon® or Neoflon	PFA Teflon® or Neoflon		-267 to 260°C -450 to 500°F	Excellent	Good	Excellent
KK	Kapton	Kapton		-267 to 316°C -450 to 600°F	Excellent	Good	Good
TG	Glass Braid	PFA Teflon® or Neoflon		-73 to 260°C -100 to 500°F	Good	Good	Excellent
GG (Extension Grade-EXGG)	Glass Braid	Glass Braid		-73 to 482°C -100 to 900°F	Poor	Good	Poor
HH	High-Temp Glass Braid	High-Temp Glass Braid		-73 to 871°C -100 to 1300°F	Poor	Good	Poor
XR	Refrasil Braid	Refrasil Braid		-73 to 871°C -100 to 1600°F	Poor	Good to 315°C (600°F)	Poor to 315°C (600°F)
XC Standard Braid XL-Loose Braid XT-Tight Braid	Nextel Braid	Nextel Braid		-73 to 1204°C -100 to 2200°F	Poor	Good	Poor
XS	Silica	Silica		-73 to 1038°C -100 to 1990°F	Poor	Good	Poor
TFE	TFE Teflon®	TFE Teflon®		-267 to 260°C -450 to 500°F	Excellent	Good	Excellent

ANSI colour code shown | **To order IEC colour code see omega.ca**

and Application Guide

Resistance To:					Comments
Solvent	Acid	Base	Flame	Humidity	
Fair	Good	Good	Good	Good	Colour-Coded PVC Extruded Over Each Bare Wire. PVC Applied Over Insulated Primaries. Affected by Ketones, Esters.
Excellent	Excellent	Excellent	Excellent	Excellent	Colour-Coded PVC Extruded Over Each Bare Wire. PVC Applied Over Insulated Primaries. Affected by Ketones, Esters.
Excellent	Excellent	Excellent	Excellent	Excellent	Colour-Coded PFA Extruded Over Each Bare Wire. PFA Jacket Extruded Over Insulated Primaries. Superior Abrasion and Moisture Resistance. Same Basic Characteristics as FEP but Higher Temperature Rating.
Good	Good	Good	Good	Excellent	Fused Kapton Tape Approx. 0.15 mm Applied to Conductors. A 0.10 mm Jacket Is Then Applied to Both. Excellent Moisture and Abrasion Resistance, High Dielectric Strength (7 kV/mil). Retains Much Physical Integrity After Gamma Radiation. FEP Is Used as Adhesive Binding Agent [Melts at Approx. 260°C (500°F)].
Excellent	Excellent	Excellent	Excellent	Excellent	PFA Extruded Over Each Bare Wire and a Glass Braid on the Jacket. May Be Used for Single Measurement to 343°C (650°F).
Excellent	Excellent	Excellent	Excellent	Fair	0.12 mm Glass Braid Over Each Conductor, and Binder Impregnated. Overall Glass Braid Applied and Bindered. Binder Improves Moisture and Abrasion Resistance but is Destroyed Above 204°C (400°F).
Excellent	Excellent	Excellent	Excellent	Fair	High-Temp. Glass Braid Over Each Conductor, and Binder Impregnated. Overall High-Temp Glass Braid Applied and Bindered. Binder Improves Moisture and Abrasion Resistance but is Destroyed Above 400°F.
Excellent	Good to 315°C (600°F)	Good to 315°C (600°F)	Excellent	Poor	Braid of Vitreous Silica Fiber Applied to Each Bare Wire, Then Over Both. Suitable to 982°C (1800°F) if Not Subjected to Flexure or Abrasion.
Excellent	Good	Good	Excellent	Fair	High-Temp, Alumina-Boria-Silica Ceramic Fiber Braided Over Each Conductor Then Over Both. Not Recommended for Platinum Thermocouples or Exposure to Molten Tin and Copper, Hydrofluoric or Phosphoric Acids, or Strong Alkalies.
Excellent	Good	Poor	Excellent	Fair	Silica is a Very High Purity, Chemically Stable Yarn (SiO2 Content 99%).
Excellent	Excellent	Excellent	Excellent	Excellent	Colour-Coded TFE Tape Applied to Conductors and Jacket. Superior Abrasion, Moisture, and Chemical Resistance.



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