

NOTICE:

Prices and availability are subject to change without notice.

Please contact Marlin Manufacturing before ordering for updated pricing.

THERMOCOUPLE WIRE GENERAL

Accuracy of Marlin Wire

Marlin insulated and bare thermocouple wire is matched to meet standard initial calibration tolerances for temperatures above 0°C as given in ANSI MC96.1 and shown in the table below without regard for wire size (see page E-0 for wire size upper temperature limits).

Wire conforming to special initial calibration tolerances, wire for use at sub-zero temperatures, and wire with certified traceable calibration is available on request. Designate special limit grade wire using a double ANSI symbol (e.g. KK,JJ). Sub-zero and calibration requirements should be spelled out on the Purchase Order.

INITIAL CALIBRATION TOLERANCES FOR THERMOCOUPLE WIRE							
THERMOCOUPLE TYPE		°C.			°F.		
WIRE ALLOYS	ANSI TYPE SYMBOL	TEMPERATURE RANGE	STANDARD LIMITS	SPECIAL LIMITS	TEMPERATURE RANGE	STANDARD LIMITS	SPECIAL LIMITS
Copper (+) vs. Constantan (-)	T	-200° to -65° -65° to +130° +130° to +350°	±1.5% ±1° ±0.75%	±0.8% ±0.5% ±0.4%	-330° to -85° -85° to +270° +270° to +660°	±1.5% ±1.8% ±0.75%	±0.8% ±0.9% ±0.4%
*Iron (+) vs. Constantan (-)	J	0° to +285° +285° to +750°	±2.2° ±0.75%	±1.1° ±0.4%	+32° to +545° +545° to +1400°	±4° ±0.75%	±2° ±0.4%
Chromel™ (+) vs. Constantan (-)	E	-200° to -170° -170° to +250° +250° to +340° +340° to +900°	±1% ±1.7° ±1.7° ±0.5%	±1° ±1° ±0.4% ±0.4%	-330° to -270° -270° to +480° +480° to +640° +640° to +1600°	±1% ±3° ±3° ±0.5%	±1.8° ±1.8° ±0.4% ±0.4%
Chromel™ (+) vs. *Alumel™ (-)	K	-200° to -110° -110° to 0° 0° to +285° +285° to +1250°	±2% ±2.2° ±2.2° ±0.75%	±1.1° ±0.4%	-330° to -165° -165° to +32° +32° to +545° +545° to +2300°	±2% ±4° ±4° ±0.75%	±2° ±0.4% ±0.4%
Nicrosil (+) vs. Nilil (-)	N	0° to +285° +285° to +1250°	±2.2° ±0.75%	±1.1° ±0.4%	+32° to +545° +545° to 2300°	±4° ±0.75%	±2° ±0.4%
Platinum -10% Rhodium (+) vs. Platinum (-)	S	0° to +600° +600° to +1450°	±1.5° ±0.25%	±0.6° ±0.1%	+32° to +1110° +1110° to 2650°	±2.7° ±0.25%	±1.1° ±0.1%
Platinum -13% Rhodium (+) vs. Platinum (-)	R	0° to +600° +600° to +1450°	±1.5° ±0.25%	±0.6° ±0.1%	+32° to +1110° +1110° to +2650°	±2.7° ±0.25%	±1.1° ±0.1%
Platinum -30% Rhodium (+) vs. Platinum -6% Rhodium (-)	B	+870° to +1700°	±0.5%	±0.25%	+1600° to +3100°	±0.5%	±0.25%
Tungsten -5% Rhenium (+) vs. Tungsten -26% Rhenium (-)	C†	+400° to +2300°	±1%		+800° to +4200°	±1%	

*Magnetic

™TradeMark, Hoskins Mfg. Co.

†NOT ANSI Type Symbol

NOTE — Per cent limits apply directly to temperatures in °C units, but for °F equivalents are applied to the number of °F above or below the ice point (+32°F.).

[i.e., Limit (°F) = (Temp. °F - 32°F) × Percentage]

Thermocouple Extension Wire

Thermocouple extension wire has approximately the same thermoelectric characteristic as thermocouple wire but its accuracy is guaranteed over a more limited range of temperatures. Thermocouple extension wire can offer advantages in cost or mechanical properties when used for connections between thermocouples and instruments. For base metal types of thermocouples, extension wire is of substantially the same composition as the corresponding thermocouple type. For noble metal types, however, an entirely different alloy is formulated to match the noble metal characteristics over a specified temperature range. This is necessary due to the high cost of the noble metals which could otherwise be necessary for the interconnection. The "X" in the ANSI code denotes extension grade wire.

INITIAL CALIBRATION TOLERANCES FOR THERMOCOUPLE EXTENSION WIRE							
THERMOCOUPLE TYPE		°C.			°F.		
EXTENSION WIRE ALLOY	ANSI TYPE SYMBOL	TEMPERATURE RANGE	STANDARD LIMITS	SPECIAL LIMITS	TEMPERATURE RANGE	STANDARD LIMITS	SPECIAL LIMITS
Copper vs. Constantan	TX	-60° to +100°	±1°	±5°	-75° to +210°	±2°	±1°
*Iron vs. Constantan	JX	0° to +200°	±2.2°	±1.1°	+32° to +400°	±4°	±2°
Chromel™ vs. Constantan	EX	0° to +200°	±1.7°	±1.1°	+32° to +400°	±3°	±2°
Chromel™ vs. *Alumel™	KX	0° to +200°	±2.2°	±1.1°	+32° to +400°	±4°	±2°
Nicrosil vs. Nilil	NX	0° to +200°	±2.2°	±1.1°	+32° to +400°	±4°	±2°
Copper vs. Copper Alloy	SX RX	+25° to +200°	±7°		+75° to +400°	±12°	
PCLW630 vs. Copper	BX	0° to +200°	±2.2°		+32° to +400°	±4°	
Copper vs. Copper	BX	0° to 65°	±1°		+32° to +150°	±2°	
Alloy 405 vs Alloy 426	CX†	0° to 870°	±7°		+32° to +1600°	±12°	

*Magnetic

™Trade Mark Hoskins Mfg. Co.

†NOT ANSI Symbol



Calibration Type Characteristics

Type T (COPPER vs CONSTANTAN) is used for service in oxidizing, inert or reducing atmospheres or in vacuum. It is highly resistant to corrosion from atmospheric moisture and condensation and exhibits high stability at low temperatures; it is the only type with limits of error guaranteed for cryogenic temperatures.

Type J (IRON vs CONSTANTAN) is used protected or unprotected in vacuum, oxidizing, inert or reducing atmospheres. Iron element oxidizes rapidly at temperatures exceeding 1000°F, and therefore heavier gauge wire is recommended for longer life at these temperatures.

Type E (CHROMEL vs CONSTANTAN) May be used protected or unprotected in oxidizing, inert or dry reducing atmospheres, or for short periods of time under vacuum. Must be protected from sulfurous and marginally oxidizing atmospheres. Produces the highest EMF per degree of any standardized thermocouple.

Type K (CHROMEL™ vs ALUMEL™) is used protected or exposed in oxidizing, inert or dry reducing atmospheres. Exposure to vacuum limited to short time periods. Must be protected from sulfurous and marginally oxidizing atmospheres. Reliable and accurate at high temperatures.

*Hoskins Mfg. Co.

Type N (NICROSIL vs NISIL) is used protected or exposed in oxidizing, inert or dry reducing atmospheres. Must be protected from sulfurous atmospheres. Very reliable and accurate at high temperatures.

Type S (PLATINUM - 10%, RHODIUM vs PLATINUM)

Type R (PLATINUM - 13%, RHODIUM vs PLATINUM)

Type B (PLATINUM-30% RHODIUM vs PLATINUM-6% RHODIUM)

Platinum alloy thermocouples are all recommended for use in inert or oxidizing atmospheres, or for short periods of time in a vacuum. Easily contaminated, these elements must be protected from the effects of reducing atmospheres and contaminating vapors. Alumina protecting tubes are recommended for directly containing platinum element.

Type Ct (TUNGSTEN 5% RHENIUM vs TUNGSTEN 26% RHENIUM)

Tungsten Alloy thermocouples are recommended for use in vacuum, high purity hydrogen, or high purity inert atmospheres. Very poor oxidation resistance.

† — Not ANSI symbols

Thermocouple Insulation provides electrical insulation for thermocouple and thermocouple extension wire. If the insulation breaks down for any reason, the indicated temperature may be in error. When selecting insulation moisture, abrasion, flexing, chemical attack, temperature extremes and any other adverse environmental considerations must be evaluated. Insulations are rated for a maximum continuous use temperature and also a maximum single exposure temperature because after excessive temperatures have been encountered the insulation may become conductive or conductive residues may form even though the insulation remains physically intact. Also do not assume the temperature rating as the temperature at the sensing junction of the thermocouple without evaluating the thermocouple system.

Fibrous Insulation is either braided or wrapped on the conductors. In general, fibrous insulations are used for applications where extreme moisture and abrasion resistance requirements are not prevalent. Available at moderate cost for upper utilization temperatures of 900°F (482°C) for fiberglass, 1600°F (780°C) for high temperature silica fiber, and 2400°F (1315°C) for ceramic fiber.

Plastic Insulation is used on comparatively lower temperature applications and provides good moisture and abrasion resistance. Available at low to moderate cost with typical upper utilization temperatures of 220°F (104°C) for PVC and 500°F (260°C) for teflon and silicone rubber.

Wiring Electronic Instruments to conform to national and local codes does not address the "noise" problems of electronic instruments. Shielding of thermocouple and thermocouple extension wire may be necessary but not the only requirement of reducing noise. Ever since the introduction of electronics into instruments, noise generated by external relays, switches, motors, phase fired thyristors, etc. have caused problems that interfere with the instrument's operation. Now that microprocessors are being increasingly incorporated into many more varied instruments, external sources that generate noise pulses that, in some cases, may render the instrument completely inoperative, have become crucial to instrument applications. While much can be done within the instrument to reduce its sensitivity to external noise, the solution in many cases can only be resolved by suppressing the noise generation at its source.



THERMOCOUPLE WIRE GENERAL

ANSI COLOR CODE FOR THERMOCOUPLE AND THERMOCOUPLE EXTENSION WIRE

ANSI TYPE	WIRE ALLOYS	POLARITY	THERMOCOUPLE WIRE COLOR		ANSI TYPE	T/C EXTENSION WIRE COLOR	
			INDIVIDUAL	OVERALL		INDIVIDUAL	OVERALL
T	COPPER CONSTANTAN	+TP -TN	BLUE RED	BROWN	TX	BLUE RED	BLUE
J	IRON CONSTANTAN	+JP -JN	WHITE RED	BROWN	JX	WHITE RED	BLACK
E	CHROMEL™ CONSTANTAN	+EP -EN	PURPLE RED	BROWN	EX	PURPLE RED	PURPLE
K	CHROMEL™ ALUMEL™	+KP -KN	YELLOW RED	BROWN	KX	YELLOW RED	YELLOW
N	NICROSIL NISIL	+NP -NN	ORANGE RED	BROWN	NX	ORANGE RED	ORANGE
R	PLATINUM 13% RHODIUM PLATINUM	+RP -RN			RX	BLACK RED	GREEN
S	PLATINUM 10% RHODIUM PLATINUM	+SP -SN			SX	BLACK RED	GREEN
B	PLATINUM 30% RHODIUM PLATINUM 6% RHODIUM	+BP -BN			BX	GREY RED	GREY

NOMINAL THERMOCOUPLE RESISTANCE Ohms per Double Foot @ 68°F (20°C)

Wire Ga B & S	Wire Size DIA.	ANSI TYPES						
		J	K	T	E	S	R	B
6	.162	.014	.023	.012	.027	.007	.007	.008
7	.144	.021						
8	.128	.022	.036	.019	.044	.010	.010	.013
14	.064	.089	.147	.074	.176	.044	.044	.054
16	.050	.141	.232	.117	.277	.069	.069	.086
18	.040	.229	.377	.190	.450	.112	.113	.139
20	.032	.357	.588	.297	.702	.175	.178	.218
24	.020	.905	1.488	.745	1.778	.449	.453	.550
26	.015	1.441	2.45	1.20	2.84	.701	.708	.875
28	.012	2.297	3.59	1.92	4.33	1.062	1.073	1.392
30	.010	3.65	6.02	2.94	7.19	1.794	1.813	2.213
36	.005	14.66	24.08	12.22	28.80	7.150	7.226	8.897

*Double feet 7 Ga Type J=7 Ga Iron/8 Ga Constantan

American Wire Gauge (AWG)	Size DIA. Inches
7/0	—
6/0	0.5800
5/0	0.5165
4/0	0.4600
3/0	0.4096
2/0	0.3648
1/0	0.3249
1	0.2893
2	0.2576
3	0.2294
4	0.2043
5	0.1819
6	0.1620
7	0.1443
8	0.1285
9	0.1144
10	0.1019
11	0.0907
12	0.0808
13	0.0720
14	0.0641
15	0.0571
16	0.0508
17	0.0453
18	0.0403
19	0.0359
20	0.0320
21	0.0285
22	0.0253
23	0.0226
24	0.0201
25	0.0179
26	0.0159
27	0.0142
28	0.0126
29	0.0113
30	0.0100
31	0.00893
32	0.00795
33	0.00708
34	0.00630
35	0.00561
36	0.00500
37	0.00445
38	0.00396
39	0.00353
40	0.00314
41	0.00280
42	0.00249
43	0.00222
44	0.00198
45	0.00176
46	0.00157
47	0.00140
48	0.00124
49	0.00111
50	0.00099

BARE THERMOCOUPLE WIRE APPROXIMATE WEIGHT FEET/LB.

Wire Ga B & S	Wire Size DIA.	TYPE J		TYPE K		TYPE T		TYPE E	
		Iron + JP	Constantan— JN	Chromel + KP	Alumel— KN	Copper + TP	Constantan— TN	Chromel + EP	Constantan— EN
6	.162	14.2	12.6	13	13	12.6	12.6	13	12.6
7	.144	18.0							
8	.128	22.8	20.2	21	21	19.8	20.2	21	20.2
14	.064	91.2	80.9	83	83	80.5	80.9	83	80.9
16	.050	144	127	130	130	128	127	130	127
18	.040	233	207	212	212	203	207	212	207
20	.032	365	324	331	331	324	324	331	324
24	.020	925	821	838	838	820	821	838	821
26	.015	1478	1312	1340	1340	1299	1312	1340	1312
28	.012	2353	2089	2130	2130	2062	2089	2130	2089
30	.010	3736	3316	3370	3370	3294	3316	3370	3316
36	.005	14940	13260	13500	13500	13250	13260	13500	13260









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THERMOCOUPLE AND THERMOCOUPLE EXTENSION WIRE GENERAL

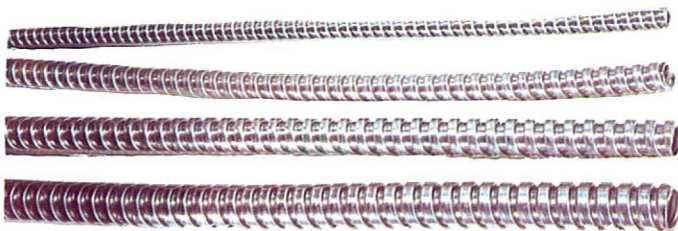
Constructions are arrangements of the conductor and insulation that suit the application. For instance, singles can be used to wire panels more easily than a jacketed construction. And duplex constructions can be more easily used in conduits. And Twisted duplex constructions are more flexible than paralleled ones and counteract flux induced noises. Twisted and shielded constructions provide the best noise reduction.

	CONSTRUCTIONS	
	Code	Description
	1	Insulated Single Conductor
	3	Insulated Duplex Conductors — Ripcord
	4	Insulated Duplex Conductors — Paralleled with Overall Insulation Jacket
	7	Insulated Duplex Conductors — Twisted
	8	Insulated Duplex Conductors — Twisted with Overall Insulation Jacket
	9	Insulated Duplex Conductors — Twisted with Mylar backed Aluminum Shield, Drain Wire, and Overall Insulation Jacket

Protective metal overbraids are used to enhance abrasion and cut-through resistance. With an approximately 85% coverage they also provide a noise shield although not as effective as the aluminized mylar tape full coverage shields.

	Protective Overbraid	
	Code	Description
None	0	No Attendant
	1	Stainless Steel 1400°F (760°C) Wire Braided over Insulated Construction
	2	Inconel wire 1800°F (982°C) Braided over Insulated Construction

[Sold Separately]



SS Flex Tubing			
Code	*Price \$/Ft.	I.D.	Approx. O.D.
FT-125	1.30	0.125"	0.200"
FT-187	0.90	0.187"	0.280"
FT-250	1.00	0.250"	0.340"
FT-312	1.10	0.310"	0.420"

*No Discounts.



THERMOCOUPLE AND THERMOCOUPLE EXTENSION WIRE GENERAL

Example: J-20-GG40

Type J, T/C Grade, Standard Tolerance, Solid, 20 GA., Glass/Glass Insulation, Parallel, No Overbraid

CONDUCTOR:
T/C Type/
Grade - T/C or Extension
Tolerance
Solid or Standard

WIRE GA.:

INSULATION:
CONDUCTOR OVERALL

CONSTRUCTION: PROTECTIVE OVERBRAID

J

↑

CODE
T
J
E
K
N
TX
JX
EX
NX
RX
SX
BX
CX

-

20

↑

CODE
14
16
18
20
24
30
36
40

-

G

↑

INSULATION	CODE	CODE
NONE	—	0
PVC	P	P
Silicone Rubber	L	L
Extruded Teflon FEP	E	E
Extruded Teflon PFA	F	F
Taped Teflon TFE	T	T
Kapton	K	K
Synthetic Fiber	S	S
Wrapped Glass	W	—
Glass Braid	G	G
Hi-Temp Glass	H	H
Refrasil	R	R
Ceramic	C	C

G

↑

INSULATION	CODE	CODE
NONE	—	0
PVC	P	P
Silicone Rubber	L	L
Extruded Teflon FEP	E	E
Extruded Teflon PFA	F	F
Taped Teflon TFE	T	T
Kapton	K	K
Synthetic Fiber	S	S
Wrapped Glass	W	—
Glass Braid	G	G
Hi-Temp Glass	H	H
Refrasil	R	R
Ceramic	C	C

4

↑

CONSTRUCTION	CODE
Insulated Single	1
Insulated Duplex - Ripcord	3
Insulated Duplex - Paralleled with Overall Jacket	4
Insulated Duplex - Twisted	7
Insulated Duplex - Twisted with Overall Jacket	8
Insulated Duplex - Twisted with Mylar backed Al. Shield and Overall Jacket	9

0

↑

CODE	OVERBRAID
0	NONE
1	SS
2	INCONEL

NOTES:

K - TYPE K,
Standard Tolerance
T/C Grade,
Solid Conductors

KK - Special Tolerance

KX - Extension Grade

KF - Stranded Conductors
(Flexible)

For Single Conductor:
KPF - Type K - Positive leg
Standard Tolerance
T/C Grade
Stranded Conductor

KNF - TYPE K - Negative leg

"—" designates not available.

(SEE PRICE LISTS FOR AVAILABLE CONSTRUCTIONS)

