ANSI Limits of Error

Unless otherwise specified, all thermocouple wire and extension wire is supplied to meet either Standard or Special Limits of Error per ASTM/ ANSI E - 230.

The Standard and Special Limits of Error for thermocouple and extension wires are given in the accompanying tables.

Where Limits of Error are given in percent, the percentage applies to the temperature being measured.

Limits of Error for Thermocouples and Thermocouple Wire

Reference Junction 0 °C [32 °F]

T/C TYPE	TEMPERATURE RANGE	LIMITS OF ERROR	
		STANDARD	SPECIAL
T	(0 to 133) °C [32 to 270] °F (133 to 350) °C [270 to 662] °F	± 1 °C [2 °F] ± 0.75%	± 0.5 °C [1 °F] ± 0.4%
J	(0 to 293) °C [32 to 559] °F (293 to 750) °C [559 to 1382] °F	± 2.2 °C [4 °F] ± 0.75%	± 1.1 °C [2 °F] ± 0.4%
E	(0 to 340) °C [32 to 644] °F (340 to 900) °C [644 to 1652] °F	± 1.7 °C [3 °F] ± 0.5%	± 1 °C [2 °F] ± 0.4%
K	(0 to 293) °C [32 to 559] °F (293 to 1250) °C [559 to 2282] °F	± 2.2 °C [4 °F] ± 0.75%	± 1.1 °C [2 °F] ± 0.4%
N	(0 to 293) °C [32 to 559] °F (0 to 1250) °C [559 to 2282] °F	± 2.2 °C [4 °F] ± 0.75%	± 1.1 °C [2 °F] ± 0.4%
R, S	(0 to 600) °C [32 to 1112] °F (600 to 1450) °C [1112 to 2642] °F	± 1.5 °C [3 °F] ± 0.25%	± 0.6 °C [1 °F] ± 0.1%
B	(870 to 1700) °C [1598 to 3092] °F	± 0.5%	
T[1]	(-200 to -66) °C [-328 to -87] °F (-66 to 0) °C [-87 to + 32] °F	± 1 °C [2 °F] ± 1.5%	
E[1]	(-200 to -100) °C [-328 to -148] °F (-100 to 0) °C [- 148 to 32] °F	± 1.1 °C [3 °F] ± 1%	
K[1]	(-200 to -110) °C [-328 to -166] °F (-110 to 0) °C [-166 to 32] °F	± 2.2 °C [4 °F] ± 2%	

[1] Thermocouples and thermocouple materials are normally supplied to meet the limits of error specified in the table for temperatures above 0 °C [32 °F]. The same materials, however, may not fall within the sub-zero limits of error given in the second section of the table. If materials are required to meet the sub-zero limits, the purchase order must so state. Selection of materials usually will be required. Little information is available to justify establishing special limits of error for sub-zero temperatures. Limited experience suggest the following limits for types E and T thermocouples:

Type E	(-200 to 0) °C [-328 to 32] °F
Type T	(-200 to 0) °C [-328 to 32] °F

These limits are given only as a guide for information purposes. Due to the characteristics of the materials, sub-zero limits of error for type J thermocouples and special sub-zero limits for type K thermocouples are not listed.

Limits of Error for Thermocouple

Extension Wire Reference Junction 0 °C [32 °F]

EXT. WIRE TYPE	TEMPERATURE RANGE	LIMITS OF ERROR	
		STANDARD	SPECIAL
KX	(0 to 200) °C [32 to 392] °F	± 2.2 °C [4 °F]	
JX	(0 to 200) °C [32 to 392] °F	± 2.2 °C [4 °F]	± 1.1 °C [2 °F]
EX	(0 to 200) °C [32 to 392] °F	± 1.7 °C [3 °F]	
TX	(0 to 100) °C [32 to 212] °F	± 1.0 °C [2 °F]	± 0.5 °C [1 °F]
NX	(0 to 200) °C [32 to 392] °F	± 2.2 °C [4 °F]	

Limits of Error for Thermocouple Compensating

Extension Wire Reference Junction 0 °C [32 °F]

T/C TYPE	COMPENSATION WIRE TYPE	TEMPERATURE RANGE	LIMITS OF ERROR[1]
R, S	SX§	(0 to 200) °C [32 to 392] °F	± 5 °C [9 °F]
B	BX#	(0 to 100) °C [32 to 212] °F	0 °C [0 °F] -3.7 °C [- 6 °F]

[1] Due to the non-linearity of the types R, S, and B temperature-EMF curves, the error introduced into a thermocouple system by the compensating wire will be variable when expressed in degrees. The degree C tolerances given in parentheses are based on the following measuring junction temperatures:

WIRE TYPE	MEASURING JUNCTION TEMPERATURE
SX	Greater than 870 °C [1598] °F
BX	Greater than 1000 °C [1832] °F

§ Copper (+) versus copper nickel alloy (-)

Copper versus copper compensating extension wire, usable to 100 °C [212 °F] with maximum errors as indicated, but with no significant error over (0 to 50) °C [32 to 122] °F range. Matched proprietary alloy compensating wire is available for use over the range (0 to 200) °C [32 to 392] °F with claimed tolerances of (+ 0.033 mV + 3.7) °C[1].

Calibrating, Checking, and Tagging

Pyromation thermocouple wire and extension wire is available calibrated, "checked and tagged" when so specified, at an extra charge. Wires of this classification are within the Standard Limits of Error but, most important, their specific departure at temperatures specified is known and can be taken into account. Each thermocouple, coil, reel, or spool of wire is checked and tagged to show the departure from the curve. Single conductors will be calibrated to show their EMF values versus pure platinum, with a 0 °C [32 °F] reference junction unless otherwise specified. Thermocouples and wire sample sent to the factory for evaluation must be at least 36" long.

The temperature range for all checking and selecting is from 0 °C [32 °F] to 1371 °C [2500 °F], depending on type and gauge of wire. Sub-zero checking to -79 °C [-110 °F] and high temperature rising from 1371 °F [2500 °F] to 1649 °C [3000 °F] is available. Calibration can also be accomplished at standard check points such as boiling points of helium, oxygen, and nitrogen.

Shipping
Each coil or spool is marked with its exact length, however, Pyromation reserves the right to ship plus or minus 10% of the total amount of either standard or special wire ordered.

ASTM/ANSI Letter Designations
Thermocouple and extension wires are now generally ordered and specified by ASTM/ANSI designations for calibration. Popular generic and trade name examples are Chromel/Alumel-ASTM/ANSI Type K; Iron/Constantan-ASTM/ANSI Type J; Copper/Constantan-ASTM/ANSI Type T; Chromel/Constantan-ASTM/ANSI Type E; Nicrosil/Nisil-ASTM/ANSI Type N; Platinum/Platinum 10% Rhodium-ASTM/ANSI Type S; Platinum/Platinum 13% Rhodium-ASTM/ANSI Type R; and Platinum 6% Rhodium/Platinum 30% Rhodium-ASTM/ANSI Type B. Positive and negative legs are identified by the appropriate letter suffixes P and N, respectively. Those not familiar with this system will find this table helpful.

ANSI Letter Designations	Generic or Trade Names
JP	Iron
JN, EN, or TN	Constantan, Cupron®, Advance
TP	Copper
KP or EP	Chromel®, Tophel®, T1
NP	Nicrosil
KN	Alumel®, Nial®, T2
NN	Nisil
RP	Platinum 13% Rhodium
SP	Platinum 10% Rhodium
RN or SN	Pure Platinum
BN	Platinum 6% Rhodium
BP	Platinum 30% Rhodium

Color Coding
Standard ASTM/ANSI color coding is used on all insulated thermocouple wire and extension wire when type of insulation permits. In color coding, the right is reserved to include a tracer to distinguish the calibration.

ASTM/ANSI TYPE		MAGNETIC		ASTM/ANSI COLOR CODE		
T/C	Sgl.	Yes	No	Sgl.	Overall Extension Wire	Overall T/C Wire
T	TP TN		X X	Blue Red	Blue	Brown
J	JP JN	X	 X	White Red	Black	Brown
E	EP EN		X X	Purple Red	Purple	Brown
K	KP KN	X	X	Yellow Red	Yellow	Brown
N	NP NN		X X	Orange Red	Orange	Brown
R, S	RP, SP RN, SN		X X	Black Red	Green	
B	BP BN		X X	Grey Red	Grey	

Solid and Stranded Conductors
Thermocouple wire and extension wire are usually solid conductors. When greater flexibility is required, either are available in stranded construction. The accompanying table gives the stranding combinations used in Pyromation wire. However, other stranding combinations may be ordered to suit requirements.

Stranding Combinations

CONDUCTOR		STRANDING	
GAUGE	I.S.I. TYPE	NO. of STRANDS	GAUGE
14	ALL	7	22
16	ALL	7	24
18	ALL	7	26
20	ALL	7	28
22	ALL	7	30
24	ALL	7	32

Stock Insulated Wire
'Stocked' insulated thermocouple and extension wire, as indicated in the catalog pages, is available in the following "standard packaging": 50 ft. coils - 100 ft. coils - 250 ft. spools - 500 ft. spools - 1,000 ft. spools. Coils or spools of less than 1,000 ft. packaged in non-standard lengths, are available at an additional charge and may result in a delay in shipment. Spools or reels of over 1,000 ft. can be supplied at no extra charge, but may also result in a delay in shipment.

Non-Stock Insulated Wire
'Non-stocked' insulated thermocouple and extension wire in 1,000 ft. spools and over is available at no additional charge. Coils or spools of less than 1,000 ft. are available at an additional charge. Minimum order is 100 ft.

How to Read Pyromation Catalog Numbers

EXAMPLE ORDER NUMBER:

K 20 - 1 - S - 305

- **K** — ASTM/ANSI Thermocouple type
- **20** — Wire gauge
- **1** — Conductor Type
- **S** — Opt. Overbraid Selections
- **305** — Wire/Insulation (Pages W4, W5, W9)

Conductor Type

CODE	DESCRIPTION			
T/C Grades	Solid	Stranded	Std. Limits	Special
1	X		X	
2	X			X
3		X	X	
4		X		X
Ext. Grades	Solid	Stranded	Std. Limits	Special
5	X		X	
6	X			X
7		X	X	
8		X		X

Opt. Overbraid Selections

CODE	DESCRIPTION
S	SS wire braid
C	Tinned copper wire braid
F	Flat SS ribbon wrap
W	Flat SS spiral wrap
G	Half oval galvanized steel spiral wrap
N	Alloy 600 wire braid

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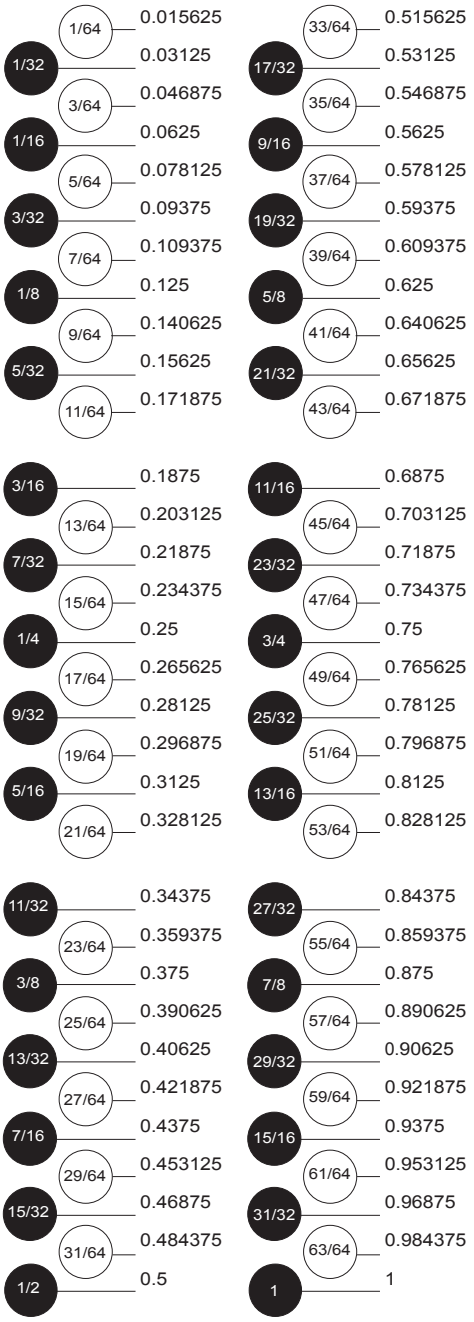

INCHES in DECIMALS of a FOOT

1/16 - 0.0052	1 - 0.0833
3/32 - 0.0078	2 - 0.1667
1/8 - 0.0104	3 - 0.2500
3/16 - 0.0156	4 - 0.3333
1/4 - 0.0208	5 - 0.4167
5/16 - 0.0260	6 - 0.5000
3/8 - 0.0313	7 - 0.5833
1/2 - 0.0417	8 - 0.6667
5/8 - 0.0521	9 - 0.7500
3/4 - 0.0625	10 - 0.8333
7/8 - 0.0729	11 - 0.9167

Standard Wire Gauges in Approximate Decimals of an Inch and mm.

WIRE GAUGE	AMERICAN or BROWN AND SHARP DIAMETER (inches)	DIAMETER MILLIMETERS	BIRMINGHAM or STUBS	US STANDARD
1	0.2893	7.348	0.300	0.281
2	0.2576	6.544	0.284	0.266
3	0.2294	5.827	0.259	0.250
4	0.2043	5.189	0.238	0.234
5	0.1819	4.621	0.220	0.219
6	0.1620	4.115	0.203	0.203
7	0.1443	3.665	0.180	0.188
8	0.1285	3.264	0.165	0.172
9	0.1144	2.906	0.148	0.156
10	0.1019	2.588	0.134	0.141
11	0.0907	2.304	0.120	0.125
12	0.0808	2.053	0.109	0.109
13	0.0720	1.829	0.095	0.0938
14	0.0641	1.628	0.083	0.0781
15	0.0571	1.450	0.072	0.0703
16	0.0508	1.291	0.065	0.0625
17	0.0453	1.150	0.058	0.0563
18	0.0403	1.024	0.049	0.0500
19	0.0359	0.9116	0.042	0.0438
20	0.0320	0.8118	0.035	0.0375
21	0.0285	0.7230	0.032	0.0344
22	0.0253	0.6438	0.028	0.0313
23	0.0226	0.5733	0.025	0.0281
24	0.0201	0.5106	0.022	0.0250
25	0.0179	0.4547	0.020	0.0219
26	0.0159	0.4049	0.018	0.0188
27	0.0142	0.3606	0.016	0.0172
28	0.0126	0.3211	0.014	0.0156
29	0.0113	0.2859	0.013	0.0141
30	0.0100	0.2546	0.012	0.0125
31	0.0089	0.2268	0.010	0.0109
32	0.0080	0.2019	0.009	0.0102
33	0.00708	0.178	0.008	0.0094
34	0.00630	0.152	0.007	0.0086
35	0.00561	0.138	0.005	0.0078
36	0.00500	0.127	0.004	0.0070
37	0.00445	0.1131		0.0066
38	0.00397	0.1007		0.0063
39	0.00353	0.08969		
40	0.00314	0.07987		

CONDUIT SIZE (I.P.S.)	Approximate No. of Insulated Double Conductor Lengths of Extension					
	Wire - Size Conductor					
	NO. 14	NO. 14[1]	NO. 16	NO. 16[2]	NO. 20	NO. 24
1/2"	1	2	2	1	7	9
3/4"	3	7	4	2	16	21
1"	5	10	6	4	24	29
1 1/4"	7	14	10	5	35	44
1 1/2"	13	23	13	7	48	69
2"	18	48	20	11	73	95

[1] Single Conductor Insulated
[2] Three Conductor Insulated