thermo sensors corporation

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

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Thermocouple Wire

This section has been developed to serve as a guide in the selection of wires to accomplish most all temperature measuring requirements. Featured is a large selection of thermoelements, insulation materials and constructions. Should you need assistance, Thermo Sensors' sales personnel are anxious to help you in selecting the wire to give optimum performance in your application.



Thermo Sensors' thermocouple and extension wires are known for their quality performance and reliability. Careful attention is given to the proper selection and matching of conductors to ensure conformance to standard limits of error as defined in ANSI C96.1. Unless otherwise specified, all wire will be furnished to standard limits of error. Many of the wires are available with special limits of error and must be specified when ordering.

Technical Data

Limits of Error

ANSI Limits of Error
Thermo Sensors' thermocouple and extension wires are known for their quality performance and reliability. Careful attention is given to the proper selection and matching of conductors to ensure conformance to standard limits of error as defined in ANSI C96.1*. Tables on this page show the limits of error for both thermocouple and extension grade wires. Unless otherwise specified, all wire will be furnished to standard limits of error. Many of the wires are available with special limits of error and must be specified when ordering.

Thermo Sensors provides a calibration service for customers who require known deviations from specified temperature points. Each coil or spool of wire so certified is marked and a "Certificate of Calibration" is furnished. Certification temperatures available are -320°F, -110°F, 32°F, and 2000°F and must be specified by the customer. All equipment used in the certification is traceable to the National Bureau of Standards.

*The American National Standards Institute (ANSI) designations have replaced the previous Instrument Society of America (ISA) designations for thermocouple materials. ANSI Standard C96.1-1975, or latest version, is the applicable standard for wires listed in this catalog unless otherwise noted.

Limits of Error for Thermocouple Wire
Reference Junction at 32°F

Type	Temperature Range	Limits of Error			
		Standard (whichever is greater)		Special (whichever is greater)	
T	0 to 350°C 32 to 662°F	± 1°C ± 2°F	or ± .75%	± .5°C ± 1°F	or ± .4%

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J	0 to 750°C 32 to 1382°F	± 2.2°C ± 4°F	or ± .75%	± 1.1°C ± 2°F	or ± .4%
E	0 to 900°C 32 to 1652°F	± 1.7°C ± 3°F	or ± .5%	± 1°C ± 2°F	or ± .4%
K	0 to 1250°C 32 to 2202°F	± 2.2°C ± 4°F	or ± .75%	± 1.1°C ± 2°F	or ± .4%
R, S	0 to 1450°C 32 to 2642°F	± 1.5°C ± 3°F	or ± .25%	± .6°C ± .1°F	or ± .1%
B	800 to 1700°C 1472 to 3092°F	± .5°			

Sub-Zero Limits of Error
Thermocouple materials are normally supplied to meet the limits of error specified in the table for temperatures above 0°C. These materials, however, may not fall within the sub-zero limits of error given in the following table. If materials are required to meet the sub-zero limits, the purchase order must so state. Special pricing for selection of materials will be required.

T	-200 to 0°C -328 to 32°F	± 1°C ± 2°F	or ± 1.5%	
E	-200 to 0°C -328 to 32°F	± 1.7°C ± 3°F	or ± 1%	
K	-200 to 0°C -328 to 32°F	± 2.2°C ± 4°F	or ± 2%	

Little information is available to justify establishing special limits of error for sub-zero temperatures. Limited experience suggests the following limits for types E and T thermocouples.

E	-200 to 0°C -328 to 32°F	± 1°C ± 2°F	or ± .5%	
T	-200 to 0°C -328 to 32°F	± .5°C ± 1°F	or ± .8%	

These limits are given only as a guide. 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 Extension Wire
Reference Junction at 32°F

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

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EX	0 to 200°C 32 to 392°F	± 1.7°C ± 3°F	
TX	-60 to 100°C -76 to 212°F	± 1°C ± 2°F	± .5°C ± 1°F

Limits of Error for Thermocouple Compensating Extension Wire
Reference Junction at 32°F

Compensating Type	Thermocouple Type	Temperature Range	Limits of Error
RSX	R, S	0 to 200°C 32 to 382°F	± 5°C ± 9°F
BX	B	0 to 100°C 32 to 212°F	± 0°C -3.7°C* ± 0°F -6.7°F*

*Due to the non-linearity of the types of 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 limits of error given in the table above are based on the following measuring junction temperatures:

Type Wire	Measuring Junction Temperature
RSX	Greater Than 870°C (1596°F)
BX	Greater Than 1000°C (1832°F)

Noise Shielding

Wire for Electromagnetic and Electrostatic Noise Shielding
Electromagnetic Noise is produced due to capacitive coupling of an electric field within the plant to the instrument circuit. The source of these electric fields may be power lines or other voltage sources mentioned below. The most effective means of isolating static noise is to have the instrument circuit enclosed within a 100% coverage shield such as an aluminum backed mylar tape. A drain wire in contact with the aluminum foil carries the interference to the ground.

Magnetic Noise is generated anytime a loop of instrument wires pass through a magnetic field. As the wires come in the stray magnetic field of an electric motor, generator, power line, relay or similar source, a current is produced in the instrument circuit to oppose the magnetic field. That current super-imposed on the sensor signal results in an erroneous and usually unstable signal input at the instrument.

Electrostatic and magnetic noise sources include but are not limited to the following conditions:
Circuits near:

- Power lines
- Medium sized (SHP) and larger motors
- Control relays
- Transformers
- electrolytic processes
- Induction heating equipment

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To minimize the effects of electrostatic and magnetic noise, the use of Thermo Sensors' type PPZS extension wire is suggested. It incorporates both twisting, 100% shielding with an Aluminum/Mylar tape and drain wire. These wires are listed in the appropriate extension wire table.

ANSI Designations

ANSI Letter Designations
The tables listed below are provided to the user for a ready reference of ANSI designations as compared to the generic and trade names for the most common thermocouple materials. The letter "P" in the designation indicates the positive (+) leg of the calibration while the letter "N" designates the negative (-). Color coding and other means of conductor identification are also provided.

Thermocouple Grade Wire

ANSI Type	Grade or Generic Trade Names*	Single Conductors	Magnetic	Conductor Color Code	Overall Color Code**
E	Chromel Constantan	EP EN	No No	Purple Red	Brown w/ Purple Tracer
J	Iron Constantan	JP JN	Yes No	White Red	Brown w/ White Tracer
K	Chromel Alumel	KP KN	No Yes	Yellow Red	Brown w/ Yellow Tracer
T	Copper Constantan	TP TN	No No	Blue Red	Brown w/ Blue Tracer

Extension Grade Wire

ANSI Type	Grade or Generic Trade Names*	Single Conductors	Magnetic	Conductor Color Code	Overall Color Code**
EX	Chromel Constantan	EPX ENX	No No	Purple Red	Purple
JX	Iron Constantan	JPX JNX	Yes No	White Red	Black
KX	Chromel Alumel	KPX KNX	No Yes	Yellow Red	Yellow
TX	Copper Constantan	TPX TNX	No No	Blue Red	Blue
RX	Copper Alloy #11	RPX RNX	No No	Black Red	Green
SX	Copper Alloy #11	SPX SNX	No No	Black Red	Green
BX	Copper Copper	BPX BNX	No No	Gray Red	Gray

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W325X***	Alloy 203 Alloy 225	W3FX W25NX	No Yes	Orange Red	Orange w/ Black Tracer
WS26X	Alloy 405 Alloy 426	WSPX W26NX	Yes Yes	Orange Red	Orange

*Trade names: Chromel, Alumel, Constantan - Hoekins Mfg. Co.

**Color Coding: Capton insulations will have a color fiber tracer under the Kapton singles. Overall insulations of Katpon and Teflon are not color coded.
Some high temperature fibrous insultions are not color coded; others will have a colored tracer. The color pigment burns off at 300°F.

***Not ANSI Designations

Stranded Wire
Thermocouple and extension wires are usually solid conductors. When greater flexibility is needed, stranded wire is used. Both constructions are listed in the wire tables. The stranding combination used is given in the wire size column of the tables.

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