CLEVELAND ELECTRIC LABORATORIES
Thermocouples & Sensing Solutions since 1920

How to read the catalog number chart

Cleveland Electric Laboratories offers a complete line of insulated thermocouple and extension grade wires in single, duplex and multipair constructions. Ordering with another manufacturer's part number is an acceptable option, or construct a Cleveland Electric Laboratories part number using the box format explained below. By filling in the boxes in the natural order of progression, construction of a part number for a thermocouple or extension grade wire is a simple seven-step process.

Step 1: Insert the "ITW" Insulated Thermocouple Wire or "IEW" Insulated Extension Wire prefix into the designated space.

Step 2: Insert the desired calibration K, J, T etc. into the corresponding box.

Step 3: Insert desired wire gauge.

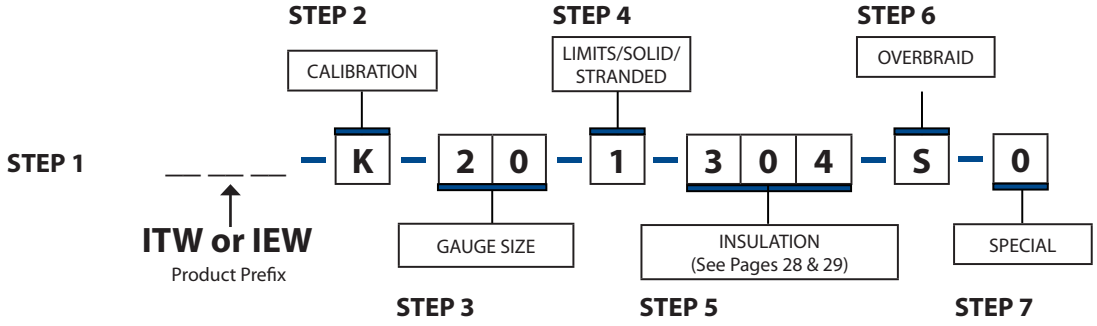
Step 4: The "limits/solid/stranded" box consists of a single digit. The #1 indicates solid conductors standard limits of error, while the #3 indicates stranded conductors standard limits of error for thermocouple grade wire. When constructing an extension cable, insert the #5 for solid conductors standard limits of error or the #7 for stranded conductors standard limits of error. NOTE: When special limits of error material is required, these digits must be changed to the next higher even digit, i.e., from ITW-K-20-1-304-0-0 to special limits ITW-K-20-2-304-0-0.

Step 5: Select desired insulation type.

Step 6: Select overbraid material. If none, insert "0".

Step 7: This box is reserved for certified and custom constructions. If certified (see below) or a custom built wire is required, please consult factory for further instructions. If none, please insert "0" in this box.

CERTIFICATION: **ISO/IEC 17025**
Cleveland Electric Laboratories is an approved source to certify bulk thermocouple wire or individual elements traceable to N.I.S.T. Each thermocouple element, coil or spool of wire is tagged with the individual temperature departure from the corresponding calibration curve. Please consult factory for additional information.



ANSI TOLERANCES:
Unless specified, our thermocouple and extension wires are supplied to meet Standard Tolerances of ANSI circular MC96.1-1982. Special Tolerances are also available per ANSI MC96.1. Tolerances for thermocouple and extension wires are given in the accompanying tables. Where tolerances are given in percent, the percentage applies to the temperature being measured.

Initial Calibration Tolerances for Thermocouples

THERMOCOUPLE TYPE	TEMPERATURE RANGE		TOLERANCES †	
	°C	°F	STANDARD	SPECIAL
T	0 to 370	32 to700	±1.0°C or ±0.75%	±0.5°C or 0.4%
J	0 to 760	32 to 1400	±2.2°C or ±0.75%	±1.1°C or 0.4%
E	0 to 870	32 to 1600	±1.7°C or ±0.5%	±1.0°C or ±0.4%
K or N	0 to 1260	32 to 2300	±2.2°C or ±0.75%	±1.1°C or ±0.4%
R or S	0 to 1480	32 to 2700	±1.5°C or ±0.25%	±0.6°C or ±0.1%
B	870 to 1700	1600 to 3100	±0.5°C%	±0.25%
C	0 to 2315	32 to 4200	±4.4°C or ±1%	
E*[A]	-200 to 0	-328 to 32	±1.7°C or ±1%	*B
K*[A]	-200 to 0	-328 to 32	±2.2°C or ±2%	*B
T*[A]	-200 to 0	-328 to 32	±1.0°C or ±1.5%	* B

* [A] Thermocouples and thermocouple materials are normally supplied to meet the tolerances specified in the table for the temperature above 0°C. The same materials, however, may not fall within the tolerances given for temperatures below °C in the second section of the table. If materials are required to meet the tolerances stated for temperatures below 0°C, the purchase order must so state. Selection of materials will be required.

* [B] Special tolerances for temperatures below 0°C are difficult to justify due to limited available information. However, the following values for types E and T thermocouples are suggested as a guide between purchaser and supplier:

Type **E** -200 to 0°C ±1.0°C or ±0.5% (whichever is greater)
Type **T** -200 to 0°C ±0.5°C or ±0.8% (whichever is greater)

Initial values of tolerance for Type J thermocouples at temperatures below 0°C and special tolerances for Type K thermocouples below 0°C are not given due to the characteristics of the materials.

Initial Calibration Tolerances for Thermocouple Extension Wires

Reference Junction 0°C (32°F)

THERMOCOUPLE TYPE	TEMPERATURE RANGE		TOLERANCES †			
	°C	°F	STANDARD		SPECIAL	
			°C	°F	°C	°F
TX	-60 to 100	-75 to 200	±1.0	±1.8	±0.5	±0.9
JX	0 to 200	32 to 400	±2.2	±4.0	±1.1	±2.0
EX	0 to 200	32 to 400	±1.7	±3.0	±1.0	±1.8
KX	0 to 200	32 to 400	±2.2	±4.0	±1.1	±2.0
NX	0 to 200	32 to 400	±2.2	±4.0	±1.1	±2.0

† Tolerances represent the maximum error contribution allowable from new and essentially homogeneous thermocouple extension wire when exposed to the full temperature range given in the table above. Extension grade materials are not intended for use outside the temperature range shown.

Note: Thermocouple extension wire makes a contribution to the total thermoelectric signal that is dependent upon the temperature difference between the extreme ends of the extension wire length. The actual magnitude of any error introduced into a measuring circuit by homogeneous and correctly connected extension wires is equal to the algebraic difference of the deviations at its two end temperatures, as determined for that extension wire pair.

Initial Calibration Tolerances for Thermocouple Extension Wires

Reference Junction 0°C (32°F)

THERMOCOUPLE TYPE	TEMPERATURE RANGE		TOLERANCES †		
	°C	°F	STANDARD		SPECIAL
			°C	°F	
SX	0 to 200	32 to 400	±5	±9	*A*
RX	0 to 200	32 to 400	±5	±9	*A*
BX[B]	0 to 200	32 to 400	±4.2	±7.6	*A*
BX[C]	0 to 100	32 to 200	±3.7	±6.7	---
CX	0 to 200	32 to 400	±2.2	Initial Calibration Tolerances ±0.110 mV	

† Tolerances apply to new and essentially homogeneous thermocouple compensating extension wire when at temperatures within the range given in the table above.

Note: Thermocouple compensating extension wire makes a contribution to the total thermoelectric signal that is dependent upon the temperature difference between the extreme ends of the compensating extension wire length.

[A] Special tolerance grade compensating extension wires are not available.
[B] Proprietary alloy compensating extension wire is available for use over a wide temperature range.
[C] Special compensating extension wires are not necessary with Type B over the limited temperature range 0 to 50 °C (32 to 125 °F), where the use of non-compensated (copper/copper) conductors introduces no significant error. For a somewhat larger temperature gradient of 0 to 100 °C (32 to 210 °F) across the extension portion of the circuit, the use of non-compensated (copper/copper) extension wire may result in small errors, the magnitude of which will not exceed the tolerance values given in the table above for measurements above 1000 °C (1800 °F).

Ansi Letter Designations

Thermocouple and extension wires are now generally ordered and specified by ANSI letter designations for wire type. Positive and negative legs are identified by the appropriate letter suffixes P and N, respectively.

ANSI LETTER	DESCRIPTION	POPULAR GENERIC & TRADE NAMES*
T	TP	Copper
	TN	Constantan, Cupron, Advance
J	JP	Iron
	JN	Constantan, Cupron, Advance
E	EP	Chromel, Tophel, T1
	EN	Constantan, Cupron, Advance
N	NP	Nicrosil
	NN	Nisil (Magnetic)
K	KP	Chromel, Tophel, T1
	KN	Alumel, Nial, T2
S	SP	Platinum 10% Rhodium
	SN	Pure Platinum
R	RP	Platinum 13% Rhodium
	RN	Pure Platinum
B	BP	Platinum 30% Rhodium
	BN	Platinum 6% Rhodium
C	CP	Tungsten 5% Rhenium
	CN	Tungsten 26% Rhenium

Color Coding

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

ANSI Type		Magnetic		Single	ANSI Color Code	
T/C	Single	Yes	No		Overall Extension Wire	Overall T/C Wire
T	TP		•	Blue	Blue	Brown
	TN		•	Red		
J	JP	•		White	Black	Brown
	JN		•	Red		
E	EP		•	Purple	Purple	Brown
	EN		•	Red		
K	KP		•	Yellow	Yellow	Brown
	KN	•		Red		
S, R	RP, SP		•	Black	Green	
	RN, SN		•	Red		
B	BP		•	Grey	Grey	
	BN		•	Red		
N	NP			Orange	Orange	Brown
	NN	•		Red		
C	CP		•	Green	Red	
	CN		•	Red		

Solid and Stranded Conductors

Thermocouple and extension wires are usually solid conductors, but both are available in stranded construction if greater flexibility is required.

Conductor		Stranding	
Gauge	ANSI Type	No. of Strands	Gauge
14	All	7	22
16	All	7	24
18	All	7	26
20	All	7	28
22	Al	7	30
24	All	7	32

Thermocouple Wire, Insulation, Construction and Characteristics

Insulation Code	Single Conductor		Duplex Conductors		Temperature Rating**		ANSI Color Coded	Physical Properties		Notes
	Insulation	Impregnation	Insulation	Impregnation	Continuous	Single Reading		Abrasion Resistance	Moisture Resistance	
200	High Temp. Glass Braid	High Temp. Varnish	None Twisted	—	704°C	871°C	Yes	Good	Good	Impregnation retained to 204°C (400°F)
					1300°F	1600°F				
232	High Temp. Glass Braid	High Temp. Varnish	High Temp. Glass Braid	High Temp. Varnish	704°C	871°C	Yes	Good	Good	
					1300°F	1600°F				
301	Vitreous	None	Vitreous Silica	None	871°C	1092°C	NO	Fair	Fair	—
	Silica Fiber	—	Fiber	—	1600°F	2000°F				Impregnation retained to 204°C (400°F)
304	Glass Braid	Silicone Modified Resin	Glass Braid	Silicone Modified Resin	482°C	538°C	Yes	Fair	Good	
					900°F	1000°F				
305	Double Glass Wrap	High Temp. Varnish	Glass Braid	Silicone Modified Resin	482°C	538°C	Yes	Fair	Good	
					900°F	1000°F				Teflon good to 260°C (500°F)
307	TFE Tape (not fused)	—	TFE Coated	—	482°C	538°C	Yes	Good	Excellent	
	TFE Coated Glass	—	Glass Braid	—	900°F	1000°F				
350	Ceramic Fiber	—	Ceramic Fiber	—	1204°C	1427°C		Good	Fair	—
					2200°F	2600°F	No			
505	Polyvinyl	—	Ripcord	—	-29 to +150°C			Good	Excellent	—
					-20 to +221°F		Yes			
507	FEP Extr.	—	FEP Extr.	—	204°C	316°C		Very Good	Excellent	—
					400°F	600°F	Yes			
508	TFE Tape Fused	—	TFE Tape Fused	—	260°C	316°C		Good	Excellent	—
					500°F	600°F	Yes			
509	FEP Extr.	—	FEP Extr. Twisted	—	204°C	316°C		Very Good	Excellent	Aluminum/ Mylar® shield with drain wire
					400°F	600°F	Yes			
513	Fused Kapton	—	Fused Kapton	—	316°C	427°C				FEP binder melts at approx. 260°C (500°F)
	Tape Polymide		Tape		600°F	800°F	Yes	Excellent	Excellent	
514	Tefzel®	—	Tefzel	—	150°C	200°C				
					302°F	392°F	Yes	Excellent	Excellent	—

*Trade names of E I duPont de Nemours & Co.
**Thermocouple extension grade wire is only calibrated up to 204°C (400°F).

Extension Wire, Insulation, Construction and Characteristics

Insulation Code	Single Conductor		Duplex Conductors		Temperature Rating**		ANSI Color Coded	Physical Properties		Notes
	Insulation	Impregnation	Insulation	Impregnation	Continuous	Single Reading		Abrasion Resistance	Moisture Resistance	
155	Glass Braid	Silicone Modified Resin	ServTex Braid	Moisture Resistant	288°C 550°F	343°C 650°F	Yes	Good	Fair	Impregnation retained to 204°C (400°F)
157	TFE Tape (not fused) Glass Braid	Silicone Modified Resin	ServTex Braid	Compound	288°C 550°F	343°C 650°F	Yes	Good	Good	Impregnation retained to 204°C (400°F) Teflon good to 260°C (500°F)
232	High Temp. Glass Braid	High Temp. Varnish	High Temp. Glass Braid	Moisture Resistant Compound	704°C 1300°F	871°C 1600°F	NO	Good	Fair	Impregnation retained to 204°C (400°F)
304	Glass Braid	Silicone Modified Resin	Glass Braid	High Temp. Varnish	482°C 900°F	538°C 1000°F	Yes	Fair	Good	
502	Polyvinyl	—	Polyvinyl	—	-29 to +150°C -20 to +221°F		Yes	Good	Excellent	—
507	FEP Extr.	—	FEP Extr.	—	204°C 400°F	316°C 600°F	Yes	Very Good	Excellent	—
509	FEP Extr.	—	FEP Extr.	—	204°C 400°F	316°C 600°F	Yes	Very Good	Excellent	Aluminum/ Mylar® shield with drain wire
510	Polyvinyl	—	Polyvinyl Twisted	—	-29 to +150°C -20 to +221°F		Yes	Good	Excellent	
514	Tefzel	—	Tefzel	—	150°C 302°F	200°C 392°F	Yes	Excellent	Excellent	

*Trade names of E I duPont de Nemours & Co.
**Thermocouple extension grade wire is only calibrated up to 204°C (400°F).

Note: ServTex synthetic fibers are organic compounds. Good ventilation is recommended in areas where this product may be subjected to elevated temperatures.