

## Industrial Thermocouples

Thermo Sensors Industrial thermocouples are widely used in process industry applications. Thermocouples are generally selected by determining the particular conditions under which it must perform. These conditions which have recommended wire and material selections and are grouped in types.



Thermo Sensors thermocouple element types include:

- Type E Chromel-Constantan Thermocouple
- Type J Iron-Constantan Thermocouple
- Type K Chromel-Alumel Thermocouple
- Type N Nicrosil-Nisil Thermocouple
- Type R Platinum-Platinum 13% Rhodium Thermocouple
- Type S Platinum-Platinum 10% Rhodium Thermocouple
- Type B Platinum 6% Rhodium-Platinum 30% Rhodium Thermocouple
- Type T Copper- Constantan Thermocouple

The wire gauge and recommended temperature ranges are of various sizes as well.

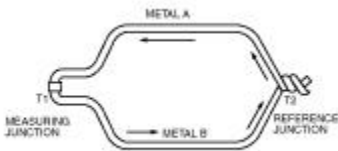
Please refer to our order guide to assist in determining your needs. We can also provide technical design assistance and application suggestions. Give us a call.

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

## Introduction to Thermocouples

### The Principles and Features of Thermocouples

Today's thermocouple designs are the result of many years of research and field experience. Together with quality instruments they provide the answer to thousands of temperature sensing and control problems.



### The Seebeck Effect

Basically, a thermocouple is a closed circuit formed of two dissimilar metallic conductors to produce an electromotive force (EMF) or voltage. The voltage causes a current to flow when heat is applied to one of the junctions. The current will continue to flow as long as the two junctions are at different temperatures. This is called the Seebeck effect, after T. J. Seebeck who discovered the principle.

The direction of the current flow at the cooler of the two junctions (T1) determines polarity. For example, in Figure 2 when the current flows from A to B, A is considered positive.



### The Peltier Effect

Peltier found that when current flows across the junction of two dissimilar metals the junction will either release heat or absorb it, depending on the direction the current is flowing. If the current flows in the same direction as the current produced in a thermocouple at the measuring junction, heat will be absorbed and heat will be released at the opposing (cold) junction. The amount of heat absorbed and released is proportional to the quantity of electricity flowing across the junction.

### Thermoelectric Laws

- A. a circuit of a single homogeneous wire cannot maintain a current by means of heat application alone.
- B. In a circuit of two dissimilar homogeneous wires, if one junction is maintained at one temperature and the other junction at another, the resulting thermal EMF will be independent of the temperature gradient along the wires.
- C. a third metal may be introduced into a circuit of two dissimilar homogeneous wires--with their measuring junction and cold junction maintained at different temperatures - without affecting the total EMF (voltage) in the circuit. This law, often called the law of intermediate metals, works in the following manner: In a circuit of two dissimilar homogeneous wires A & B with measuring junction and cold junction maintained at different temperatures, introduce the third metal C by cutting the a wire and inserting wire C making two additional junctions a to C. If C is uniform in temperature over its entire length, the total

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

EMF in the circuit will be unaffected. This law can be applied, in various forms, to a thermocouple head where the thermocouple wires are connected to the extension wires through a copper or brass block.

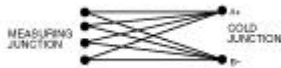
**Common Thermocouple Circuitry**

Below are examples of the most common thermocouple circuitry.

1. Standard single thermocouple composed of two dissimilar wires and a single measuring junction:



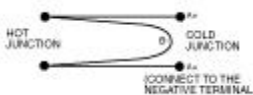
2. An averaging thermocouple composed two or more thermocouples connected in parallel to a common cold junction. The EMF generated will correspond to the mean of the temperature of the individual junctions, provided resistances of all the elements are equal.



3. a thermopile is composed of a series of two or more connected thermocouples. The resultant EMF will be the aggregate of all individual junctions.



4. a Delta Thermocouple, also known as a differential thermocouple, is composed of two similar wires "A" joined to a single dissimilar wire "B" with the two measuring junctions normally at different temperatures. The resulting EMF will be the difference between the two junctions, commonly referred to as the differential temperature.



Note: At least one of the thermocouple junctions must be ungrounded and the measuring instrument must be of the differential type. a typical scale range might be: -150 to 0 to +150

**Purpose of Connection Heads**

The thermocouple connection or terminal head provides a positive electrical connection between the thermocouple and extension wires and provides a means of attachment for a protecting tube and extension wire conduit. The head contains a terminal block for all electrical connections. Connection heads are available for every application. Typical heads include a cast aluminum cover head, ideal for applications which must be completely weatherproof; a polypropylene head for extreme corrosion areas, explosion-proof conduit type.

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

### Extension Wire Use

Extension wire is used to extend the thermocouple to the reference junction in the instrument. The wire is furnished as a matched pair of conductors with insulation designed to meet the service needs of a particular application.

## Application and Technical Data

(See Section 100 "Cerampak Thermocouple" for Metal Sheathed Thermocouple Information)

### How to Select Thermocouple Elements

The material selected for the thermocouple will be determined by the particular conditions under which it must perform.

Suggested in this catalog are a series of element sizes and types of protections desirable under broad, general conditions. For maximum efficiency, however, the customer should carefully consider his particular needs and uses in terms of how long the element must be in service, the temperatures to which it will be exposed, the atmosphere, and the desired speed of response.

Ranges of temperatures for the most commonly used thermocouple elements are shown in the Thermocouple Selection Data table. Where sensitivity for speed of response is important, select smaller gauge wires. Where longer life is a primary consideration, especially at elevated temperatures, select a heavier gauge wire.

When ordering replacement thermocouple wire or elements be certain that the type (K, S, R, etc.) corresponds to the instrument calibration for which it is intended. This information can usually be found on the face of the instrument.

Following are type of elements available and descriptions of their general use:

**Table 1 Bare Wire - Ceramic Insulators**  
**Thermocouple Selection Data**

Type of Thermocouple or Wire & Material	Wire Gauge (AWG)	Recommended Upon Temperature Limits ° F		Recommended Conditions For Use
		° F	° C	
Type E Chromel - Constantan	8 gauge	1600	870	Chromel-Constantan thermocouple suitable for use at temperatures up to 1600° F in vacuum, inert, mildly oxidizing or reducing atmospheres. Not subject to corrosion at cryogenic temperatures. Has highest EMF output per degree of all commonly used thermocouples.
	14 gauge	1200	650	
	20 gauge	1005	540	
	24 gauge	805	430	
Type J Iron - Constantan	8 gauge	1400	760	Used with or without protective tubing where deficiency of free oxygen exists. Protective tube recommended but not essential, desirable for cleanliness and longer service. Since JP wire oxidizes rapidly above 1000° F, compensate by using larger gauge wires.
	14 gauge	1100	590	
	20 gauge	900	480	
	24 gauge	700	370	

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

				Maximum recommended operating temperature: 1400° F.
Type K Chromel - Almel	8 gauge 14 gauge 20 gauge 24 gauge	2300 2000 1800 1600	1260 1080 980 820	Used extensively at temperatures up to 2300° F. Use of metal or ceramic protective tube always recommended, especially in reducing atmospheres. In oxidizing atmospheres protective tubing not essential, but desirable for longer service.
Type N Nicrosil - Nisil	8 gauge 14 gauge 20 gauge 24 gauge	2300 2000 1800 1600	1260 1080 980 820	
Type R Platinum - Platinum 13% Rhodium	24 gauge	to 2700		For high temperature applications in oxidizing atmospheres, Type B reduces effects of chemical contamination and rhodium migration. It has greater mechanical strength than types S and R. Use a ceramic protection tube to obtain maximum reliability above 1830° F in a neutral atmosphere, or air above 2190° F.
Type S Platinum - Platinum 10% Rhodium	24 gauge	to 2700		
Type B Platinum 6% Rhodium - Platinum 30% Rhodium	24 gauge	to 3150		
Type T Copper - Constantan	14 gauge 20 gauge 24 gauge	700 500 400	370 260 204	Use in either oxidizing or reducing atmospheres. Protection tube not essential but recommended for cleanliness and longer service. Stable at lower temperatures. Superior for a wide variety of use in low cryogenic temperatures. Operating range: - 300° F to 700° F, but can be used to - 425° F (boiling helium).

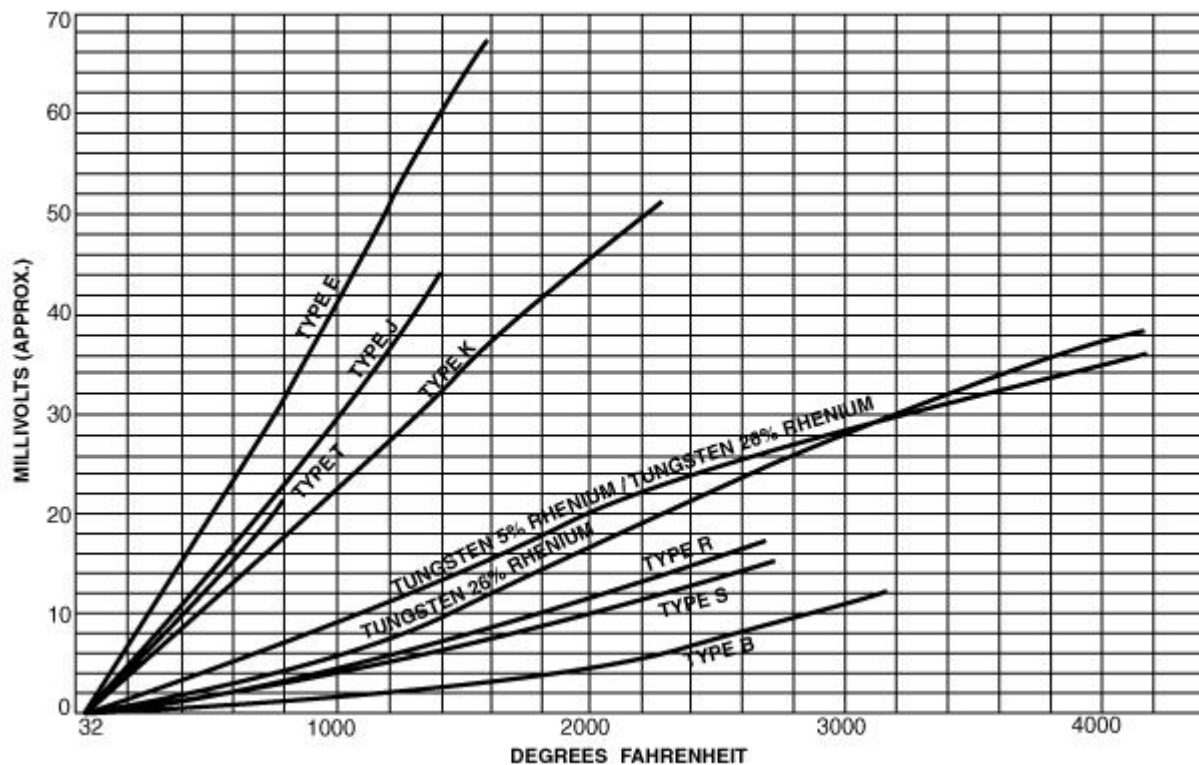
**Table 2 - Limit of Error**  
 Reference Junction at 32° F

Thermocouple Calibration	Temperature Range	Limits of Error			
		Standard (Whichever is greater)		Special (Whichever is greater)	
T	-200 to 350° C -328 to 662° F	± 1° C ± 2° F	or 0.75% above 0° C or 1.5° below 0° C	± .5° C ± 1° F	or ± .4%
J	0 to 750° C 32 to 1382° F	± 2.2° C ± 4° F	or ± .75%	± 1.1° C ± 2° F	or ± .4%
E	-200 to 900° C -328 to 1652° F	± 1.7° C ± 3° F	or 0.5% above 0° C or 1.0% below 0° C	± 1° C ± 2° F	or ± .4%
K	-200 to 1250° C	± 2.2° C	or 0.75% above 0° C	± 1.1° C	or ± .4%

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

	-328 to 2282° F	± 4° F	or 2.0% below 0° C	± 2° F	
R, S	400 to 1400° C 752 to 2550° C	± 1.5° C ± 3° F	or ± .25%	or ± .1%	
B	800 to 1800° C 1475 to 3270° F	± 0.5% over 800° C (1470° F)	or ± .50%	or ± .25%	
N	0 to 1250° C 32 to 2282° F	± 2.2° C ± 4.0° F	or ± 0.75% above 0° C or ± 2.0% below 0° C	± 1.1° C ± 2° F	or ± .4%
When the limit of error is given in %, the percentage applies to the temperature being measured, not the range.					

Table 3 Temperature - Millivolt Curves



Note: EMF values for other calibrations available on request.

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

T/C Material Types	
E = CR/CN	R = Pt/Pt 13% Rh
J = I/C	S = Pt/Pt 10% Rh
K = C/A	B = Pt 30% Rh/Pt 6% Rh
T = CU/CN	

## Installation and Maintenance

### Thermocouple Installation

- Carefully select the location and insertion depth at a point where the temperature is most likely representative of the process temperature. It is important to avoid stagnant areas of the measured media which do not have representative temperatures.
- Locating the thermocouple where the hot end can be seen assures visual confirmation of the junction location.
- Immerse the thermocouple far enough to ensure that the measuring junction is entirely included in the temperature area to be measured. a depth ten times that of the diameter of the protection tube is recommended. Heat which is conducted away from the hot junction will cause a lower reading due to "stem loss."
- Keep the connecting head and cold junction in coolest ambient temperature available.
- To prevent breakage due to thermal shock, never insert a ceramic tube into a hot area rapidly. Preheat gradually while installing.
- Avoid direct flame impingement on protecting tube. Impingement shortens the tube life and causes temperature readings to be inaccurate.
- When measuring high temperatures, install the thermocouple vertically, whenever possible. Such installation minimizes sagging of the tube or sheath.

### Extension Wire Installation

- Be sure to select the correct type of extension wire for a given calibration of thermocouple. (See Bulletin 300).
- Use the color coding of individual wires as a guide for connecting the negative wire to the negative-wire terminal at both the thermocouple connection head and the instrument. Red is always Negative (-).
- To prevent spurious EMF due to electrostatic and electromagnetic noise, never run thermocouple extension wire in same conduit, parallel to the conduit or near any power source. Keep thermocouple wire at least 12" from power source.
- In "high noise" areas, use thermocouple extension wire with twisted and shielded conductors and a drainwire.
- Select the proper insulation to meet the specific conditions under which it must perform. (See Bulletin 300).

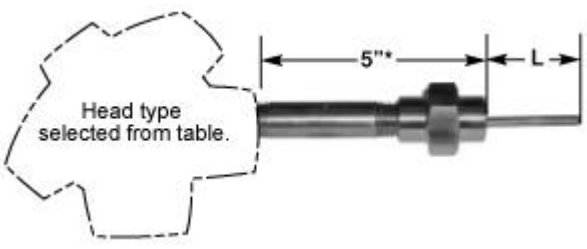
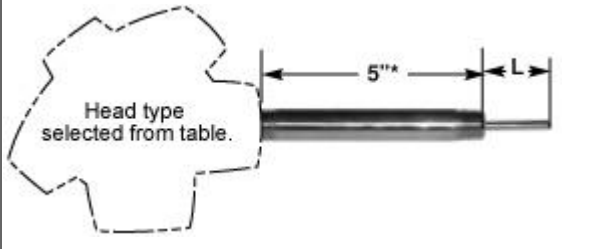
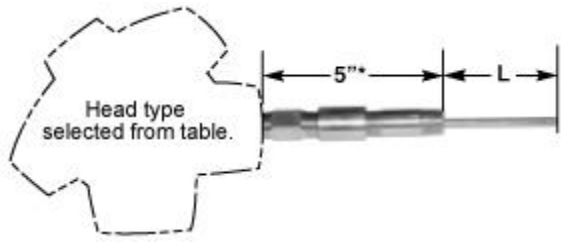
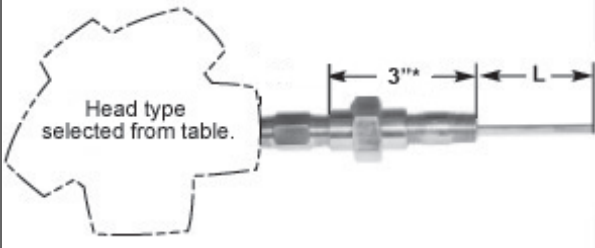
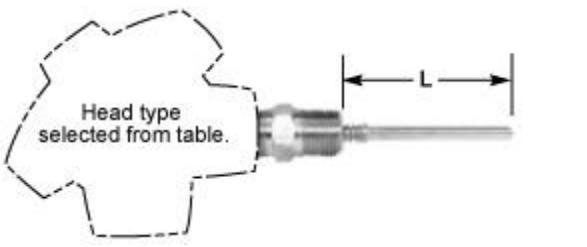
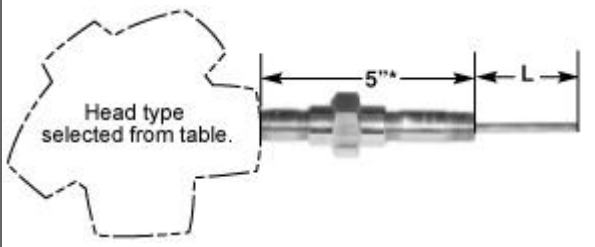
### General Maintenance

- Monthly maintenance checks are usually sufficient for base metal thermocouples. Individual conditions, however, may require more frequent checks.
- Keep rotary switches clean and free of oxidation at contact points.
- When reinserting a thermocouple, it is extremely important that the depth of insertion not be changed. Be especially careful not to decrease the depth. Wires which are not homogeneous, due to exposure to the process, will cause errors in regions of temperature gradients.
- A type K thermocouple should not be exposed to temperatures of 1600° F or higher if it is to be used for accurate measurements below 1000° F.
- Do not use thermocouples with burned-out protecting tubes. Thermocouples can become damaged with contamination if allowed to remain within tubes of poor condition.
- If thermocouples are to be connected in series, parallel or differential, refer to the diagrams on Page 3.



## Terminal Head Connected Thermocouple Assemblies

Table A

<p><b>Figure 1</b></p>	<p>T/C Assembly with 1/2" NPT Nipple/Union Extension (For Male Threaded Tubes and Wells)</p>	<p><b>Figure 4</b></p>	<p>Spring-Loaded T/C Assembly with 1/2" NPT Pipe Nipple Extension</p>
			
<p><b>Figure 2</b></p>	<p>T/C Assembly with 1/2" NPT Hex Fitting/Coupling/ Nipple Extension</p>	<p><b>Figure 5</b></p>	<p>Spring-Loaded T/C Assembly with 1/2" NPT Hex Fitting/Union Nipple Extension</p>
			
<p><b>Figure 3</b></p>	<p>Spring-Loaded T/C Assembly with 1/2" NPT Hex Fitting</p>	<p><b>Figure 6</b></p>	<p>Spring-Loaded T/C Assembly with 1/2" NPT Nipple/Union/Nipple Extension</p>
			

\* For custom extension length, add desired length as suffix to basic order code.

Example: 5046, for 6" long extension.

\*\* Fitting/Extension shown in figures 2, 3, & 5 only available in stainless steel.



A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

\*\*\*Hockey puck transmitter will fit these heads (see accessories section)

\*\*\*\*For corrosion resistance, epoxy coating can be ordered on these head options, Add "EC" as suffix to basic order code.  
 Example: 300EC.

- If connection head is not required, simply insert figure number as basic order code Example: 3






### How to Order:

Tables A -B (Pages 6-8)

Page 6	- Page 7	-	- TW Section
Basic Order Code	Element	"L" Length	Order Code for Thermowell
104	CU4K	12	If required (See Thermowell Section)
Table A	Table B	Table C	

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

Table 4 continued

Type of Head	Head Material	Basic Order Code					
		Figure 1	Figure 2	Figure 3	Figure 4	Figure 5	Figure 6
 Industrial Weatherproof Screw Cover Head	Cast Aluminum	100	200	300	400	500	600
 Epoxy Coated Weatherproof Screw Cover Head <small>3/4" Conduit</small>	Cast Iron	102	202	302	402	502	602
 General Purpose Weatherproof Screw Cover Head For Flip Top Style, add suffix "F" to basic order code	Cast Aluminum	104	204	304	404	504	604
 Corrosion Resistant Weatherproof Screw Cover Head <small>1/2" Conduit</small> For Flip Top Style, add suffix "F" to basic order code	Nylon	106	206	306	406	506	606
 CSA / ATEX / FM Approved Explosion Proof Head meets NEC Class I Div I Groups B, C, D Class II Div I, Groups E, F, G NEMA 4X, 7, 9, II2G, Ex d, IIC, Gb, II2 D, Ex tb, IIC Db, IECEx	Cast Aluminum	108	208	308	408	508	608
	316 Stainless Steel	110	210	310	410	510	610

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

## Elements

### Single Thermocouple, 1/4" O.D. 316 S.S. Metal Sheathed Element



Grounded Hot Junction    Ungrounded Hot Junction

Table B

ANSI Calibrations	Ordering Code	
	Grounded	Ungrounded
J - Iron - Constantan	C4J	CU4J
K - Chromel - Alumel	C4K	CU4K
N - Nicrosil - Nisil	C4N	CU4N
T - Copper - Constantan	C4T	CU4T
E - Chromel - Constantan	C4E	CU4E

### Dual Thermocouple 1/4" O.D. 316 S.S. Metal Sheathed Element



Grounded Hot Junction    Ungrounded Hot Junction    Ungrounded & Isolated (Remote) Hot Junction

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

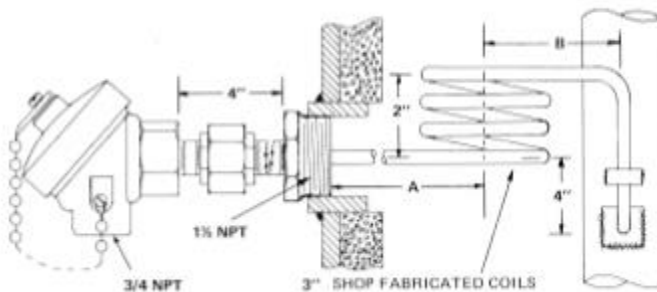
Table B continued

ANSI Calibrations	Ordering Code		
	Grounded	Ungrounded	Ungrounded Isolated
J - Iron - Constantan	D4J	DU4J	DUR4J
K - Chromel - Alumel	D4K	DU4K	DUR4K
N - Nicrosil - Nisil	D4N	DU4N	DUR4N
T - Copper - Constantan	D4T	DU4T	DUR4T
E - Chromel - Constantan	D4E	DU4E	DUR4E

- Sheath materials other than 316 S.S. can be ordered by choosing a material code from the [Material Table](#) in Thermowell section. Insert desired material code as suffix to order code. Example DU4K61.

### Tube Skin Thermocouples

Many types of tube skin thermocouples can be specified by using the tables on the preceding pages. Units with expansion loops and special mounting arrangements are illustrated below. Tube Skin/Furnace tube thermocouple configurations vary widely with individual customers. If you have designs other than shown below, please send us your specifications. We are experienced in fabricating all designs currently used by most industries.



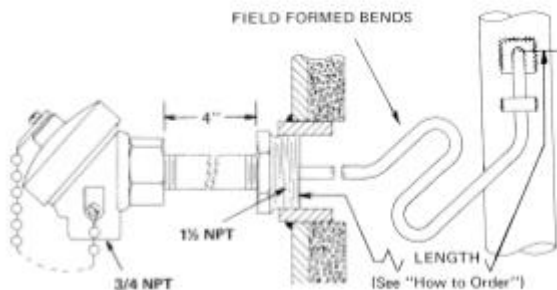
Description	Head Assembly	Calibration	Order Code
As illustrated above with 1/4" Cerampak, 310 S.S. sheath, Grounded welding pad 1 x 1 x 1/8" S.S. Furnished with one (1) hold down clamp. Expansion loops shop fabricated.	Nipple Type (not shown)	Chromel/Alumel	TSA-K-(A)-(B)
		Iron/Constantan	TSA-J-(A)-(B)
	Nipple-Union-Nipple Type	Chromel/Alumel	TSB-K-(A)-(B)
		Iron/Constantan	TSB-J-(A)-(B)

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

**How to Order:**

Specify "Order Code" desired and replace (A) & (B) with desired dimension in Inches.

**Example:** TSA-K-40-16



Description	Head Assembly	Calibration	Order Code
As illustrated above with 1/4" O.D. Cerampak, 310 S.S. sheath, Grounded welding pad 1 x 1 x 1/8" S.S. Furnished with one (1) hold down clamp. "S" bends for expansion are formed by field personnel.	Nipple Type	Chromel/Alumel	TSC-K-(Length)
		Iron/Constantan	TSC-J-(Length)
	Nipple-Union-Nipple Type (not shown)	Chromel/Alumel	TSD-K-(Length)
		Iron/Constantan	TSD-J-(Length)

**How to Order:**

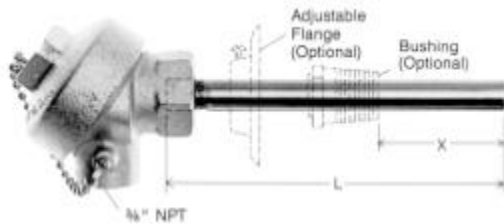
Specify "Order Code" of assembly desired and replace (Length) with length desired in inches.

Important: Length is measured from the bottom of the 1 1/2" NPT bushing to end of pad. Be sure to include sufficient length to field form the "S" bends.

**Example:** TSD-K-120

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

## Metal Protecting Tube Assemblies - Straight



Calibration	Element* Gauge- AWG	Tube ***		Ordering Code				Options
		IPS	O.D.	Type	Material	Head	"L"	
Type J Iron - Constantan	8 AWG	1/2"	.840	JA12	Select Material Code from the <a href="#">Material Table</a> in the Thermowell section	Select from table below	Specify in Inches	Adjustable Flange - If Adjustable Flange is desired, Add Suffix "-A" to complete Ordering Code. ----- ** Welded Bushing If a Welded Bushing is desired, Specify by Adding Suffix: -D(x) for 1/2 " NPT -F(x) for 3/4" NPT -H(x) for 1" NPT -K(x) for 1 1/4" NPT -M(x) for 1 1/2" NPT -P(x) for 2" NPT Replace the (x) with desired "X" dimension in inches. ----- Welded Flange If a Welded Flange is desired, follow "L" dimension in Ordering Code with a) Flange Size b) Rating c) Facing d) Material e) "X" in Inches This Option is Not Illustrated.
		3/4"	1.050	JA34				
		1"	1.315	JA10				
	14 AWG	1/4"	.540	JB14				
		1/2"	.840	JB12				
		3/4"	1.050	JB34				
		1"	1.315	JB10				
Type K Chromel - Alumel	8 AWG	1/2"	.840	KA12				
		3/4"	1.050	KA34				
		1"	1.315	KA10				
	14 AWG	1/4"	.540	KB14				
		1/2"	.840	KB12				
		3/4"	1.050	KB34				
		1"	1.315	KB10				
Type E Chromel - Constantan	8 AWG	1/2"	.840	EA12				
		3/4"	1.050	EA34				
		1"	1.315	EA10				
	14 AWG	1/4"	.540	EB14				
		1/2"	.840	EB12				
		3/4"	1.050	EB34				
		1"	1.315	EB10				
Type N Nicrosil - Nisil	14 AWG	1/4"	.540	NB14				
		1/2"	.840	NB12				
		3/4"	1.050	NB34				
		1"	1.315	NB10				

Other Calibrations and Tube Sizes are Available. Specify Your Requirements.

\* A single or dual element will be furnished according to the type of head selected from the table below.

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

## Right Angle Assemblies - Pipe Extended



Calibration	Element* Gauge- AWG	Tube (Hot Leg)		Ordering Code					Options
		IPS	O.D.	Type	Hot Leg**	Material	Head	Cold Leg	
Type J Iron - Constantan	8 AWG	1/2"	.840	JA42	Select material code from the <a href="#">Material Table</a> in the Thermowell section	Select from table below	Specify in Inches	Specify in Inches	Adjustable Flange - If an adjustable flange is desired, add suffix "A" to complete ordering code.
		3/4"	1.050	JA64					
	1"	1.315	JA40						
Type K Chromel - Alumel	8 AWG	1/2"	.840	KA42					
		3/4"	1.050	KA64					
	1"	1.315	KA40						
Type E Chromel - Constantan	8 AWG	1/2"	.840	EA42					
		3/4"	1.050	EA64					
	1"	1.315	EA40						
	14 AWG	1/2"	.840	JB42					
		3/4"	1.050	JB64					
	1"	1.315	JB40						



A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

Type N Nicrosil - Nisil	8 AWG	1/2"	.840	NA42					
		3/4"	1.050	NA64					
		1"	1.315	NA40					
	14 AWG	1/2"	.840	NB42					
		3/4"	1.050	NB64					
		1"	1.315	NB40					

\* a Single or dual element will be furnished according to the type of head selected from the table below.

\*\* All assemblies are supplied with standard hot legs made with schedule 40 pipes. To specify schedule 80 or 160 - insert "(80)" or "(160)" between the "Type" and "Material" selections in the ordering code table. Example: JA42(80)34-A-18-24. Exception: When a cast iron tube (material code 86 or 87) is used, pipe schedules do not apply. See page 41 for dimensions.

Note: An ordering code type having a "64" in it (3/4" IPS) should be used when ordering an angle assembly with a cast iron tube (material code 86 or 87).

Terminal Head Options		
Head	Terminal Block	Specify
Cast Iron Screw Cover	Single	A
	Dual	AD
Cast Aluminum Screw Cover	Single	B
	Dual	BD

### How To Order:

1. Select the type and gauge of element desired, the size of tube available from the first four columns of the table. Specify by "Type" under ordering code.
2. Select desired "Hot Leg" material code from the [Material Table](#) and add to "Type" designation.
3. Select a head from table above and place its code letter next.
4. Specify cold leg length in inches.
5. Specify hot leg length in inches.
6. Specify option next if desired.

### For Example:

KA6436 - A - 18 - 24 - A

Type/Matl. Head Cold Leg Hot Leg Option

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

## Right Angle Assemblies - 90° Bend



Calibration	Element* Gauge- AWG	Tube (Hot Leg)		Ordering Code					Options
		IPS	O.D.	Type	Hot Leg** Material	Head	Cold Leg	Hot Leg	
Type J Iron - Constantan	8 AWG	1/2"	.840	JA52	Select material code from the <a href="#">Material Table</a> in the Thermowell section	Select from table below	Specify in Inches	Specify in Inches	Adjustable Flange - If an adjustable flange is desired, add suffix "A" to complete ordering code.
	14 AWG	1/2"	.840	JB53 JB74					
Type K Chromel - Alumel	8 AWG	1/2"	.840	KA52					
	14 AWG	1/2"	.840	KB52 KB74					
Type E Chromel - Constantan	8 AWG	1/2"	.840	EA52					
	14 AWG	1/2"	.840	EB52 EB74					
Type N Nicrosil - Nisil	8 AWG	1/2"	.840	NA52					
	14 AWG	1/2"	.840	NB52 NB74					

\* a single or dual element will be furnished according to the type of head selected from the table below.

\*\* All assemblies are supplied with standard schedule 40 pipes. To specify schedule 80 or 160 - insert "(80)" or "(160)" between the "Type" and "Material" selections in the ordering code table. Example: JA52(80)36-A- 24-36 for a schedule 80 pipe.

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

Terminal Head Options		
Head	Terminal Block	Specify
Cast Iron Screw Cover	Single	A
	Dual	AD
Cast Aluminum Screw Cover	Single	B
	Dual	BD

### How to order:

1. Select the type and gauge of element desired, the size of tube available from the first four columns of the table. Specify by "Type" under ordering code.
2. Select desired tube material code from the [Material Table](#) and add to "Type" designation.
3. Select a head from table above and place its code letter next.
4. Specify cold leg length in inches.
5. Specify hot leg length in inches.
6. Specify option next if desired.

### For Example:

KA748 - A - 18 - 24 - A  
 Type/Matl. Head Cold Leg Hot Leg Option

## Ceramic Protecting Tube Characteristics

Thermo Sensors Corporation ceramic tubes are high quality, fine grained, \* non-porous tubes. They are impervious to gases at temperatures near their melting point. Materials available range from mullite (C3 Ceramic) to high purity alumina (C98 Ceramic). Material selection depends upon operating conditions and performance requirements such as temperature, atmosphere, sensitivity to contamination and others.

### C30 Ceramic (Mullite)

Maximum operating temperature of 2900° F (1600° C). Impervious to air to 3000° F, to dry hydrogen and carbon monoxide to 2550° F. Low rate of thermal expansion (2.8 x 10<sup>-6</sup>/° F) enhances thermal shock resistance. Resistance to acid slag is good. Basic slag is fair. Recommended for J, K, N, and E type thermocouples.

### C98 Ceramic (99.8% alumina)

Maximum operating temperature 3450° F (1900° C) in both oxidizing and reducing atmospheres. Inert to hydrogen, carbon, platinum, rhodium and refractory metals under most conditions. High thermal conductivity for fast temperature response. Being more dense than C30, affords longer life in acids, alkalis, molten metals, molten salts and slags. Impervious to most industrial furnace gases even at high temperatures. Recommended for R, S and B type thermocouples.

### **MCT Metal - Ceramic (LT-1)**

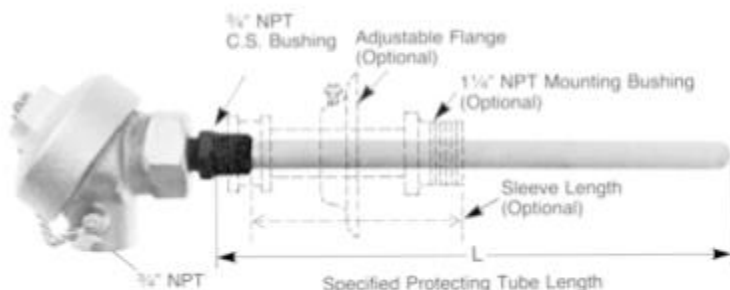
Maximum operating temperature of 2800° F (1538° C). This tube is a combination of aluminum oxide and chromium. Stable in oxidizing atmospheres to 2200° F. Thermal and mechanical shock characteristics are better than pure ceramic tubes, but an extreme temperature span requires a slow insertion time to allow tube to preheat. Sulphur dioxide, sulphur trioxide and concentrated sulphuric acids have little effect on MCT tubes. Since copper, zinc, lead, brass and ferrous alloys do not "wet" MCT tubes their life is longer in such melts, abrasive resistance even at 2200° F. Do not use in acid or carbide slags or molten aluminum.

### **SCT (Silicon Carbide)**

Maximum operating temperature of 3000° F (1649° C). Suggested as primary tube in molten aluminum. Porous\* and affords protection from flame cutting. a secondary tube to provide thermal and mechanical shock resistance in assemblies using C30 and C98 as a primary.

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

## Ceramic Protecting Tube Assembly - Straight



Calibration	Element * Gauge (AWG.)	Tube ** Material	NPT *** I.D. x O.D.	Ordering Code			Options	
				Type	Head	"L"		
Type N Nicrosil - Nisil	8 AWG.	C30 Ceramic C98 Ceramic	9/16" x 3/4"	NA30 NA98	Select Head From Table Below	Specify "L" In Inches Standard Lengths 12"-72" in 6" Increments	Adjustable Flange on a Steel Sleeve: Specify by adding suffix "-A(x)" to ordering code. Replace (x) with sleeve length in inches.  Example: KB30-A-24-A12 a 12"-Flange on 12" Sleeve	1 1/4" NPT Steel Bushing Welded To End of Steel Sleeve. Specify by adding suffix "-K(x)" to ordering code. Replace (x) with sleeve length in inches.  Example: KA30-B-18-K6 K6-1 1/4" NPT Bushing on 6" Sleeve
	14 AWG.	C30 Ceramic C98 Ceramic	7/16" x 11/16"	NB30 NB98				
Type K Chromel - Alumel	8 AWG.	C30 Ceramic C98 Ceramic	9/16" x 3/4"	KA30 KA98				
	14 AWG.	C30 Ceramic C98 Ceramic	7/16" x 11/16"	KB30 KB98				
Type R Platinum - Plat. 13% Rhodium	24 AWG. (.020")	C98 Ceramic	7/16" x 11/16"	RD98				
		RD98 Assembly with 1/4" x 3/8" C98 Inner Primary		RD982				
Type S Platinum - Plat. 10% Rhodium	24 AWG. (.020")	C98 Ceramic	7/16" x 11/16"	SD98				
		SD98 Assembly with 1/4" x 3/8" C98 Inner Primary		SD982				
Type B Rhodium - Plat. 30% Rhodium	24 AWG. (.020")	C98 Ceramic	7/16" x 11/16"	BD98				
		BD98 Assembly with 1/4" x 3/8" C98 Inner Primary		BD982				

\*A single or dual element will be furnished according to type of head selected from table below.

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

Optional Threads*** Materials and Sizes		
NPT	Bushing Material	Order Code
3/4"	Carbon Steel	(Standard)
3/4"	304 S.S.	6S
1"	Carbon Steel	8C
1"	304 S.S.	8S

### How to order:

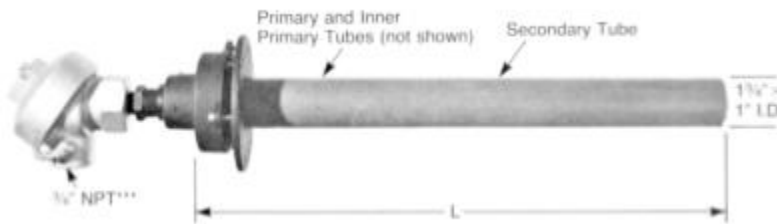
1. Select calibration and gauge of element desired, tube material and size from first four columns of the table. Specify by "Type" under Ordering Code.
2. Select a head from table above and place its code letter next.
3. Specify "L" in inches.
4. Specify option next if desired.

**For Example:**

RD98 - C - 18 - K8  
 Type Head "L" Option

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

## Ceramic Protecting Tube Assembly - Straight For Molten Metals and Furnaces



Calibration	Element** Gauge	Primary* Tube	Tube Size I.D. x O.D.	Secondary* Tube	Ordering Code			
					Type	Head	Length	
Base Metal	Type K Chromel - Alumel	8 AWG.	C30 Ceramic	9/16" x 3/4"	SCT (Silicon Carbide)	KA30SC	Select from table below	Specify "L" in inches
	Type N Nicrosil - Nisil	8 AWG.	C30 Ceramic	9/16" x 3/4"		NA30SC		
						NASC		
Non- Metal	Type R Platinum - Platinum - 13% Rhodium	24 AWG. (.020")	C98 Ceramic	7/16" x 11/16"	SCT (Silicon Carbide)	RD98SC		
			RD98SC Assembly with 1/4" x 3/8" C98 Inner Primary			RD982SC		
	Type S Platinum - Platinum-10% Rhodium	24 AWG. (.020")	C98 Ceramic	7/16" x 11/16"		SD98SC		
			SD98SC Assembly with 1/4" x 3/8" C98 Inner Primary			SD982SC		
	Type B Plat. -6% Rhodium Plat. 30% Rhodium	24 AWG. (.020")	C98 Ceramic	7/16" x 11/16"		BD98SC		
			BD98SC Assembly with 1/4" x 3/8" C98 Inner Primary			BD982SC		

\*\* Selection of a head from table below will determine whether a single or dual element is furnished.



A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

Terminal Head Options		
Head	Terminal Block	Specify
Cast Iron Screw Cover	Single	A
	Dual	AD
Cast Aluminum Screw Cover	Single	B
	Dual	BD
Polished Cast Aluminum General Purpose	Single	C
	Dual	CD

**How to order:**

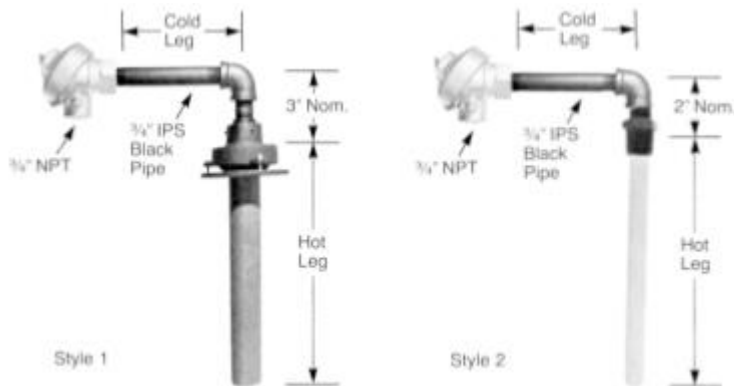
1. Select the desired calibration, wire size, primary and secondary tubes required from the first 4 columns of the table. Specify by "Type" under Ordering Code.
2. Select the desired head from table above and place its code letter next.
3. Place the desired "L" dimension (in inches) after the "Type" code.

**For Example:**

KA30SC - A - 24

Type Head "L"

**Ceramic Protecting Tube Assembly - Angle Type For Molten Metals**



A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

Calibration	Element * Gauge	Style	Hot Leg ** Material	Ordering Code			
				Type	Head	Cold Leg Length	Hot Leg Length
Type N Nicrosil - Nisil	8 AWG.	1	SCT (Silicon Carbide)	N8SC	Select from table below.	Specify in inches.	
	14 AWG.			N14SC			
	8 AWG.	2***	C30 Ceramic C98 Ceramic	N8C30 N8C98			
	14 AWG.		C30 Ceramic C98 Ceramic	N14C30 N14C98			
Type K Chromel - Alumel	8 AWG.	1	SCT (Silicon Carbide)	K8SC			
	14 AWG.			K14SC			
	8 AWG.	2***	C30 Ceramic C98 Ceramic	K8C30 K8C98			
	14 AWG.		C30 Ceramic C98 Ceramic	K14C30 K14C98			

\* Selection of a head from table below will determine whether a single or dual element is furnished.

\*\*\* The hot leg tube of style 2 assemblies has a 3/4" NPT male thread as standard. It is not normally required for this type of assembly, but is provided so that standard tubes can be used for fabrication.

Terminal Head Options		
Head	Terminal Block	Specify
Cast Iron Screw Cover	Single	A
	Dual	AD
Cast Aluminum Screw Cover	Single	B
	Dual	BD

### How to order:

1. Select the desired calibration, wire size, style and hot leg material from the first 4 columns of the table. Specify by "Type" under ordering code.
2. Select desired terminal head from table above and place its letter code next.
3. Place the desired "Cold Leg" length (in inches) next.
4. Place the desired "Hot Leg" length (in inches) next.

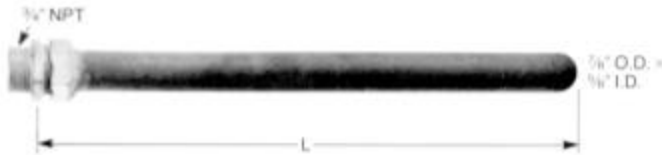
#### For Example:

K8C30 - A - 24 - 18  
 Type Head Cold Leg Hot Leg

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

## \*Metal-Ceramic Protecting Tube with Fitting

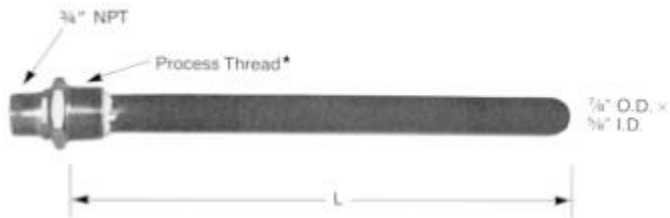
### Single Thread Tube



Also available without 3/4" Instrument Thread

Part Number
MCT580F-(L)
Without Instrument Thread (not shown) MCT580-(L)
Specify "L" in Inches

### Double Thread Tube



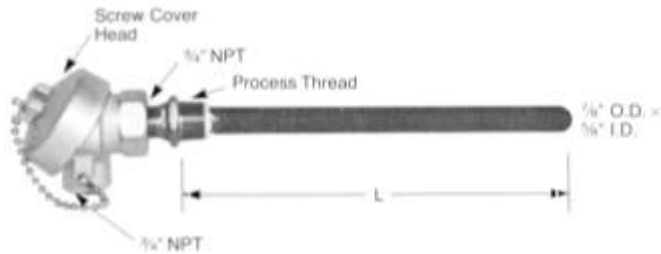
Process Thread	Ritting Material	Part Number
1" NPT (Standard)	C.S.	MCT581H-(L)
	ST.ST.	MCT581HSS-(L)
1 1/4" NPT	C.S.	MCT581K-(L)
	ST.ST.	MCT581KSS-(L)
1 1/2" NPT	C.S.	MCT581M-(L)
	ST.ST.	MCT581MSS-(L)
2" NPT	C.S.	MCT581P-(L)
	ST.ST.	MCT581PSS-(L)

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

### How to Order:

Select Desired Part Number and Specify "L" in Inches  
**Example:** MCT581H-18

### \*Metal-Ceramic Protecting Tube Assembly



ANSI Calibration	Element Gauge	Ordering Code			Process Thread	
		Type	Head	"L"		
Iron/Constantan Type J	8 AWG	J8MCT	Specify Head from Table Below	Specify in Inches	Specify "Order Code" from Table Below	
	14 AWG	J14MCT				
Chromel/Alumel Type K	8 AWG	K8MCT	Specify Head from Table Below	Specify in Inches		Specify "Order Code" from Table Below
	14 AWG	K14MCT				

Terminal Head Options		
Head	Terminal Block	Specify
Cast Iron Screw Cover	Single	A
	Dual	AD
Cast Aluminum Screw Cover	Single	B
	Dual	BD

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

Process Thread Options		
Thread	Order Code	
	Carbon Steel	Stainless Steel
1" NPT	H	HSS
1 1/4" NPT	K	KSS
1 1/2" NPT	M	MSS
2" NPT	P	PSS

### How to Order:

1. Select the type and gauge of thermocouple desired from the first three columns of the table. Specify by "Type" under ordering code.
2. Select a head from the "Terminal Head Options" table and place its code letter next.
3. Specify "L" in inches and place after head code.
4. Specify option from "Process Thread Options" table.

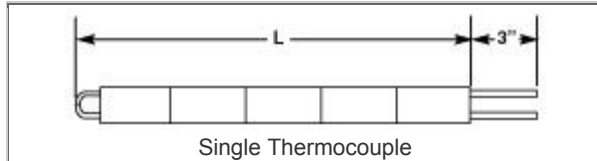
**For Example:**

K8MCT - B - 24 - HSS

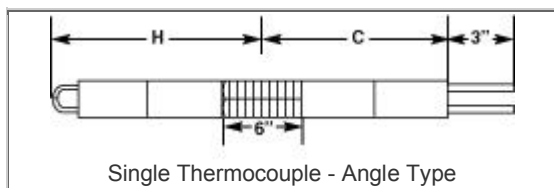
Type Head "L" Option

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

## Replacement Elements - Ceramic Insulated



ANSI Calibration	Gauge (AWG)	Part Number	
		Single	Dual
Type J Iron - Constantan	8	A8J (L)	B8J (L)
	14	A14J (L)	B14J (L)
	20	A20J (L)	B20J (L)
Type K Chromel - Alumel	8	A8K (L)	B8K (L)
	14	A14K (L)	B14K (L)
	20	A20K (L)	B20K (L)
Type E Chromel - Constantan	8	A8E (L)	B8E (L)
	14	A14E (L)	B14E (L)
	20	A20E (L)	B14E (L)
Type T Copper - Constantan	14	A14T (L)	B14T (L)
	20	A20T (L)	B20T (L)

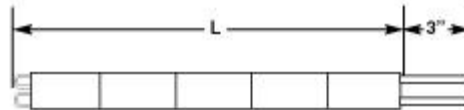


ANSI Calibration	Gauge (AWG)	Part Number
Type J Iron - Constantan	8	L8J-(C)-(H)
	14	L14J-(C)-(H)
Type K Chromel - Alumel	8	L8K-(C)-(H)
	14	L14K-(C)-(H)
Type E Chromel - Constantan	8	L8E-(C)-(H)
	14	L14E-(C)-(H)

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

### How to Order:

Select the calibration and element size desired. Specify the corresponding part number replacing the (C) and (H) with the required lengths in inches.  
 Example: L8K18-24



Dual Thermocouple

### How to Order:

Select the calibration, gauge and element (single or dual) desired. Specify the corresponding part number replacing the (L) with required length in inches.

Example: A8J24

Insulation Dimensions:

- 8 AWG - .500" x .284 Oval
- 8 AWG - .500" Round
- 14 AWG Single & Dual - .250" Round
- 20 AWG Single - .172" x .118" Oval
- 20 AWG Dual - .188" Round

ANSI Calibration	Gauge (AWG)	Part Number	
		Single	Dual
Type R Platinum - Plat. - 13% Rhod.	24 (.020") with .188" O.D. Insulator	N24R (L)	N24RR (L)
Type S Platinum - Plat. - 10% Rhod.		N24S (L)	N24SS (L)
Type B Plat. - 6% Rhod - Plat. - 30% Rhod.		N24B (L)	N24BB (L)
*Platinel II		N24P (L)	N24PP (L)
* Not ANSI Designation			

### How to Order:

Select the calibration desired and specify the corresponding part number replacing the (L) with the required length in inches.  
 Example: N24R24



## Replacement Elements - Bare (no insulators)

### How to Order:

Specify the part number of the desired insulated element from one of the tables above and add suffix - "B."

**Example:** A8K36-B  
(The overall length of this element will be 38")