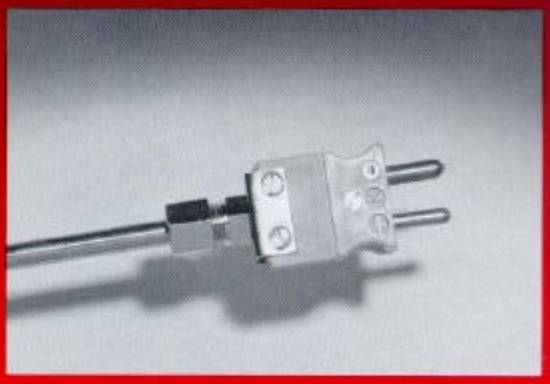
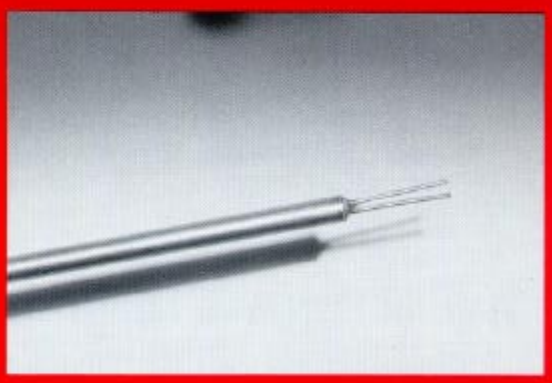
MARSHALL
THERMOCOUPLES





Thermocouples
and Accessories

Thermocouple Application

ANSI Type	Wire Alloys	Temperature Range ºF	Limits of Error	
			Standard	Special
J	Iron (+) vs. Constantan (-)	32 to 530 530 to 1400	± 4° F ± 3/4%	± 2° F \± 3/8 %
K	Chromel (+) vs. Alumel (-)	32 to 530 530 to 2300	± 4°F ± 3/4 %	± 2°F ± 3/8%
T	Copper (+) vs. Constantan (-)	- 300 to - 75 -150 to -75 - 75 to 200 200 to 700	— ± 2% ± 1 1/2° F ± 3/4%	± 1% ± 1% ± 3/4° F ± 3/8%
E	Chromel (+) vs. Constantan (-)	32 to 600 600 to 1600	± 3° F ± 1/2%	— —
R	Platinum (-) vs. Pt. 13% Rhodium (+)	32 to 1000 1000 to 2700	± 5° F ± 1/2%	± 2 1/2° F ± 1/4%
S	Platinum (-) vs. Pt. 10% Rhodium(+)	32 to1000 1000 to 2700	± 5° F ± 1/2%	± 2 1/2° F ± 1/4%
B	Pt. 6% Rhodium (-) vs. Pt. 30% Rh (+)	1600 to 3100	± 1/2%	—
C	Tungsten 26% Rhenium (-) vs. Tungsten 5% Rhenium (+)	800 to 4200	± 1 %	—

Although some of the thermocouples listed above can be used at higher temperatures than those shown, these are generally considered to be maximum reliable operating temperatures.

Type J (Iron vs. Constantan) Can be used protected or unprotected. Reducing atmosphere recommended. Iron wire oxidizes rapidly above 1000° F.

Type K (Chromel-Alumel*) Recommended for oxidizing atmospheres. Should be used in suitable protection tube when in a reducing or sulphurous atmosphere.

Type T (Copper-Constantan) Useable in oxidizing, reducing or inert atmospheres.

Type E (Chromel*-Constantan) Oxidizing atmospheres recommended. Highest EMF of common base metal thermocouples.

Type R (Platinum vs. Platinum 13% Rhodium) Oxidizing atmosphere recommended. Should be protected with ceramic protection tube. Higher EMF output than Type S.

Type S (Platinum vs. Platinum 10% Rhodium) Same general conditions as Type R.

Type B (Platinum 6% Rhodium vs. Platinum 30% Rhodium) Same general conditions as Type R & S. EMF output is lower than Type R & S.

Type C (Tungsten 26% Rhenium vs. Tungsten 5% Rhenium) For use in vacuum or inert gas applications.

*Chromel-Alumel trade name Hoskins Mfg. Co.

Special Purpose Thermocouples

L.H. Marshall Co. has been making thermocouples since 1927 with emphasis on types used worldwide for the taking of molten nonferrous metal temperatures. Today our expertise extends even further into foundry, plastic injection molding and other industrial and commercial thermocouple applications.

Our knowledge in all phases of thermocouple design and manufacture is available to you; both to assist you in answering questions of application and to develop custom thermocouples tailored to your own special needs. Give us a call, or send your specifications for prompt, courteous attention. Call toll-free 1-800-THERMOC. Or FAX (614) 294-0297. In Ohio, call (614) 294-6433 collect. L. H. Marshall Company, Box 02226, Columbus, Ohio 43202.

Emergency Shipping Service

In emergency situations L.H. Marshall Co. will ship small quantities of in-stock thermocouples within 24 hours at no additional charge.

Porta-Probe™Pyrometer

The Porta-Probe pyrometer is a new approach to high accuracy digital temperature measurement for nonferrous melts.

Porta-Probe combines the Marshall thermocouple, a 43" curved Marshall lance and a highly sensitive digital thermometer into one portable, hand-held unit. It measures temperatures from -328° F to + 2498° F (-200° C to + 1370° C) with an accuracy of ± 0. 10% to the nearest degree. The Porta-Probe provides °F readings with 1° or 0.2° resolution, °C resolution of 1° or .1°. Conversion between °F and °C is instantaneous and requires no recalibration.

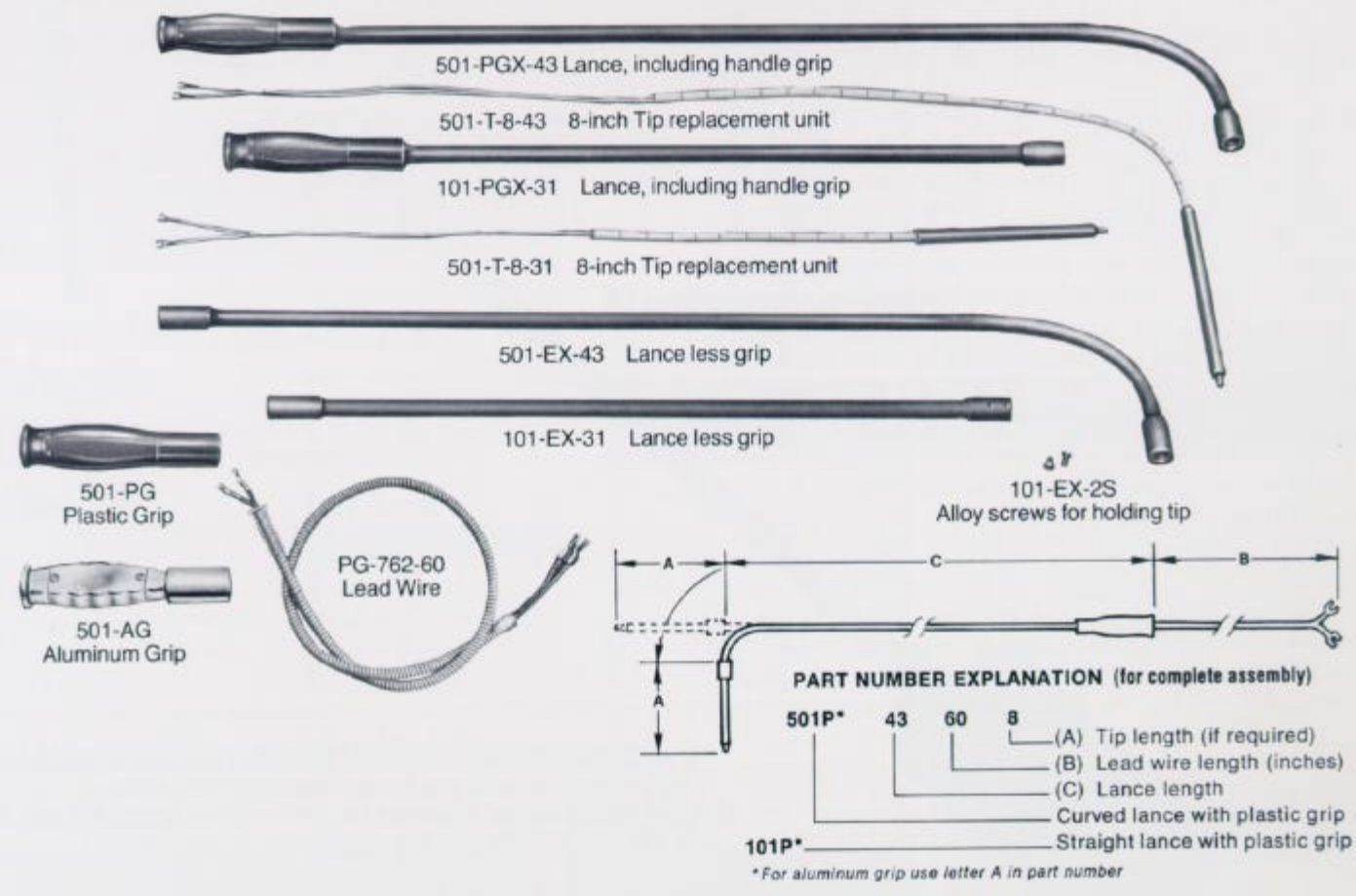
Sixteen gauge Type K thermocouple wires are swaged cl~-rectly into a chrome-iron protection tube, providing a rapid response hot junction. The wires are completely protected from contamination. Thethermometer is housed in acustom molded, high-impact plastic case.

The Porta-Probe can operate for more than 1,200 hours continuously on a single 9-volt transistor radio battery. The 0.30" LCD display indicates temperature, scale in use (°F or °C), low battery and overranged or "open" sensor.

Thermometer Specifications

Temperature Range	-328° F to + 2498° F (- 200° C to + 1370° C)
Display	0.30" LCD
Accuracy	± 1° F, ± 0. 10° F rdg
Resolution	High: 0.2°F, 0.1°C Low: 1°F, 1°C
Indication	°F / °C selectable
Operating Range	0° to 50° C
Accuracy with Time	90 days: add ± 0.05% rdg 1 year: add 0.1% rdg
Temperature Drift	zero: ± 2µ V° C span: ± 0.02% / °C
Probe Connection	Standard mini-connector Type K
Storage Temperature	-20° C to + 70° C
Normal Mode Rejection	50 db at 50 or 60 Hz
Common Mode Rejection	140 db at 50 or 60 Hz
Maximum Common Mode Voltage	1000 VAC, ± 2000 V peak
Measurement Technique	Dual-slope A/D conversion
Linearization	100% digital. Typically 100 segments depending on range selected.
Reference Junction Stability with Temperature	Thermocouple: ± 0.7°C from 5°C to 45°C ±1.3°F from 41°F to 113°F
Input Resistance	Thermocouple: 13M Ω
Update Rate	1 reading / second typical
Battery	9 volt transistor NEDA #1604
Battery Life	I n excess of 1200 continuous hours for thermocouple. Low battery indicator.
Warranty	1 year

Thermocouple Parts List



Curved Lance (90* Bend*)

with grip		without grip
501-PGX-31	31 inch model	501-EX-31
501-PGX-43	43 inch model	501-EX-43
501-PGX-55	55 inch model	501-EX-55
501-PGX-72	6 foot model	501-EX-72
501-PGX-96	8 foot model	501-EX-96
501-PGX-120	10 foot model	501-EX-120

**Special bends available on request.*

Straight Lance

with grip		without grip
101-PGX-31	31 inch model	101-EX-31
101-PGX-43	43 inch model	101-EX-43
101-PGX-55	55 inch model	101-EX-55
101-PGX-72	6 foot model	101-EX-72
101-PGX-96	8 foot model	101-EX-96
101-PGX-120	10 foot model	101-EX-120

Lead wires**

PG-762-40	40 inch
PG-762-60	5 foot
PG-762-120	10 foot
PG-762-180	15 foot
PG-762-240	20foot
PG-762-300	25 foot
PG-762-360	30 foot

***Other lengths available on request.*

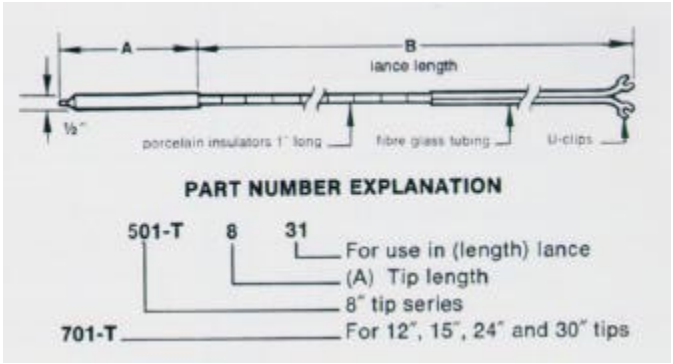
Lead wire assemblies for use with aluminum grip (501-AG) use Part No. R- 762 plus length.

Typical tip replacement units

No. 501-T series are 8" tips	"A" Inches	"B" Inches	for use In lance length
501-T-8-31	8	36	31 in.
501-T-8-43	8	49	43 in.
501-T-8.55	8	61	55 in.
501-T-8-72	8	79	6 ft
501-T-8-96	8	103	8 ft.
501-T-8-120	8	127	110H.

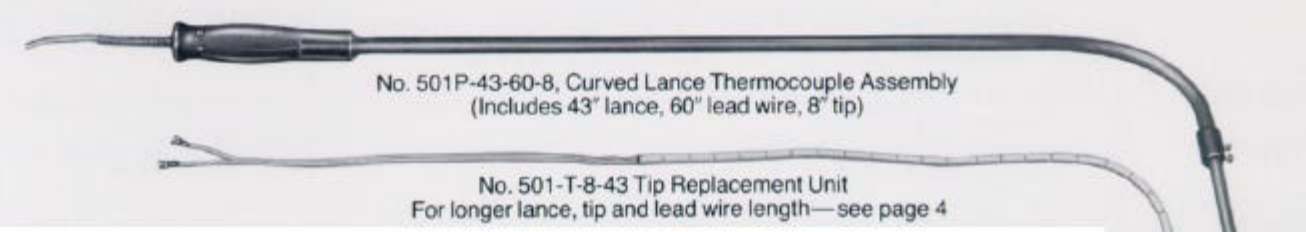
No. 701-T series are the longer tips: 12", 15", 24" and 30". Specify 701 - T plus tip length followed by lance length in inches, as shown in examples below:

701-T-12-72	12	83	6 ft.
701-T-15-55	15	68	55 in.
701-T-20-43	20	61	43 in.
701-T-24-96	24	119	8 ft.



The Marshall Lance

The heavy duty, stainless steel Marshall lance is an important accessory to the Marshall Thermocouple. It is designed for ease of use and carefully constructed to allow for expansion and contraction of the wires during the heating and cooling cycle. The grip has a built-in terminal strip for attaching the thermocouple and extension wires. Two stainless steel screws are provided for holding the tip in place.



Curved

The curved lance is a well-balanced unit ruggedly constructed of heat resistant stainless steel to withstand severe foundry duty. Standard units have a 90' bend and are available in lengths to meet all needs. Special bends are available on request.

Straight

The straight lance is similar in construction to the curved type, and finds many uses such as checking melts in the ladle, pit furnaces, or as the melt enters the mold. It also is available in a variety of standard lengths.

Barber Colman Series DB 17 Digital Indicator

A single-chip microprocessor gives you superior performance and accuracy (± .03% of full scale), with 1° or . 1° resolution. LED display offers four digits with °F or °C legend.
The series D13 17 Digital Indicator provides ranges and calibrations for types E, J, K and T thermocouples.

Barber Colman Input Selector Switches

Here's a convenient way to transfer thermocouple inputs to a single temperature controller or indicator. Model 801A-10 accepts input from eleven different thermocouples, Model 801A-6 accepts seven inputs. Panel mount in any position,

Protection Tubes

Common Materials Protection Tube	
Materials*	**Characteristics**
Type 304	Up to 1650 F (900 C) under oxidizing conditions. Has generally good oxidation and corrosion resistance in a wide range of industrialenvironments. Subject to carbide precipitation, which can reduce corrosion resistance, in the 800-1000 F (430-540 C) range. Good Mechanical properties from - 300 to 1450 F (- 185 to 790 C). Main areas of usage: chemicals, foods, plastics, petroleum. Generally regarded as a standard protection tube material.
Type 310	Up to 2100 F (1150 C) under oxidizing conditions. Power plant boiler tubes to 1800 F (980 C) are main area of application.
Type 316	Up to 1700 F (930 C) under oxidizing conditions. Same areas of application as type 304, plus improved resistance to acid and pitting corrosion,
Type 446	Up to 2000 F (1090 C) under oxidizing conditions. Excellent high temperature corrosion and oxidation resistance. Main areas of application are hardening, nitriding, and annealing furnaces: salt baths, molten lead; tin and babbitt metal-, sulfurous atmospheres. Not for carburizing atmospheres. Other areas are steel soaking pits, tinning pots, waste heat boilers, ore roasters, cement exit flues, boiler tubes to 1800 F (980 C), asphalt mixing incinerators to 2000 F (1090 C), glass tank flues.
Inconel 600	Up to 2100 F (1150 C) under oxidizing conditions. Reducing conditions lower maximum temperature to 1900 F (1040 C). Must not be placed in sulfurous atmospheres above 1000 F (540 C). Main areas of application. carburizing, annealing, and hardening furnaces, cyanide salt baths; blast furnace downcomers; open hearth fluestacks, steel soaking pits, waste heat boilers-, ore roasters-, cement exit flues-, incinerators, glass tank flues.
Inconel 601	Similar applications to Inconel 600, but with superior resistance to sulfur and high temperature oxidation resistance to 2300F(1260C).
Incoloy 800	Up to 2000 F (1090 C) in oxidizing conditions. Similar to Inconel, but less suitable in nitriding and molten caustics. Superior resistance to sulfur than Inconel 600.
Kanthal A-1	Up to 2300 F (1260 C) in oxidizing conditions. Good hightemperature sulfur resistance. Free halogens and alkalis, or their compounds, reduce corrosion resistance severely.
Nickel	Up to 2100 F (1150 C) under oxidizing conditions. Must not be placed in presence of sulfur above 1000 F (540 C). Main areas of application are potassium cyanide salt baths, brines, caustics, high temperature chemical exposure.
Carbon steel (C1018)	Up to 1000 F (540 C) in nonoxidizing environments. Main areas of usage are galvanizing pots, tinning pots, molten babbit metal, molten magnesium, molten zinc, petroleum refinery applications such as dewaxing and thermal cracking.
Low alloy steel (Yoloy)	Up to 1250 F (680 C) in noncorrosive environments. Somewhat superior to carbon steel; replaces wrought iron. Areas of application are annealing furnaces to 1250 F (680 C), ovens, ceramic dryers, glass tank flues.
Cast iron	Up to 1300 F (700 C) in oxidizing conditions. Main area of usage is in molten nonferrous metals: daily whiting is recommended. Can be used to 1600 F (870 C) under reducing conditions.
Metal ceramic (LT-1)	Up to 2500 F (1370 C) in oxidizing conditions. Main areas of usage are molten copper-base alloys to 2100 F (1150 C), blastturnace and stack gases to 2400 F (1315 C), sulfur burners to 2000 F (1090 C), cement kilns to 2200 F (1200 C), chemical process reactors to 2500 F (1370 C). A ceramic primary tube is required when noble metal thermocouple is used.
Mullite (63% alumina)	Up to 2750 F (1510 C). Has poor mechanical shock resistance and good thermal shock resistance. For barium chloride salt baths to 2350 F (1290 C), Should be vertically mounted or supported if horizontal. For high temperature applications of ceramic industry, heat treating, glass manufacture.
Alumina (96%)	Up to 3200 F (1760 C). Has only fair resistance to thermal and mechanical shock. Essentially same areas as mullite, including induction melting, vacuum furnaces.
Alumina (99.5%)	Applications similar to alumina (96%); can be used to 3400 F (1870 C) when properly supported.
Silicon carbide	Up to 3000 F (1650 C). For a secondary protection tube with alumina or mullite primary tube. For brick and ceramic kilns, steel soaking pits, molten nonferrous metals. Can withstand direct flame impingement.
Quartz	Up to 2000 F (1090 C). Excellent resistance to thermal shock. For molten gold and silver.

*In addition to the metallic and ceramic materials listed above, certain plastic coatings, such as Teflon (DuPont), provide corrosion resistance in numerous chemicals and environments.

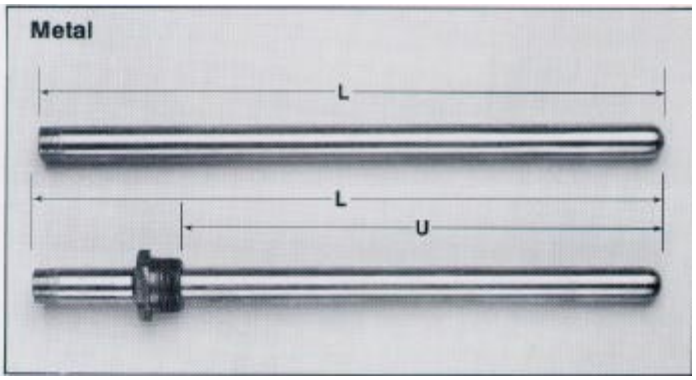
Inconel and Incoloy are trade names of International Nickel Go. Inc.; Kanthal, Kanthal Corp.; and Yoloy, Youngstown Sheet & Tube Co.

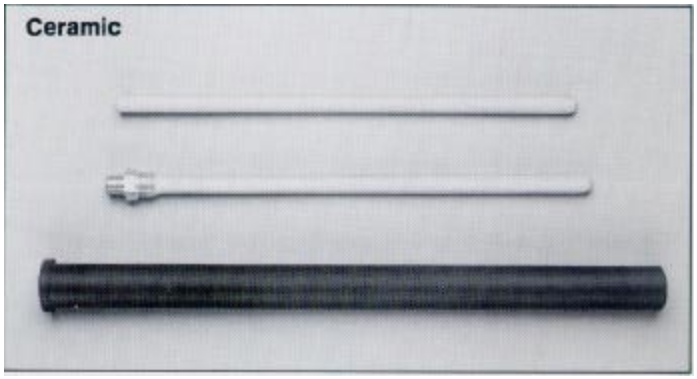
Note: This information should not be considered as a guarantee of adequate or successful use of any of the listed materials in any specific application; it is offered only as a general guide. Numerous variables such as impurities, concentration, temperature cycling, vibration, etc., will affect service given by these materials.

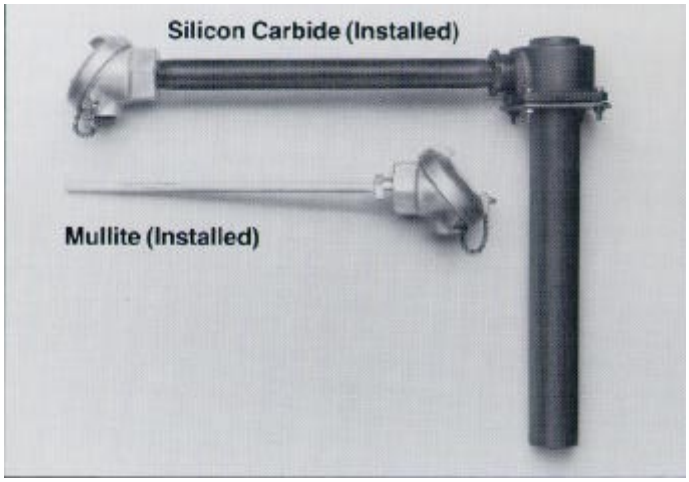
Bare Thermocouple Wire

Chromel	Alumel	Iron	Constantan	Platinum
#8 Ga.	#8 Ga.	#8 Ga.	#8 Ga.	Pure Platinum #24 Ga. (.020")
#14 Ga.	#14 Ga.	#14 Ga.	#14 Ga.	**Platinum-Rhodium**
#16 Ga.	#16 Ga.	#16 Ga.	#16 Ga.	Platinum 10% Rhodium #24 Ga. (.020")
#18 Ga.	#18 Ga.			Platinum 13% Rhodium #24 Ga. (.020")
#22 Ga.	#22 Ga.			**Tungsten- Rhenium**
				Tungsten 5% Rhenium #24 Ga. (.020")
				Tungsten 26% Rhenium #24 Ga. (.020")

Protecting Tubes







Cast Iron
1 5/8 x 7/8 x 24" with 3/4" NPT internal thread.

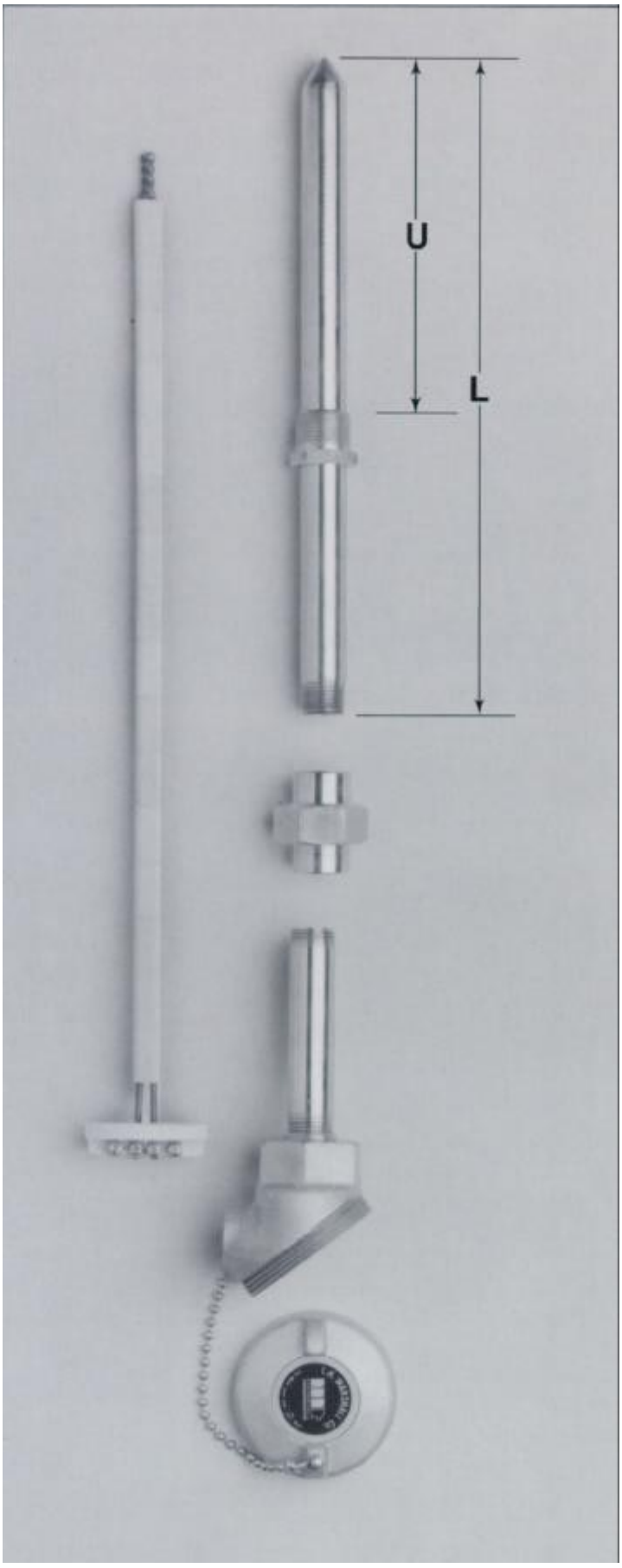
1 5/8 x 7/8 x 30" with 3/4" NPT internal thread.

Inconel 1/2" and 3/4" pipe size, length as specified.

Mullite Tubes (Closed One End, Gas Tight)		
I.D.	**O.D.**	**Long**
5mm	7mm	18"
1/4	3/8	18"
5/16	7/16	18"
3/8	1/2	18"
7/16	11/16	18"
1/4	3/8	24"
7/16	11/16	24"
5/8	7/8	24"
7/16	11/16	30"

Silicon Carbide Tubes (with or Without Flange)		
I.D.	**O.D.**	**Long**
1"	1 3/4	18"
1"	1 3/4	24"

Alumina Tubes 99.98% AL 0 (Closed One End)		
I.D.	**O.D.**	**Long**
5 mm	7mm	24"
1/4	3/8	24"
7/16	11/16	24"



Complete protection tube assemblies for your thermocouple application

L. H. Marshall has everything you need for unsurpassed thermocouple life and accuracy, such as these new protection tube assemblies tailored for your operation.
Not only will your thermocouples last longer, but, when they do need replacement, all you ever need to change are the thermocouple elements.
All this in your choice of thermocouple elements and protection tube materials, in lengths and configurations to suit your needs.

Here's all you do

Specify the sizes, lengths and materials you need:

Thermocouple type

Gauge	Calibration	Part No.	Length
8	Type K Chromel-Alumel	K8S-	(Specify)
14		K14S-	(Specify)
20		K20S-	(Specify)
8	Type J Iron-Constantan	J8S-	(Specify)
14		J14S-	(Specify)
20		J20S-	(Specify)

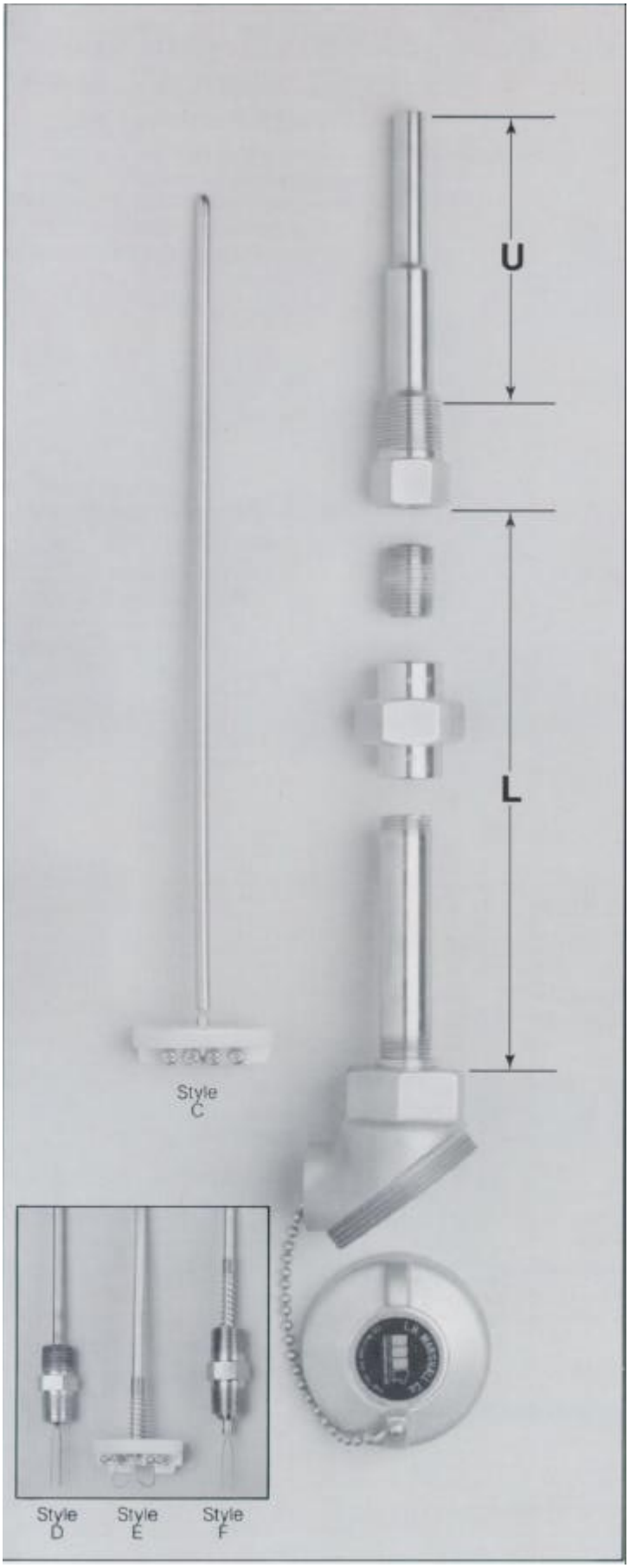
Connection head & terminal block

Part No.	Protection Tube Size	Single Element Block	Dual Element Block
SCH-1	1/2" NPT	MTB 1212	MTB 1412
SCH-2	3/4" NPT		
SCH-3	1" NPT		

Nipple, Union, Protection tube and Process mounting bushing

Indicate tube size: 1/2" NPT, 3/4" NPT or 1" NPT
Select tube material: Standard metals include 304 stainless steel, 316 stainless steel, Inconel 600 and Inconel 601. Other materials are available. Consult your L. H. Marshall Catalog.

Specify the lengths L and U that you require. If a process mounting bushing is not needed, give on!y overall protection tube (L) length.



Thermowell assemblies

L. H. Marshall thermowell assemblies provide you with the same long life and accurate performance as our thermocouples.

Select from the following components:

Thermocouple or RTD

Style	Calibration	Length
C, D, E, F	Type K Chromel-Alumel	(Specify)
	Type J Iron-Constantan	
	Type T Copper- Constantan	

Custom designed RTDs available upon request

Connection head & terminal block

Part No.	Protection Tube Size	Single Element Block	Dual Element Block
SCH-1	1/2" NPT	MTB 1212	MTB 1412
SCH-2	3/4" NPT		
SCH-3	1" NPT		

Nipple, Union and Threaded coupling

Indicate tube size: 1/2" NPT 3/4" NPT or 1" NPT
Select tube material: Standard metals include 304 stainless steel, 316 stainless steel, Inconel 446 and Inconel 601. Other materials are available for special applications. Consult your L. H. Marshall Catalog.

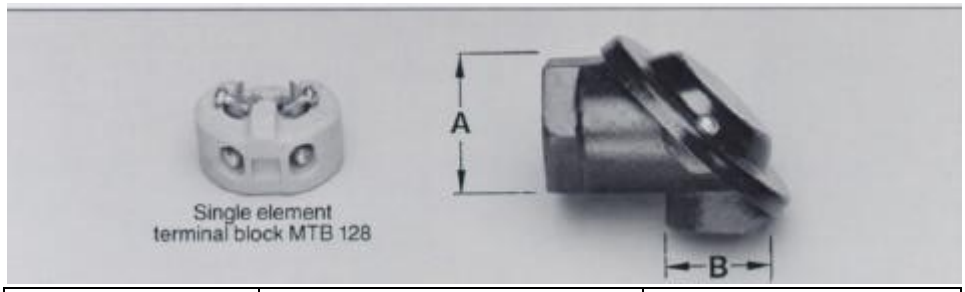
Thermowell

Indicate process size: 1/2" NPT 3/4" NPT or 1" NPT
Indicate thermowell series: Standard or Heavy-duty
Select thermowell material: Standard metals include 304 stainless steel, 316 stainless steel, carbon steel, brass or Monel. Other materials are available.
For further information on thermowell applications, please consult pages 14 and 15 of the L. H. Marshall Catalog.

Specify the lengths L and U that you require.

Thermocouple Components

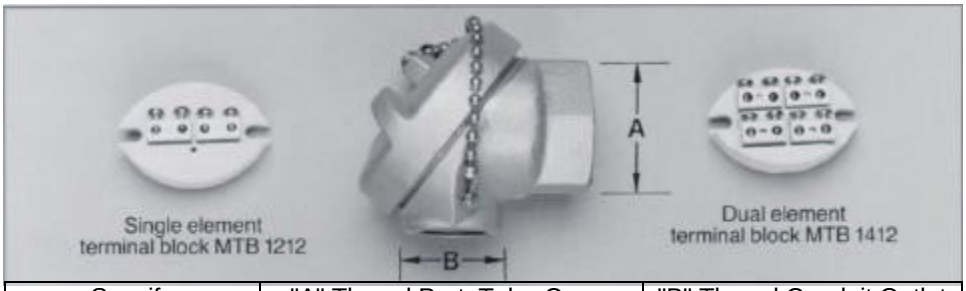
Connection Heads, Terminal Blocks



Specify	"A" Thread Prot. Tube Conn.	"B" Thread Conduit Outlet
GPH-1	1/2 in. NPT	1/2 in. NPT
GPH-2	3/4 in. NPT	
GPH-3	1 in. NPT	

General Purpose Head

Cast iron base with gasketed pressed steel cover. For single element terminal block only. Single element terminal block MTB 128 accommodates #12 B&S ga. or smaller extension wire, #8 B&S ga. or smaller thermocouple wire.



Specify	"A" Thread Prot. Tube-Conn.	"B" Thread Conduit Outlet
SCH-1	1/2 in. NPT	3/4 in. NPT
SCH-2	3/4 in. NPT	
SCH-3	1 in. NPT	

Screw Cover Head

Cast iron base with high temperature aluminum enamel finish. For single or dual element terminal blocks. Single element block MTB 1212 or dual element block MTB 1412 accommodates #12 B&S ga. or smaller extension wire, #14 B&S ga. or smaller thermocouple wire.

Conduit Fitting

For use with silicon carbide tube. Threaded for 1" pipe. Angle type is part number 1478-1. Straight type is part number 1478-2.

Noble Metal Thermocouples

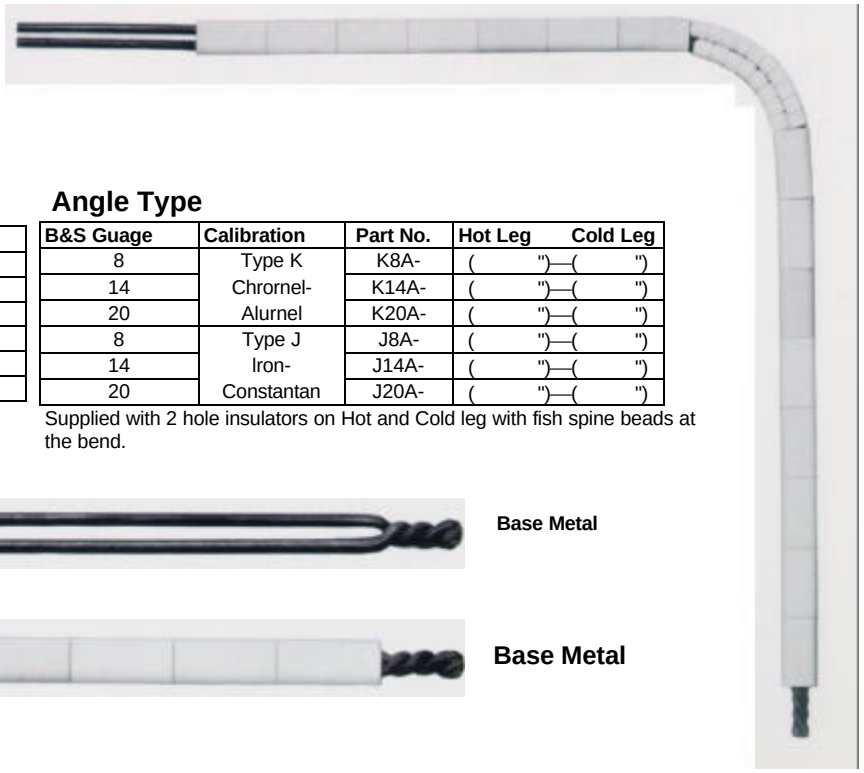
Thermocouple Element with Full Length Insulators

B & S Gauge	Calibration	Part No.	Overall Length (A)	Insulator Length (B)
#24 .020" Dia.	Type R Pt/Pt 13% Rh	PT13	(")	(")
#24 .020" Dia.	Type S Pt/Pt 10% Rh	PT10	(")	(")
#24 .020 Dia.	Type B Pt 6%/Pt 30% Rh	PT630	(")	(")

AL203 Insulator $V' O.D.

Thermocouple Elements

Consisting of matched wires twisted and welded to form the "Hot" junction. Furnished either bare or with conventional ceramic insulators.



Straight Type

Gauge	Calibration	Part No.	length
8	Type K	K8S-	(specified length)
14	Chrornel-	K14S-	(specified length)
20	Alurnel	K20S-	(specified length)
8	Type J	J8S-	(specified length)
14	Iron-	J14S-	(specified length)
20	Constantan	J20S-	(specified length)

Specify "Bare" if insulators are not required.

Angle Type

B&S Guage	Calibration	Part No.	Hot Leg	Cold Leg
8	Type K	K8A-	(")—(	")
14	Chrornel-	K14A-	(")—(	")
20	Alurnel	K20A-	(")—(	")
8	Type J	J8A-	(")—(	")
14	Iron-	J14A-	(")—(	")
20	Constantan	J20A-	(")—(	")

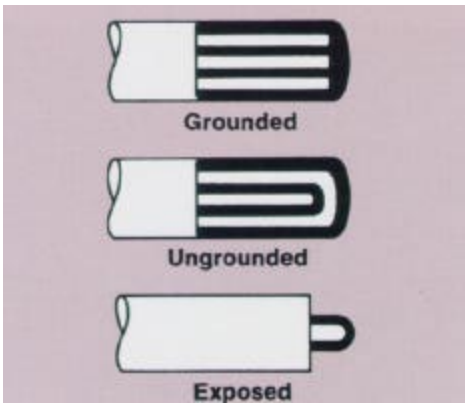
Supplied with 2 hole insulators on Hot and Cold leg with fish spine beads at the bend.

Bare Elements

Base Metal

Base Metal

Measuring Junction Selection for Oxide Insulated Thermocouples



Grounded: Wires are welded securely into the closure end of the sheath, becoming an integral part of the weld. Recommended in presence of liquids, moisture gas or high pressure. The wire is ad equately protected from corrosive or erosive conditions. This type is standard on all assemblies unless otherwise specified.

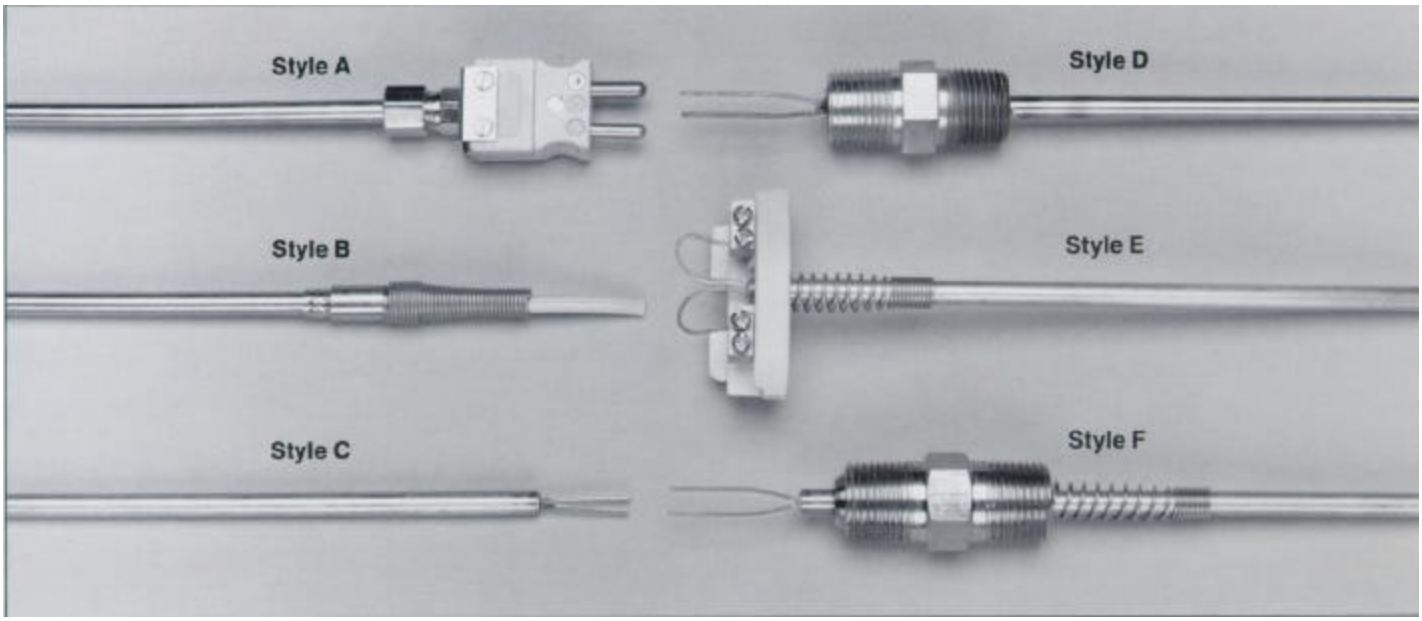
Ungrounded: This ungrounded sensing junction is insulated from the sheath. Recommended where electrical apparatus would introduce stray EMF's and affect the reading.

Exposed: The thermocouple wires are welded beyond the sheath; this reduces mass and shortens the response time. Recommended where fast response is desired, and contaminating conditions are nonexistent.

Thermocouples
Metal Sheathed, Oxide Insulated

Fast, accurate low cost temperature readings. Ruggedly built to read temperatures as high as 2300°F. RTDs also available in most configurations.

Sheath		
Diameter	**Wall Thickness**	**Nominal Conductor Size**
1/16"	.010"	28 Ga.
1/8"	.018"	24 Ga.
3/16"	.025"	20 Ga.
1/4"	.032"	18 Ga.
5/16"	.040"	16 Ga.
3/8"	.049"	14 Ga.
1/2"	.070"	12 Ga.



Catalog Number for Style A Sheathed Thermocouples

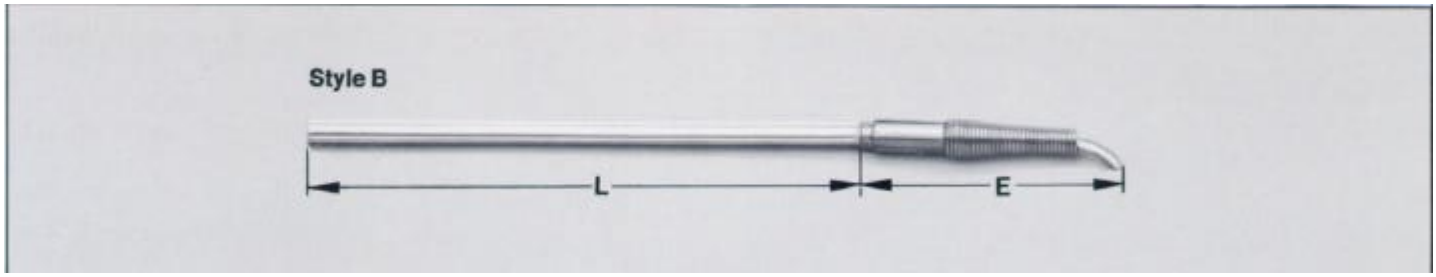
Item 1 Calibration	Item 2 Sheath Diameter*	Item 3, Type of Junction (Hot End)	Item 4 Sheath Material**	Item 5 Type of End	Item 6 Length
K = Chromel-Alumel* J = Iron Constantan T = Copper Constantan	1/16" = 063 1/8" = 125 3/16" = 188 1/4" = 250 3/8" = 375	G = Grounded U = Ungrounded E = Exposed	A = 304 St. St. B = 316 St. St. C = Incone1600	P = Plug J = Jack PJ = Plug and Jack	"L" Dimension in inches

Example: K 125-U-C-P-12 = Type K Chromel-Alumel thermocouple, 1/8" O.D. sheath, ungrounded junction, Inconel sheath, male plug, 12" long.

Item I	Item 2	Item 3	Item 4	Item 5	Item 6
K	125	U	C	P	12

*Trade name Hoskins Mfg. Co.
**Additional sheath materials and sizes available.

Catalog Number for Style B Sheathed Thermocouples



Item 1 Calibration	Item 2 Sheath Diameter**	Item 3 Type of Junction (Hot End)	Item 4 Sheath Material**	Item 5 (Cold End)
K = Chromel-Alumel* J = Iron Constantan T = Copper Constantan	1/16" = 063 1/8" = 125 3/16" = 188 1/4" = 250 3/8" = 375	G = Grounded U = Ungrounded	A = 304 St. St. B = 316 St. St. C = Inconel 600	TF = Transition Fitting

Item 6 Sheath Length	Item 7 Lead Wire Length	Item 8 Flexible Armor	Item 9 Plug, Jack, Both or Spade Lugs	Item 10 Type of Extension Wire
L" Dimension in inches	"E" Dimension in inches	3/16"Dia. 304 St. St. BX Type	P = Plug J = Jack PJ = Plug and Jack LCC = # 8 Spade Lug & 1/2" Conduit Connector	See Pages 9-12

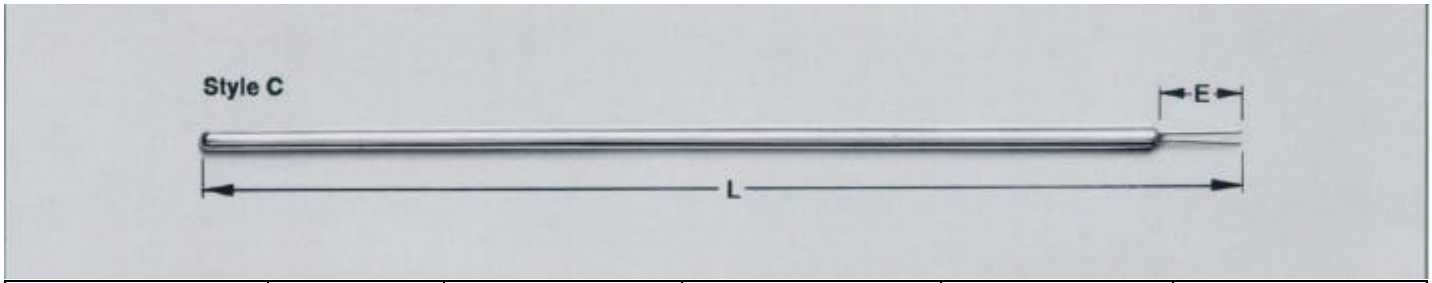
Example: K-125-G-C-TF-12-72-BX-P (205-502) = Type K Chromel-Alumel thermocouple, 1/8" O.D., grounded junction, Inconel sheath, transition fitting, 12" long sheath, 72" long lead wire, BX type flexible armor, male plug, with K20-5-502 extension wire.

Item I	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10
K	125	G	C	TF	12	72	BX	P	(205-502) = K20-5-502

*Trade name Hoskins Mfg. Co.
**Additional sheath materials and sizes available.

Note: If bend is required, indicate by inserting letter **B** after item 6, followed by the degree of bend and length from closed end. **Example:** 90° bend, six inches from closed end = B-90-6.

Catalog Number for Style C Sheathed Thermocouples



Item 1 Calibration	Item 2 Sheath Diameter*	Item 3 Type of Junction (HotEnd)	Item 4 Sheath Material* *	Item 5 Strip Length	Item 6 Overall Length
K = Chromel-Alumel* J = Iron Constantan T = Copper Constantan	1/16" = 063 1/8" = 125 3/16" = 188 1/4" = 250 3/8" = 375	G = Grounded U = Ungrounded E = Exposed	A = 304 St. St. B = 316 St. St. C = Inconel 600	Use letter S plus length ininches	L = Length in inches

Example: K-125-U-C-S3-21 = Type K Chrome-Alumel thermocouple, 1/8" O.D., ungrounded junction, Inconel sheath, 3" strip length, 21" overall length.

Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
K	125	U	C	S3	21

*Trade name Hoskins Mfg. Co. * *Additional sheath materials and sizes available.

Catalog Number for Style D Sheathed Thermocouples

Item I Calibration	Item 2 Sheath Diameter**	Item 3 Type of Junction (Hot End)	Item 4 Sheath Material**	Item 5 Type of Head and Mounting Thread	Item 6 Length
K = Chromel-Alumel* J = Iron Constantan T = Copper Constantan	1/16" = 063 1/8" = 125 3/16" = 188 1/4" = 250 3/8" = 375	G = Grounded U = Ungrounded	A = 304 St. St. B = 316 St. St. C = Inconel 6OO	SC = Screw cover head GP = General purpose head MP = Mini plastic head 1212 = 1/2 x 1/2 Hex pipe bushing brazed to sheath. 3412 = 3/4 x 1/2 Hex pipe bushing brazed to sheath, with 3/4" pipe thread for mounting †	"L" Dimension ininches

Note: to specify screw cover head see Page 8.

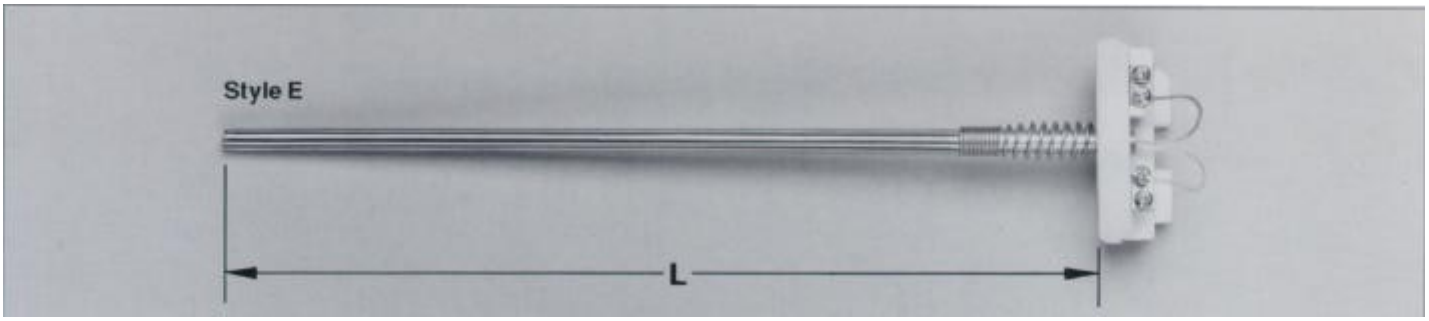
Example: J-125-U-A-SC1212-12 = Type J Iron-Constantan thermocouple, 1/8" O.D., ungrounded junction, 304 stainless steel sheath, screw cover head with 1/2 x 1/2 hex pipe bushing brazed to the sheath, 12" long.

Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
J	125	U	A	SC1212	12

*Trade name Hoskins Mfg. Co.
**Additional sheath materials and sizes available.

If no mounting thread is needed or desired use letters SC or GP to designate head only. 1/2" conduit opening will be supplied unless otherwise designated.

Catalog Number for Style E Sheathed Thermocouples



Item 1 Calibration	Item 2 Sheath Diameter	Item 3 Type of Junction (Hot End)	Item 4 Sheath Material	Item 5 Length
K Chromel-Alumel* J Iron Constantan T Copper Constantan	3/16" = 188 1/4" = 250	G = Grounded U = Ungrounded	A = 304 S.S. B = 316 S.S. C = Inconel 600	"L" Dimension in inches

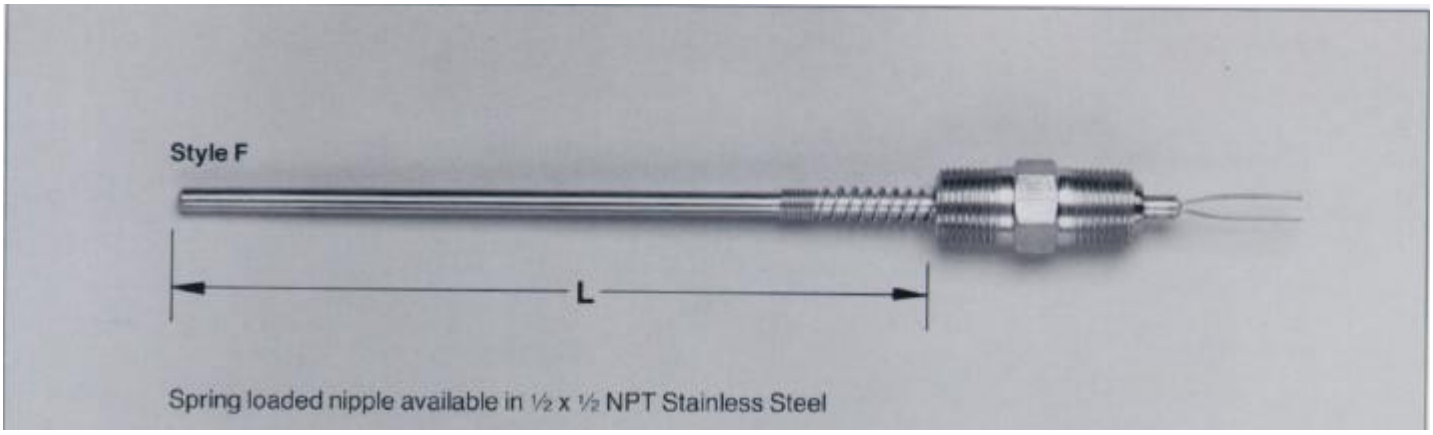
Note: Item 5 = Allow 1" for mounting the terminal block in screw cover head. To specify screw cover head see Page 8.

Example: Style E - K-188-G-B-13 = Type K Chromel-Alumel thermocouple, 3/16" O.D. sheath, grounded junction, 316 stainless steel sheath, 13 L-dimension

Item 1	Item 2	Item 3	Item 4	Item 5
K	188	G	B	13

*Trade name Hoskins Mfg. Go.

Catalog Number for Style F Sheathed Thermocouples



Item I Calibration	Item 2 Sheath Diameter	Item 3 Type of Junction (Hot End)	Item 4 Sheath Material	Item 5 Mounting Thread	Item 6 Length
K = Chromel-Alumel* J = Iron Constantan T = Copper Constantan	1/8" = 125 3/16" = 188 1/4" = 250	G = Grounded U = Ungrounded	A = 304 S.S. B = 316 S.S. C = Inconel 600	1212 = 1/2 x 1/2 S. S. Hex bushing only	"L" Dimension in inches

Note: To specify screw cover head see Page 8.

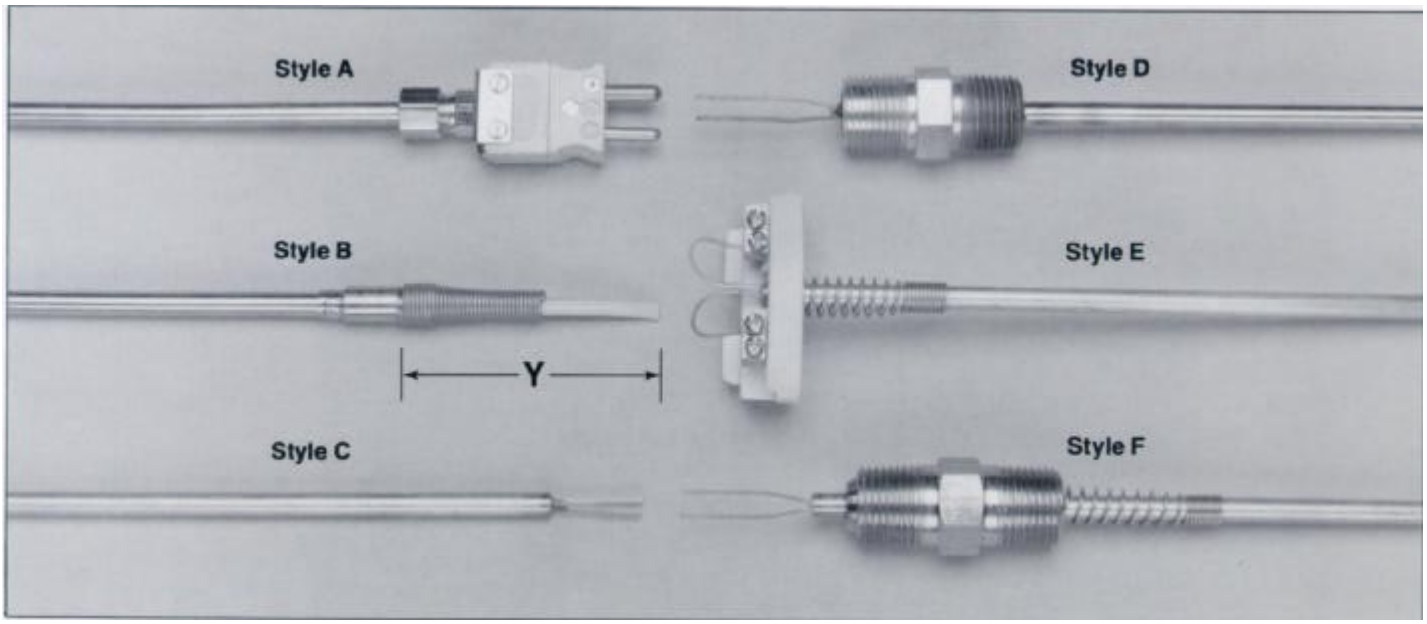
Example: Style F - J-250-G-B-1212-8 = Type J Iron Constantan thermocouple 1/4" O.D. sheath, grounded junction 316 stainless steel sheath 1/2 x 1/2 NPT hex nipple 8 L-dimension

Style	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
(F)	J	250	G	B	1212 S.S.	8

*Trade name Hoskins Mfg. CO.

RTD Assemblies

Platinum 100 ohm RTDs provide fast, accurate and economical temperature readings.



Catalog Number for RTDs

RD - 0 - 0 - 0 - 0 - 0 - 000 - 0 - 00 - 0 - 0

TYPE
A PT 100 ohm (385 curve)
B Other-specifv

NUMBER OF WIRES
A 2
B 3
C 4

TUBE SIZE
A 3/16
B 1/4
C 3/8

MATERIAL
A 304
2 316
3 Inconel

STYLE
A
B-Specify Y lead length
C
D
E
F

TEMP RANGE
A 0-400°F (to 204°C)
B 400-1000°F (204-540°C)

OUTER CONNECTION
A SC head
B Explosion Proof Head
C 8" lead only

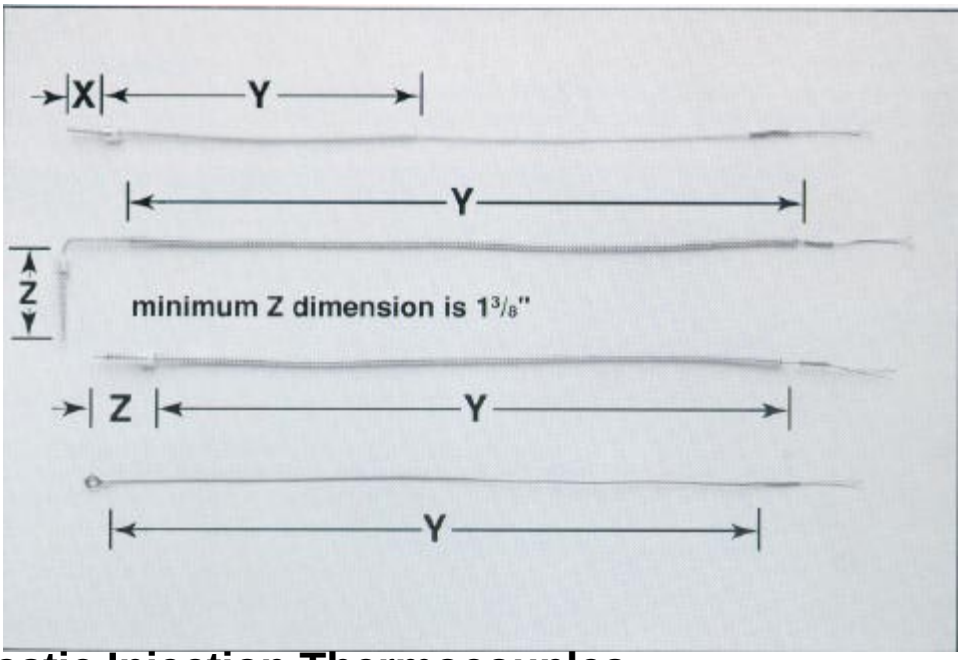
Nipple-Union-Nipple-Specify Length

DRILLED WELL-Specity

LENGTH IN INCHES

Thermocouples for Plastic Injection Molding Applications

Thermocouples are available 'in variable depth, fixed bayonet and other types. Overall length and irr~mersion depth as per customer requirements.



Catalog Number for Plastic Injection Thermocouples

P - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 00 - 000 - 00

STYLE
1 Fixed Immersion
2 Vari-depth
3 Rigid Tube
4 Adjustable Device
5 Lug
6 Ring
7 Melt Bolt
8 Other

TYPE
1 J
2 K
3 T

WIRE-FIBERGLASS STANDARD
1 20 ga solid
2 20 ga stranded
3 20 ga stranded s.s.
4 20 ga solid s.s.
5 24 ga solid
6 24 ga stranded
7 24 ga stranded s.s.
8 24 ga solid s.s.

TUBE
1 1/8
2 3/16
3 1/4
4 3/16-BX
5 3/16-spring

X Dimension in inches Y Dimension in inches Z

COLD END
1 21/2 Split end
2 21/2 Split end lug
3 21/2 Split end lug & box connector
4 Plug
5 Plug and jack

FITTING
1 None
2 Compression 1/8 NPT
3 Compression 1/4 NPT
4 Hex nipple 1/2 x 1/2 NPT
5 Other

ELEMENT
1 Single
2 Single 450 bend
3 Single 900 bend

Add the letter U for ungrounded after element number.

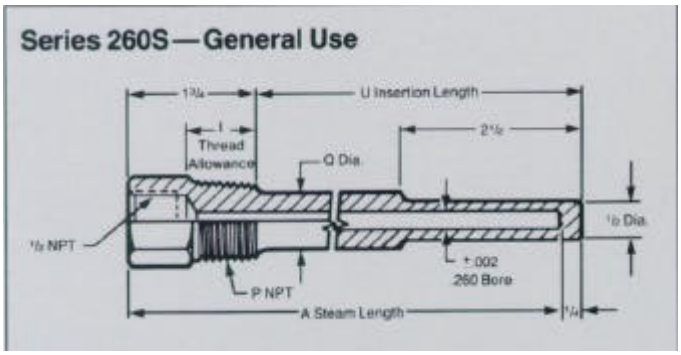
Standard Threaded Thermowells for 1/4" Diameter Elements

Application:
Standard length, 1/4" Stem, Bi-metal thermometers; #20 gauge thermocouple elements-, unarmored liquid-in-glass test thermometers. Other temperature sensing elements having .252 in. maximum diameter.

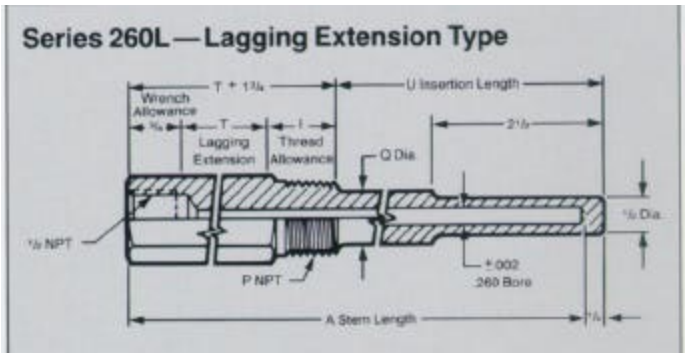
Connection Size:
1/2", 3/4" and 1 " NPT are standard. Other thread sizes are available upon request.

Materials:
Brass (ASTM B-16): Carbon Steel (C-1018); Stainless Steel A.I.S.I.-304 & A.I.S.I.-316; Monel. Wells are availablealso in special materials, prices on request.

Cap & Chain:
Brass captive cap is available for keeping well bore clean when not in use.



EXT TH'D P	TYPE NUMBER	STEM LGTH. A	INSERT. LGTH. U	SHANK DIA. Q
1/2" NPT	1/2"-260S -U 2 1/2	4	2 1/2	-
	-U 4 1/2	6	4 1/2	5/8
	-U 7 1/2	9	7 1/2	"
	-U 10 1/2	12	10 1/2	"
	-U 13 1/2	15	13 1/2	"
	-U 16 1/2	18	16 1/2	"
	-U 22 1/2	24	22 1/2	"
1/4" NPT	3/4"-260S -U 2 1/2	4	2 1/2	-
	-U 4 1/2	6	4 1/2	3/4
	-U 7 1/2	9	7 1/2	"
	-U 10 1/2	12	10 1/2	"
	-U 13 1/2	15	13 1/2	"
	-U 16 1/2	18	16 1/2	"
	-U 22 1/2	24	22 1/2	"
1" NPT	1"-260S -U 2 1/2	4	2 1/2	-
	-U 4 1/2	6	4 1/2	7/8
	-U 7 1/2	9	7 1/2	"
	-U 10 1/2	12	10 1/2	"
	-U 13 1/2	15	13 1/2	"
	-U 16 1/2	18	16 1/2	"
	-U 22 1/2	24	22 1/2	"



EXT TH'D P	TYPE NUMBER	STEM LGTH. A	INSERT LGTH. U	LAG. EXT. T	SHANK DIA. A
1/2 NPT	1/2"-260L -U 2 1/2	6	2 1/2	2	-
	-U 4 1/2	9	4 1/2	3	5/8
	-U 7 1/2	12	7 1/2	3	"
	- U 10 1/2	15	10 1/2	3	"
	-U 13 1/2	18	13 1/2	3	"
	-U 19 1/2	24	19 1/2	3	"
3/4" NPT	3/4" - 260L - U 2 1/2	6	2 1/2	2	-
	-U 4 1/2	9	4 1/2	3	3/4
	-U 7 1/2	12	7 1/2	3	"
	-U 10 1/2	15	10 1/2	3	"
	-U 13 1/2	18	13 1/2	3	"
	-U 19 1/2	24	19 1/2	3	"
1" NPT	I" - 260L -U 2 1/2	6	2 1/2	2	-
	-U 4 1/2	9	4 1/2	3	7/8
	-U 7 1/2	2	7 1/2	3	"
	-U 10 1/2	15	10 1/2	3	"
	-U 13 1/2	18	13 1/2	3	"
	-U 19 1/2	24	19 1/2	3	"

Pressure-Temperature Rating
Lbs. Per Sq. Inch
(Values based on allowable stress levels published in the 1956 edition of the A.S.M.E. Boiler Code, Section VIII.)

Material	TEMPERATURE -°F.						
	70°	200°	400°	600°	800°	1000°	1200°
Brass	5000	4200	1000	—	—	—	—
Carbon Steel	5200	5000	4800	4600	3500	1500	—
A.I.S.I.-304	7000	6200	5600	5400	5200	4500	1650
A.I.S.I.-316	7000	7000	6400	6200	6100	5100	2500
Monel	6500	6000	5400	5300	5200	1500	—

To Order, Please Specify:

1. Complete Type Number
2. Material
3. Cap & Chain - If Desired

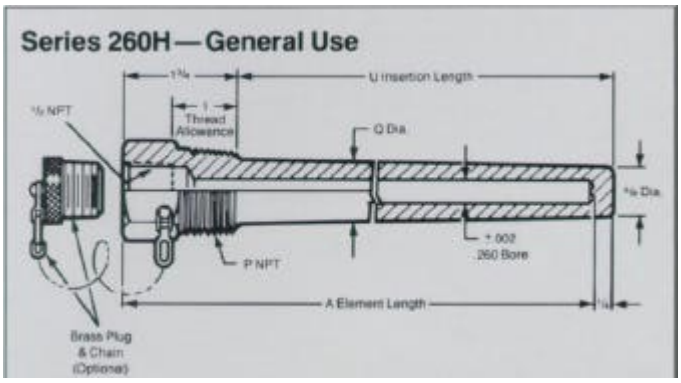
Heavy Duty Threaded Thermowells for 'W'Diameter Elements

Application: Standard length, 1/4" Bi-metal thermometers; #20 gauge thermocouple elements. Unarmored liquid-in-glass test thermometers. Other temperature sensing elements having .252 in. maximum diameter.

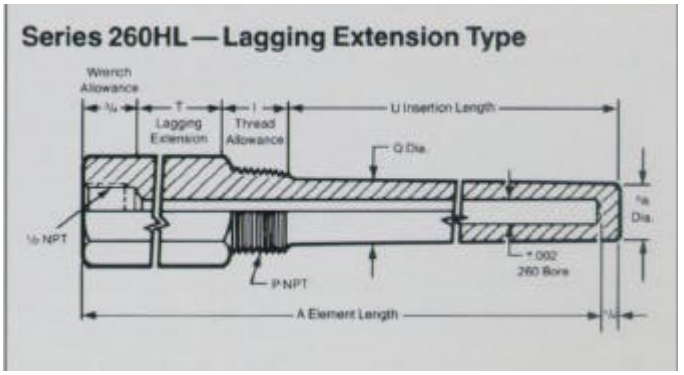
Connection Size: 3/4" NPT and 1" NPT are standard. Other thread sizes are available upon request.

Materials:
Brass (ASTM B-16); Carbon Steel (C-1018); Stainless Steel A.I.S.I.-304 & A.I.S.1-316; Monel. Wells are available also in special materials, prices on request.

Cap & Chain:
Brass captive cap is available for keeping well bore clean when not in use.



EXTERNAL THREAD P	TYPE NUMBER	ELEM. LGTH. A	INSERT. LGTH. U	SHANK DIA. Q
3/4" NPT	3/4" - 260H -U 2 1/2	4	2 1/2	7/8
	-U 4 1/2	6	4 1/2	"
	-U 7 1/2	9	7 1/2	"
	-U 10 1/2	12	10 1/2	"
	-U 13 1/2	15	13 1/2	"
	-U 16 1/2	1 8	16 1/2	"
	-U 22 1/2	24	22 1/2	"
1" NPT	1" - 260H -U 2 1/2	4	2 1/2	1 1/16
	-U 4 1/2	6	4 1/2	"
	-U 7 1/2	9	7 1/2	"
	-U 10 1/2	12	10 1/2	"
	-U 13 1/2	15	13 1/2	"
	-U 16 1/2	1 8	16 1/2	"
	-U 22 1/2	24	22 1/2	"



EXTERNAL THREAD P	TYPE NUMBER	LAG. EXT T	ELEM. LGTH. A	INSERT. LGTH. U	SHANK DIA. Q
3/4" NPT	3/4" - 260HL -U 2 1/2	2	6	2 1/2	7/8
	-U 4 1/2	3	9	4 1/2	"
	-U 7 1/2	3	12	7 1/2	"
	-U 10 1/2	3	15	10 1/2	"
	-U l3 1/2	3	18	13 1/2	"
	- U 19 1/2	3	24	19 1/2	"
1" NPT	1" -26OHL -U 2 1/2	2	6	2 1/2	1 1/16
	-U 4 1/2	3	9	4 1/2	"
	-U 7 1/2	3	12	7 1/2	"
	- U 10 1/2	3	15	10 1/2	"
	-U 13 1/2	3	1 8	13 1/2	"
	-U 19 1/2	3	24	19 1/2	"

Pressure-Temperature Rating
Lbs. Per Sq. Inch
(Values based on allowable stress levels published in the 1956 edition of the A.S.M.E. Boiler Code, Section V111.)

Material	TEMPERATURE -°F.						
	70°	200°	400°	600°	800°	1000°	1200°
Brass	5300	4750	1100	—	—	—	—
Carbon Steel	5950	5750	5450	5250	4000	1750	—
A ISI-304	7800	7050	6400	6150	6000	5190	1875
A I.SI-316	7800	7800	7250	7100	6950	5800	2720
Monel	7450	6850	6150	6100	5940	1750	—

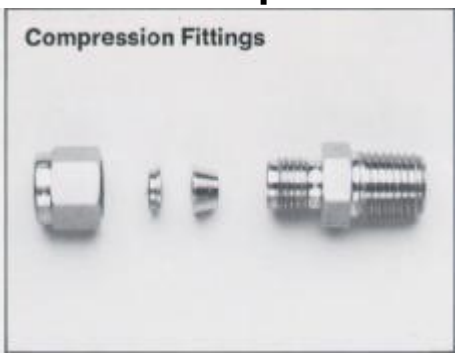
To Order, Please Specify:

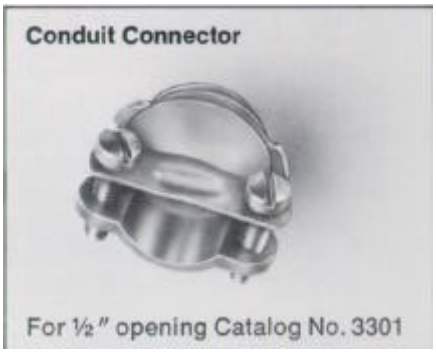
1. Complete Type Number
2. Material
3. Cap & Chain - If Desired

Accessories for Sheathed Thermocouples

Sheath O.D.	Male N.P.T.	Cat. No.
.125"	1/8"	M-12518
.188"	1/8"	M-18818
.250"	1/8"	M-25018
.250"	1/4"	M-25014
.250"	1/2"	M-50014
.313"	1/4"	M-31314
.375"	1/4"	M-37514

To specify Teflon ferrule, add the letter T to the end of the catalog number. Example: M-12518T.





Lightweight gray plastichas 1/4" N.P.T. threaded entrance and exit holes. Temperature rated at 350° F and will accommodate two. three or four 16 ga. wires. It is weatherproof and resists weak acids, organic solvents, alkalies, sunlight and dust.
Catalog No. MP-35014

Plugs and Jacks

Standard Size

Recommended for use with #16 ga. wire or smaller, having outside diameter not exceeding 1/4". Withstands temperature to 400° F.

High temperature plugs and jacks withstand temperatures to 1000° F. To specify, add the letters HT to part number. Example: HT-2060-K.

Type	Color	Cat. No.
J	Black	2060-J
K	Yellow	2060-K
T	Blue	2060-T
R or S	Green	2060-R

Type	Color	Cat. No.
J	Black	2010-J
K	Yellow	2010-K
T	Blue	2010-T
R or S	Green	2010-R

Cable Clamp

Tube Adapter for Plug or Jack

Tube Size	Cat. No.
1/16"	2070-1
1/8"	2070-2
3/16"	2070-3
1/4"	2070-4

Mini Size

Recommended for use with #24 ga. or smaller having outside diameter not exceeding 1/8".

Plugs		
Type	Color	Cat. No.
J	Black	3060-J
K	Yellow	3060-K
T	Blue	3060-T
R or S	Green	3060-R

Jacks		
Type	Color	Cat. No.
J	Black	301 O-J
K	Yellow	301 O-K
T	Blue	301 O-T
R or S	Green	3010-R

Thermocouple Wire Types and Construction

	Single Conductor		Duplex Conductors		Temperature Rating		ANSI	Physical Properties		Notes
Type	Insulation	Impregnation	Insulation	Impregnation	Continuous	Single Reading	Color Coded	Abrasion Resistance	Moisture Resistance	
301	Vitreous Silica Fiber.015"	None	Vitreous Silica Fiber.02011	None	871° C 1600° F	1093° C 2000° F	No	Fair	Fair	
302	Double Glass Braid .012" Wall	Silicone Modified Resin	Glass Braid .006"	Silicone Modified Resin	482° C 900° F	538° C 1000° F	Yes	Good	Good	Impregnation retained to 204°C (400°F)
304	Glass Braid .006"	Silicone Modified Resin	Glass Braid .006"	Silicone Modified Resin	482°C 900°F	538° C 1000° F	Yes	Fair	Good	Impregnation retained to 204°C(400° F)
305	Double Glass Wrap .005"	High Temp. Varnish	Glass Braid .006"	Silicone Modified Resin	482° C 900° F	538° C 1000° F	Yes	Fair	Good	Impregnation retained to 204°C(400° F)
306	Glass Braid .006"	None	Glass Braid .006"	None	482° C 900°F	538° C 1000° F	No	Fair	Fair	Heat treated
307	Teflon* TFE Tape (notfused).004"TFE Coated Glass .006"	—	Teflon Coated Glass Braid	—	482° C 900° F	538° C 1000° F	Yes	Good	Excellent	Teflon good to 260°C (500°F)
310	Fused Teflon Tape TFE .004"	—	Teflon TFE Coated Glass Braid .006"	—	260° C 500° F	316° C 600° F	Yes	Fair	Very Good	—
411	High Temp. Glass Braid .012"	—	High Temp. Glass Braid .012"	Light Lacquer Coating	704° C 1300° F	871° C 1600° F	No	Fair	Fair	Coating retained to 149°C(300°F)
350	TeflonTFE Coated CeramicFiber .018"	—	Teflon TFE Coated Ceramic Fiber .018"	—	1430° C 2600° F	1430° C 2600° F	Yes	Good	Fair	Teflon good to 371°C (700°F)
504	Nylon .010"	—	Nylon .008" - .010"	—	177° C 350° F	—	Yes	Excellent	Fair	Over-all jacket is clear
505	Polyvinyl .012" - .014"	—	Ripcord	—	29 to + 105°C -20to +221° F	—	Yes	Good	Excellent	
507	Teflon FEP Extr. .008"	—	Teflon FEP Extr. .010"	—	204° C 400° F	316° C 600° F	Yes	Very Good	Excellent	
508	Teflon TFE ape fused .005"	—	Teflon TFE Tape fused .0075"	—	260° C 500° F	316° C 600° F	Yes	Good	Excellent	
511	Kapton* .004"	—	None Twisted	—	316° C 600° F	427° C 800° F	Have tracer	Excellent	Excellent	

*Trade names of E.I. DuPont de Nemours & Co.

Thermocouple Wire

Duplex-ANSI Type K ANSI Color Code: Negative Wire, Red; Positive Wire. Yellow; Over-all, Brown with Tracer where possible.

	Size of Wire		Type of Wire		Insulations		Nominal over-all	Approx. Shipping
Cat. No.	B. & S Gaug!	Inch	—	Ohms	Each Conductor	Over-all	Size, Inches Minor x Major	Wt., Lbs. per 1000 Ft.
***K20-1-301**	20	.0320	Solid	.590	Vitreous Silica Fiber Braid	Vitreous Silica Fiber Braid	.102 x .174	16
K20-1-304	20	.0320	Solid	.590	Glass Braid	Glass Braid	.059 x .105	8
K20-1-305	20	.0320	Solid	.590	Glass Wrap	Glass Braid	.054 x .095	8
***K20-1-306**	20	.0320	Solid	.590	Nonimpregnated Glass Braid	Nonimpregnated Glass Braid	.057 x .102	9
K20-1-307	20	.0320	Solid	.590	Teflon (TFE)Tape,Teflon(TFE) Impregnated Glass Braid	Teflon (TFE) Impregnated Glass Braid	.075 x .137	11
+ K20-1-311	20	.0320	Solid	.590	High Temp. Glass Braid	High Temp. Glass Braid	.100 x .150	16
K20-1-350	20	.0320	Solid	.590	Teflon (TFE) Coated Ceramic Fiber	Teflon (TFE) Coated Ceramic Fiber	.096 x .147	16
K20-1-507	20	.0320	Solid	.590	Teflon (FEP) Extruded	Teflon (FEP) Extruded	.072 x .124	11
K20-1-508	20	.0320	Solid	.590	Fused Teflon (TFE) Tape	Fused Teflon (TFE) Tape	.065 x .110	10
+ + K20-1-511	20	.0320	Solid	.590	Fused Kapton Tape	Twisted	.087	10
K20-3-302	20	-	Stranded	.538	Double Glass Braid	Glass Braid	.075 x .137	9
K24-1-304	24	.0201	Solid	1.490	Glass Braid	Glass Braid	.047 x .081	4
K24-1-305	24	.0201	Solid	1.490	Glass Wrap	Glass Braid	.043 x .073	4
K24-1-505	24	.0201	Solid	1.490	Polyvinyl	None-Rip-Cord Construction	.048 x .096	4
K24-1-508	24	.0201	Solid	1.490	Fused Teflon (TFE) Tape	Fused Teflon (TFE) Tape	.047 x .078	5
K26-1-305	26	.0159	Solid	2.370	Glass Wrap	Glass Braid	.040 x .065	3
K28-1-304	28	.0126	Solid	3.770	Glass Braid	Glass Braid	.039 x .064	3
K28-1-305	28	.0126	Solid	3.770	Glass Wrap	Glass Braid	.036 x .057	3
K30-1-305	30	.0100	Solid	5.980	Glass Wrap	Glass Braid	.033 x .053	2

*No, color coded.
Heat treated to remove binders. Not color coded.

+ Light lacquer on duplex only. Not color coded.
+ +Both legs have tracer. Not color coded.

Ohms per double foot at 200C (680F).

Thermocouple Wire

Duplex-ANSI Type T

ANSI Color Code: Negative Wire, Red; Positive Wire, Blue; Over-all. Brown with Tracer where possible.

Cat. No.	Size of Wire B. & S. Gauge	Size of Wire Inch	Type of Wire	Ohms t	Insulations Each Conductor	Insulations Over-all	Nominal over-all Size, Inches Minor x Major	Approx. Shipping Wt., Lbs. per 1000 FL
T20-1-304	20	.0320	Solid	.298	Glass Braid	Glass Braid	.059 x .105	5
T20-1-305	20	.0320	Solid	298	Glass Wrap	Glass Braid	.054 x.095	8
T20-1-307	20	.0320	Solid	.298	Teflon (TFE) Tape,Teflon(TFE) Impregnated Glass Braid	Teflon (TFE) Impregnated Glass Braid	.075 x .137	12
T20-1-507	20	.0320	Solid	.298	Teflon (FEP) Extruded	Teflon (FIEP) Extruded	.072 x .124	11
T20-1-508	20	.0320	Solid	.298	Fused Teflon (TFE) Tape	Fused Teflon (TFE) Tape	.065 x.110	10
T24-1-304	24	.0201	Solid	.753	Glass Braid	Glass Braid	.047 x .081	4
T24-1-305	24	.0201	Solid	.753	Glass Wrap	Glass Braid	.043 x .073	4
T24-1-504	24	.0201	Solid	.753	Nylon	Clear Nylon	.060 x .095	6
T24-1-505	24	.0201	Solid	.753	Polyvinyl	None-Rip-Cord Construction	.048 x .096	3
T24-1-508	24	.0201	olid	.753	Fused Teflon (TFE) Tape	Fused Teflon (TFE) Tape	.047 x .078	5
T28-1-304	28	.0126	Solid	1.905	Glass Braid	Glass Braid	.039 x .064	3
T28-1-305	28	.0126	Solid	1.905	Glass Wrap	Glass Braid	.036 x .057	3
T30-1-305	30	.0100	Solid	3.025	Glass Wrap	Glass Braid	.033 x.053	2

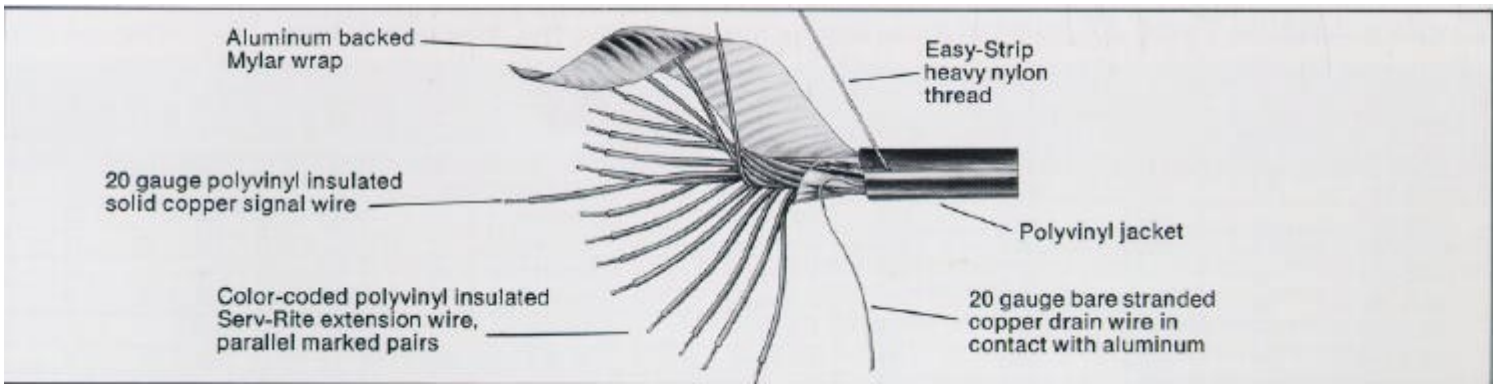
Duplex-ANSI Type J

ANSI Color Code: Negative Wire, Red; Positive Wire, White; Over-all, Brown with Tracer where possible.

Cat. No.	WireSize B&S Gauge	Wire Size Inch	Type of Wire	Ohms t	Insulations Each Conductor	Insulations Over-all	Nominal over-all Size, Inches Minor x Major	Approx. Shipping, WT., Lbs. per 1000 Ft.
J14-1-304	14	.0641	SoN-d	.0-86	Glass Braid	Glass Braid	.096 x .176	32
+ +**J16-1-511**	16	.0508	Solid	.137	Fused Kapton Tape	Twisted	.125	24
J20-1-304	20	.0320	Solid	.357	Glass Braid	Glass Braid	.059 x .105	8
J20-1-305	20	.0320	Solid	.357	Glass Wrap	Glass Braid	.054 x .095	8
****J20-1-306**	20	.0320	Solid	.357	Nonimpregnated Glass Braid	Nonimpregnated Glass Braid	.057 x 102	9
J20-1-307	20	.0320	Solid	.357	Teflon (TFE) Tape,Teflon(TFE) Impregnated Glass Braid	Teflon (TFE) Impregnated Glass Braid	.075 x .137	11
J20-1-504	20	.0320	Solid	.357	Nylon	Clear Nylon	.068 x .120	11
J20-1-507	20	.0320	Solid	.357	Teflon (FEP) Extruded	Teflon (FEP) Extruded	.072 x .124	11
J20-1-508	20	.0320	Solid	.357	Fused Teflon (TFE) Tape	Fused Teflon (TFE) Tape	.065 x.110	10
+ +**J20-1-511**	20	.0320	Solid	.357	Fused Kapton Tape	Twisted	.087	10
J20-3-302	20	—	Stranded	.317	Double Glass Braid	Glass Braid	.075 x.137	9
J24-1-304	24	.0201	Solid	.877	Glass Braid	Glass Braid	.047 x.081	4
J24-1-305	24	.0201	Solid	.877	Glass Wrap	Glass Braid	.043 x .073	4
J24-1-307	24	.0201	Solid	.877	Teflon (TFE) Tape,Teflon(TFE) Impregnated Glass Braid	Teflon (TFE) Impregnated Glass Braid	.062 x .112	8
J24-1-310	24	.0201	Solid	.877	Fused Teflon (TFE) Tape	Teflon (TFE) Impregnated Glass Braid	.050 x .082	8
J24-1-505	24	.0201	Solid	.877	Polyvinyl	None-Rip-Cord Construction	.048 x.096	4
J24-1-508	24	.0201	Solid	.877	Fused Teflon (TFE) Tape	Fused Teflon (TFE) Tape	.047 x .078	5
+ +**J24-1-511**	24	.0201	Solid	.877	Fused Kapton Tape	Twisted	.063	5
J26-1-305	26	.0159	Solid	1.394	Glass Wrap	Glass Braid	.040 x .065	3
J28-1-305	28	.0126	S lid	2.216	Glass Wrap	Glass Braid	.036 x .057	3
J30-1-304	30	.0100	Solid	3.520	Glass Braid	Glass Braid	.037 x .059	3
J30-1-305	30	.0100	Solid	3.520	Glass Wrap	Glass Braid	.033 x .053	3

*Not color coded.
'* Heat treated to remove binders. Not color coded.
+Light lacquer on duplex only+ Not color coded
+ + Both legs have tracer. Not color coded.
T Ohms per double foot at 20º C (68º F).

Multipair Thermocouple Extension Cable



Extension Wire Types, Construction and Characteristics

Type	Single Conductor		Duplex Conductors		Temperature Rating Continuous	ANSI Color Coded	Physical Properties		Notes
	Insulation	Impregnation	Insulation	Impregnation			Abrasion Resistance	Moisture Resistance	
151	Felted ServTex®	Hot Melt Compound	ServTex® Braid	Moisture Resistant Compound	288°C 550°F	Yes	Good	Fair	
303	Enamel/Glass Braid .006"	Silicone Modified Resin	Glass Braid .006"	Silicone Modified Resin	204°C 400°F	Yes	Fair	Good	
401	Polyvinyl .013" to # 20 .014" to #16 .016" to #14	—	Cotton Braid	Wax	88°C 190°F	Yes	Good	Excellent	
501	Polyvinyl .013"	—	Nylon .008"	—	105°C 221°F	Yes	Excellent	Excellent	Jacket is clear.
502	Polyvinyl .013" to #20 .014" to #16 .016" to #14	—	Polyvinyl .016"	—	-29 to + 105°C - 20 to + 221°F	Yes	Good	Excellent	
503	Polyvinyl .015"	—	Twisted with Filler Cotton Serve/ PVC .030"	—	-29 to + 105°C -20 to + 221°F	Yes	Good	Excellent	Stranded conductor only.
510	Polyvinyl .015"	—	Polyvinyl .020" Twisted	—	-29 to + 80°C -20 to + 176°F	Yes	Good	Excellent	Aluminum/Mylar* shield for computer application. #16 uses #18 Drain Wire. #20 uses #20 Drain Wire.

*Trade name of E. 1. duPont de Nemours & Co.

Thermocouple Extension Wire Duplex—ANSI Type KX

ANSI Color Code: Negative Wire, Red; Positive Wire, Yellow; Over-all, Yellow.

Cat. No.	Size of Wire		Type of Wire	Ohms†	Insulations		Nominal Over-all Size, Inches Minor x Major	Approx. Shipping Wt., Lbs. per 1000 Ft.
	B. & S. Gauge	Inch			Each Conductor	Over-all		
K14-5-502	14	.0641	Solid	.147	Polyvinyl	Polyvinyl	.134 x .236	38
K16-5-303	16	.0508	Solid	.233	Enamel, Glass Braid	Glass Braid	.085 x .154	23
K16-5-401	16	.0508	Solid	.233	Polyvinyl	Weatherproof Braid	.117 x.194	26
K16-5-501	16	.0508	Solid	.233	Polyvinyl	Clear Nylon	.102 x.1 86	24
K16-5-502	16	.0508	Solid	.233	Polyvinyl	Polyvinyl	.116 x.188	27
K16-5-510	16	.0508	Solid	.233	105ºC PVC	Twisted, Alum. Mylar & Drain Wire/80ºC PVC	.222	28
K18-7-503	18	—	Stranded	.315	Polyvinyl	Twisted, Filler, Polyvinyl	.254	39
K20-5-401	20	.0320	Solid	.590	Polyvinyl	Weatherproof Braid	.098 x .156	13
K20-5-502	20	.0320	Solid	.590	Polyvinyl	Polyvinyl	.095 x .158	14
K20-5-510	20	.0320	Solid	.590	Polyvinyl	Twisted, Alum. Mylar/PVC	.184	20
K20-7-502	20		Stranded	.528	Polyvinyl	Polyvinyl	.115 x.190	14

Thermocouple Extension Wire

Duplex—ANSI Type JX ANSI Color Code: Negative Wire, Red; Positive Wire, White; Over-all, Black

Cat. No.	Size of Wire		Type of Wire	Ohms ‡	Insulations		Nominal Over-all Size, Inches Minor x Major	Aprox. Shipping, Lbs.
	B.&S. Gauge	Inch			Each Conductor	Over-all		
J14-5-401	14	.0641	Solid	.086	Polyvinyl	Weatherproof Braid	.140 x .240	36
J14-5-502	14	.0641	Solid	.086	Polyvinyl	Polyvinyl	.130 x .226	37
J16-5-303	16	.0508	Solid	.137	Enamel, Glass Braid	Glass Braid	.085 x .154	18
J16-5-401	16	.0508	Solid	.137	Polyvinyl	Weatherproof Braid	.122 x .204	25
J16-5-501	16	.0508	Solid	.137	Polyvinyl	Clear Nylon	.097 x .174	26
J16-5-502	16	.0508	Solid	.137	Polyvinyl	Polyvinyl	.111 x.188	27
J16-5-510	16	.0508	Solid	.137	Polyvinyl	Twisted, Alum. Mylar/PVC	.222	28
J16-7-501	16	—	Stranded	.125	Polyvinyl	Clear Nylon	.120 x .212	24
J18-7-503	18	—	Stranded	.185	Polyvinyl	Twisted, Filler, Polyvinyl	.254	35
J20-5-401	20	.0320	Solid	.357	Polyvinyl	Weatherproof Braid	.101 x.162	25
J20-5-501	20	.0320	Solid	.357	Polyvinyl	Clear Nylon	.081 x .144	16
J20-5-502	20	.0320	Solid	.357	Polyvinyl	Polyvinyl	.095 x .158	14
J20-5-507	20	.0320	Solid	.357	Teflon(FEP)Extruded	Teflon (FEP) Extruded	.072 x .124	11
J20-5-510	20	.0320	Solid	.357	Polyvinyl	Twisted, Alum. Mylar/PVC	.184	20
J20-7-502	20	—	Stranded	.317	Polyvinyl	Polyvinyl	.115 x.190	14

Duplex—ANSI Type EX ANSI Color Code: Negative Wire, Red; Positive Wire, Purple; Over-all, Purple.

E16-5-510	16	.0508	Solid	.278	Polyvinyl	Twisted,Alum.Mylar/PVC	.222	20
E20-5-502	20	.0320	Solid	.704	Polyvinyl	Polyvinyl	.095 x .158	15

Duplex—ANSI Type TX ANSI Color Code: Negative Wire, Red; Positive Wire, Blue; Over-all, Blue.

T14-5-502	14	.0641	Solid	.074	Polyvinyl	Polyvinyl	.130 x .226	37
T16-5-502	16	.0508	Solid	.118	Polyvinyl	Polyvinyl	.111 x.188	28
T16-5-510	16	.0508	Solid	.118	105° C PVC	Twisted, Alum. Mylar & Drain Wire/80° C PVC	.222	28
T20-5-401	20	.0320	Solid	.298	Polyvinyl	Weatherproof Braid	.101 x.162	13
T20-5-502	20	.0320	Solid	.298	Polyvinyl	Polyvinyl	.095 x .158	15
T20-5-510	20	.0320	Solid	.298	Polyvinyl	Twisted,Alum.Mylar/PVC	.184	20

Duplex-ANSI Type SX and RX Compensating Extension Wires for ANSI Type R, S Thermocouples.
ANSI Color Code: Negative Wire, Red; Positive Wire, Black; Over-all, Green.

S16-5-401	16	.0508	Solid	.016	Polyvinyl	Weatherproof Braid	.122 x .204	27
S20-5-304	20	.0320	Solid	.040	Glass Braid	Glass Braid	.059 x .105	8
S20-5-501	20	.0320	Solid	.040	Polyvinyl	Clear Nylon	.081 x .144	17

Tungsten/Tungsten Rhenium Alloys

***X28-5-305-100**	28	.0126	Solid	2.40	Glass Wrap	Glass Braid	.036 x.057	3
†**X28-5002**	28	.0126	Solid	4.10	Glass Wrap	Glass Braid	.036 x .057	3

*Compensating Extension Wires for Tungsten 5% /Tungsten 26% Rhenium Thermocouples, Hoskins Alloys 405/426. Color Code: Negative Wire, Red; Positive Wire, Orange; Over-all, Orange.
Compensating Extension Wires for Tungsten 3% /Tungsten 25% Rhenium Thermocouples, Hoskins Alloys 203/225. Color Code: Negative Wire, Red; Positive Wire, Orange; Over-all, Orange with Double Black Tracer.
Ohms per double foot at 20ºC (68ºF).

Limits of Error for Thermocouples and Thermocouple Wire

Reference Junction 0ºC (321F)

Thermo-couple Type	Temperature Range	Limits of Error	
		Standard	Special
T	0 to 133ºC (32 to 270ºF) 133 to 350ºC (270 to 662ºF)	± 1ºC (2ºF) ± .75%	± 5ºC (1ºF) ± .4%
J	0 to 293ºC (32 to 559ºF) 293 to 750ºC (559 to 1382ºF)	± 2.2ºC (4ºF) ± .75%	± 1.1ºC (2ºF) ± .4%
E	0 to 340ºC (32 to 644ºF) 340 to 900ºC (644 to 1652ºF)	± 1.7ºC (3ºF) ± .5%	± 1ºC (2ºF) ± .4%
K	0 to 293ºC (32 to 559ºF) 293 to 1250ºC (550 to 2282ºF)	± 2.2ºC (4ºF) ± .75%	± 1.1ºC (2ºF) ± .4%
R, S	0 to 600ºC (32 to 1112ºF) 600 to 1450ºC (1112 to 2642ºF)	± 1.5ºC (3ºF) ± .25%	± .6ºC (1ºF) ± .1 %
B	800 to 1700ºC (1472 to 3092ºF)	± .5%	—
T*	-200 to - 66ºC (-328 to - 87ºF) - 66 to 0ºC (-87 to +32ºF)	± 1ºC (2ºF) ± 1.5%	—
E*	-200 to -100ºC (-328 to -148ºF) -100 to 0ºC (-148 to +32ºF)	± 1.1ºC (3ºF) ± 1%	—
K*	-200 to -110ºC(-328 to -166ºF) -110 to 0ºC (-166 to +32ºF)	± 2.2ºC (4ºF) ± 2%	—

*Thermocouples and thermocouple materials are normally supplied to meet the limits of error specified in the table for temperatures above 0ºC (32ºF). 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 suggests the following limits for types E and T thermocouples:

Type E	-200 to 0ºC (-328 to + 32ºF)	1ºC or .5%
Type T	-200 to 0ºC (-328 to +32ºF)	.5ºC or .8%

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 0ºC (32ºF)

Extension Wire Type	Temperature Range	Limits of Error	
		Standard	Special
KX	0 to 200ºC (32 to 392ºF)	± 2.2ºC (4ºF)	—
JX	0 to 200ºC (32 to 392ºF)	± 2.2ºC (4ºF)	± 1.1ºC (2ºF)
EX	0 to 200ºC (32 to 392ºF)	± 1.7ºC (3ºF)	—
TX	- 60 to +100ºC (-76 to 212ºF)	± 1.0ºC (2ºF)	± .5ºC (1ºF)

Limits of Error for Thermocouple Compensating Extension Wire

Reference Junction 0ºC (32ºF)

Thermocouple Type	Compensating	Temperature	Limits of Error†
R, S	SXt	0 to 200ºC (32 to 392ºF)	±5ºC (9ºF)
B	BX#	0 to 100ºC (32 to 212ºF)	0ºC or F -3.7ºC (6.7ºF)

†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 limits of error are based on the following measuring junction temperatures:

Type Wire	Measuring Junction Temperature
SX	Greater than 870ºC (1598ºF)
BX	Greater than 1000ºC (1832ºF)

‡Copper (+I) versus copper nickel alloy (-)

#Copper versus copper compensating extension wire, usable to 100ºC (212ºF) with maximum errors as indicated, but with no significant error over 0 to 50ºC (32 to 122ºF) range. Matched proprietary alloy compensating wire is available for use over the range 0 to 200ºC (32 to 392ºF) with claimed limits of error ±3.7ºC†.

Color Coding

Standard 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.

ANSI TypeMagnetic		Magnetic		Single	ANSI Color Code Over-all Extension Wire	Over-all T/C Wire
Yes	No	Yes	No			
T	TP TN		● ●	Blue Red	Blue	Brown
J	JP JN	●	 ●	White Red	Black	Brown
E	EP		● ●	Purple Red	Purple	Brown
K	KP KN	 ●	●	Yellow Red	Yellow	Brown
R, S	RP, SP RN, SN		● ●	Black Red	Green	—
B	BP BN		● ●	Grey Red	Grey	—

ANSI LETTER DESIGNATIONS Thermocouple and extension wires are now generally ordered and specified by ANSI letter designations for calibration. Popular generic and trade name examples are Chromel/Alumel-ANSI Type K; Iron/Constantan-ANSI Type J; Copper/Constantan-ANSI Type T: Chromel/Constantan-ANSI Type E; Platinum Platinum 10% Rhodium-ANSI Type S: Platinum/ Platinum 13% Rhodium-ANSI Type R, and Platinum 6% Rhodium/ Platinum 30% Rhodium-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 the 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, T , Thermokanthal KP
KN	Alumel, Nial, T , Thermokanthal KN
RP	Platinum 13% Rhodium
SP	Platinum 10% Rhodium
RN or SN	Pure Platinum
BN	Platinum 6% Rhodium
BP	Platinum 30% Rhodium

Trade names: Cupron, Nial and Tophel—Wilbur B. Driver Co. • Advance, T , and T — Driver-Harris Co. - Chromel and Alumel-Hoskins Mfg. Go. • Thermokanthal KP and Thermokanthal KN—The Kanthal Corporation.

Fish Spine Beads- Steatite

Safe operating temperature for continuous duty: 1850º F, Softening Temperature 2550º F.

cat.	O.D.	I.D.	Length	Pieces Per Lb.
I-C	.110	.056	.110	16,600
2-B	.170	.068	.170	4,870
4-C	.260	.152	.260	1,595
9-B	.540	.350	.540	192

Porcelain Insulators- Steatite

Safe operating temperature for continuous duty: 2050º F. Softening Temperature 2500º F.

2 Hole Oval

5/16 x 3/16 x 5/64 x 1"
1/2 x 9/32 x 5/32 x 1"
1/2 x 9/32 x 3/16 x 3"
9/16 x 5/16 x 3/16 x 1"

2 Hole Round

O.D.	I.D.	Long
1/4	.070"	1"
15/32	.171"	1"
1/2	.187"	1"
1/2	.187"	3"

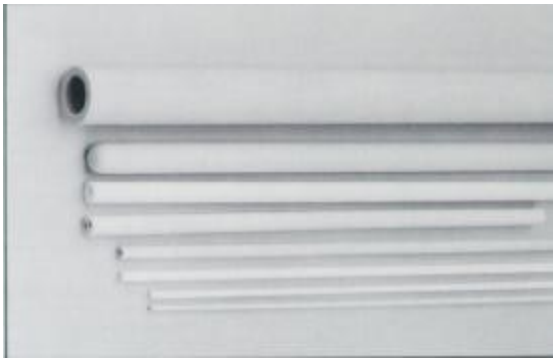
Resistance Wire

Resistance Wire 80% Ni. 20% Cr.

AWG or B & S Ga.	Inches Diameter	Ohms-per-toot	Feet per Lb.
14	.064	.1587	85
16	.051	.2499	134
18	.040	.4063	218
20	.032	.6347	341
22	.025	1.015	545
23	.023	1.273	683
24	.020	1.609	864

Alumina and Mullite Ceramics

Insulators



Lab Ware

99.8% alumina can be used at operating temperatures to 19500 C in both oxidizing and reducing atmospheres. It is inert to hydrogen, carbon and refractory metals under the most severe conditions.

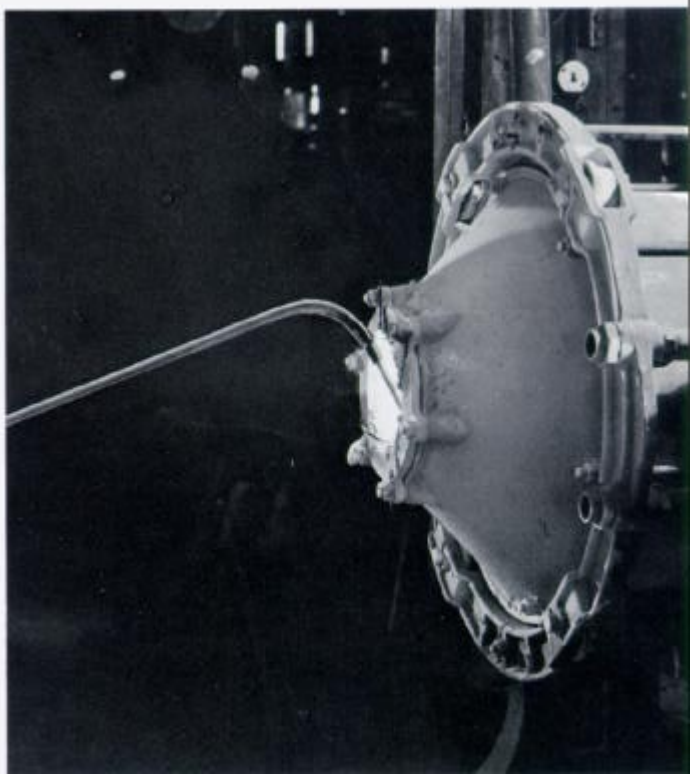
99.0% alumina offers the desirable characteristics of alumina at an economical price. It exhibits good insulating characteristics and high temperature capabilities.

Both 99.8% and 99.0% alumina are available in labware and insulators.
Also available as a high quality, economical insulating tubing is a dense matrix of 80% mullite and 20% glass.

Typical Physical Properties:

Constitution	99.8% AL O	99% AL O	80% Mullite 20% Glass
Bulk Specific Gravity	3.85	3.7	2.4
Impenetrability	Gas Tight	Gas Tight	Gas Tight
Flexural Strength (psi)	55.000	55,000	20,000
Compressive Strength (psi)	>300,000	>300,000	>100,000
Tensile Strength (psi)	30,000	30,000	14,000
Maximum Working Temperature	1950ºC	1900ºC	1650ºC
Dielectric Strength 24ºC V/Mil	>230	250	250
Volume Resistivity 24ºC ohnn-cm	$>10^{13}$	10^{13}	—
Te Value	800ºC	>1100ºC	—

Note: If insulators and labware listed above do not fulfill your needs, contact L. H. Marshall Co. for a complete product list.



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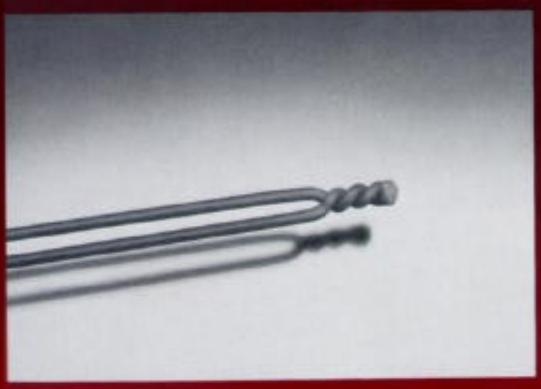

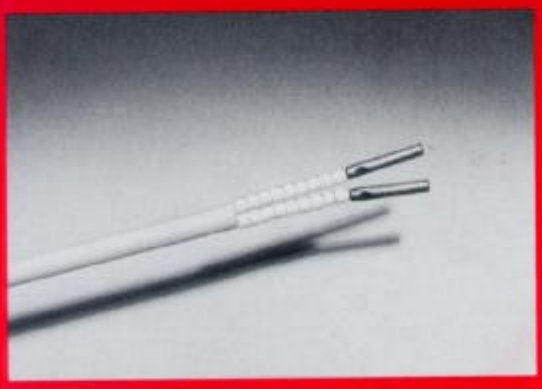

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