THERMOCOUPLES & RTD'S

INDEX

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THERMOCOUPLE ASSEMBLIES

THERMOCOUPLE ASSEMBLES

The following pages illustrate most of the commonly used types of industrial thermocouple assemblies. If you do not find exactly what you need, we will gladly manufacture special thermocouple assemblies per your exact specifications. When necessary, our own machine shop can quickly fabricate many types of unusual components to avoid unnecessary and costly delivery delays. We, at Sandelius, are committed to do everything possible to supply our customers with exactly what they need, when they need it.

METAL SHEATH TYPE ASSEMBLIES

Pages A-2 through A-11 of this catalog deal with metal sheath type thermocouple assemblies. Sandelius metal sheath type thermocouples represent the current state-of-the-art in thermocouple probe technology. The outside metal sheath protects both the thermocouple conductors and the compacted magnesium oxide (MgO) insulation from potential damage and failure caused by corrosion, contamination, oxidation or mechanical shock. Metal sheath type assemblies are easy to work with and install. The sheath material can be bent to a radius equal to approximately twice its diameter without damage. It maintains its shape after bending allowing it to be formed to fit any application. The rugged, gas-tight nature of the metal sheath makes gas-tight sealing a simple matter even without the use of a thermowell or protecting tube. When used inside a thermowell or protecting tube, the metal sheath protects the conductors from oxidation and provides an added margin of protection without appreciable loss of response time.

RTD ASSEMBLIES

Sandelius Instruments, Inc. also manufactures a full line of RTD assemblies. Any of the assembly styles described in this brochure can be modified to incorporate an RTD element in place of the thermocouple element. Specifications and ordering numbers for some of the more commonly used RTD type assemblies can be found on pages 20 and 21 of this catalog. Or you may simply call us and describe the assembly you need.

NIST TRACEABLE CALIBRATION

Sandelius maintains a state-of-the-art computerized temperature calibration laboratory to provide temperature calibration tests which are fully traceable to the National Institute of Standards and Technology (NIST; formerly NBS). Certificates of Calibration are available for all calibrated items. Reports can be customized to suit any special customer requirements.

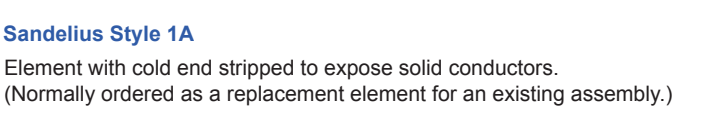
RUSH DELIVERY REQUIREMENTS

We realize the lack of a simple thermocouple, RTD or thermowell assembly can sometimes shutdown the entire plant or production line. Because we care about our customers, the people at Sandelius are ready to do whatever it takes to get out emergency orders in the minimum amount of time possible. In critical situations you will find we can even ship specially made materials in less than 24 hours.

If you do not have a current listing of our emergency late night and weekend telephone numbers, please call or write to request one. You never know when you may need it.

Sandelius Style 1A

Element with cold end stripped to expose solid conductors.
(Normally ordered as a replacement element for an existing assembly.)



Maximum recommended “S” length: 0.188” O.D. or larger 4 inches
0.125” O.D. or smaller 1 inch

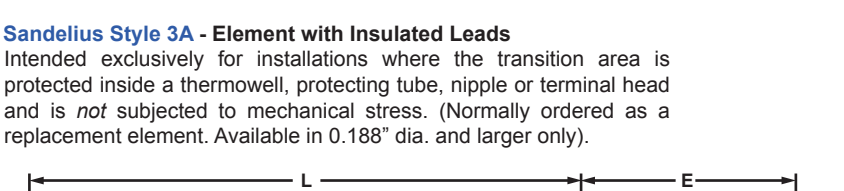
To Order Specify

1A—250J316—G—24—S2—

- Options if any. Mounting Fittings Pgs. A-16 & A-17 Weld Pads Pg. A-11
- **S** - length in inches
- **L** - length in inches
- Junction Pg. A-10
- Element Pg. A-10
- Assembly Style (See below for spring-loading)

Sandelius Style 3A - Element with Insulated Leads

Intended exclusively for installations where the transition area is protected inside a thermowell, protecting tube, nipple or terminal head and is *not* subjected to mechanical stress. (Normally ordered as a replacement element. Available in 0.188” dia. and larger only).



To Order Specify

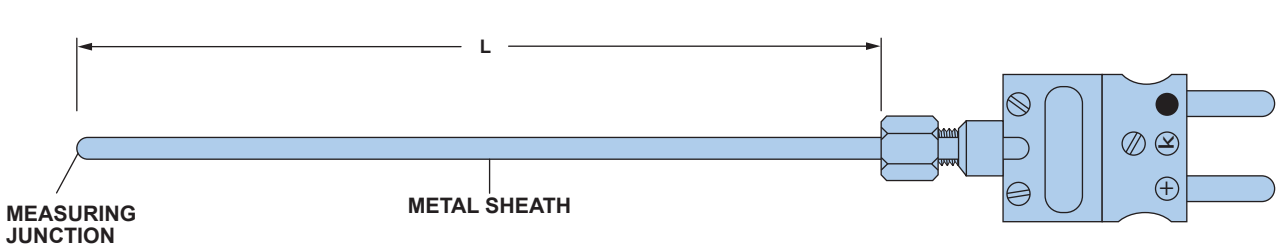
3A—188K600—G—30—G1S—6

- **E** Length in inches
- Leadwire see pg. 5
- **L** - length in inches
- Junction Pg. A-10
- Element Pg. A-10
- Assembly Style (See below for spring-loading)

Spring-Loading “A” Series Assemblies

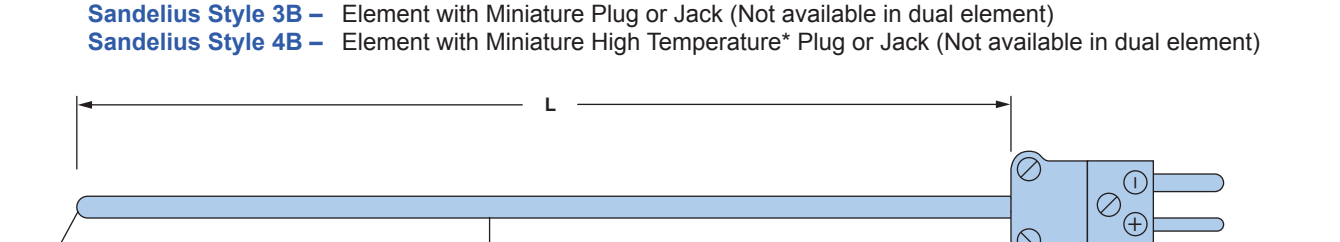
1) If spring-loading is desired, insert an “S” in front of the assembly style designation (e.g. S1A). Standard Sandelius springs are 2” long high temperature Inconel swage type springs. These adjustable springs can be forced to slide up or down the sheath for accurate positioning in the field. Testing has proven that these springs will not slip in service even when subjected to tempeatures of over 1500º F.
2) While Style 1A assemblies can be spring-loaded, we recommend the use of Style 3A assemblies with stranded leadwires for spring-loading.
3) When spring-loading either 1A or 3A Style assemblies, it is good practice to loop the conductors before attaching them to the terminal block. This loop provides the slack necessary to allow for up and down travel of the sheath.

Sandelius Style 1B – Element with Standard 2-Pole Plug or Jack
Sandelius Style 2B – Element with Standard Size High Temperature* 2-Pole Plug or Jack
Sandelius Style 7B – Element with Standard Size Ultra-High Temperature* 2-Pole Plug or Jack



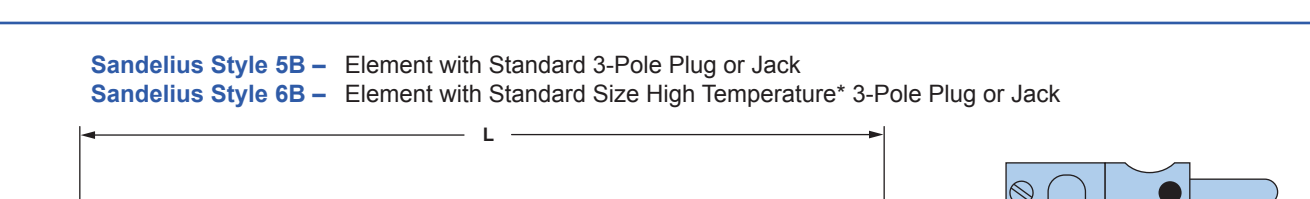
To Order See Below

Sandelius Style 3B – Element with Miniature Plug or Jack (Not available in dual element)
Sandelius Style 4B – Element with Miniature High Temperature* Plug or Jack (Not available in dual element)



To Order See Below

Sandelius Style 5B – Element with Standard 3-Pole Plug or Jack
Sandelius Style 6B – Element with Standard Size High Temperature* 3-Pole Plug or Jack



To Order See Below

To Order Any "B" Series Assembly Specify

1B—M—125K316—R—33—

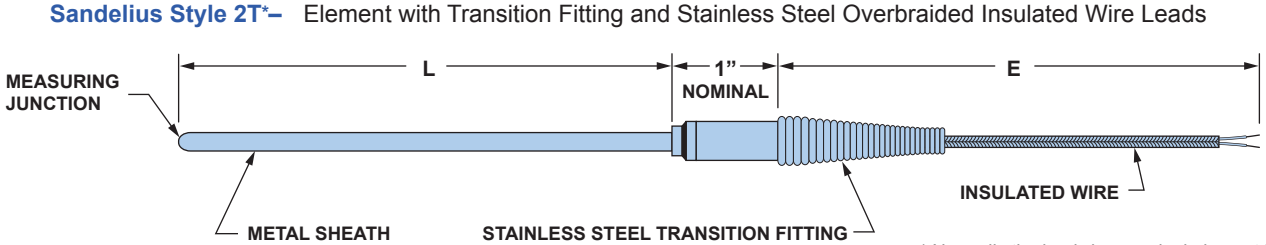
- 1B — Assembly Style
- M — Configguration (see below)
- 125K316 — Element (see pg. A-10)
- R — Junction (see pg. A-10)
- 33 — L–Length in inches
- Options if any. For Mounting Fittings see. pgs. A-16 and A-17 For Weld Pads see pg. A-11

Plug & Jack Configurations for "B" Series Assemblies

ORDER SYMBOL	DESCRIPTION
M	Male connector (plug) mounted on the sheath with no mating connector
MF	Male connector (plug) mounted on the sheath. Furnished complete with matching female connector (jack)
F	Female connector (jack) mounted on the sheath with no mating connector
FM	Female connector (jack) mounted on the sheath. Furnished complete with matching male connector (plug)

*Standard connectors are rated for ambient temperatures of 350ºF continuous or 400ºF intermittent.
High temperature connectors are rated for ambient temperatures of 500ºF continuous or 550ºF intermittent.
Ultra-high temperature connectors are rated for ambient temperatures of 800ºF continuous or 1000ºF intermittent.

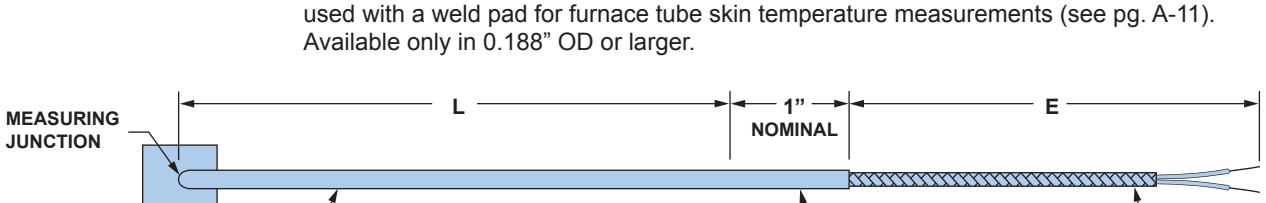
Sandelius Style 1T – Element with Transition Fitting and Insulated Wire Leads
Sandelius Style 2T*– Element with Transition Fitting and Stainless Steel Overbraided Insulated Wire Leads



* Normally the leadwires on dual element "2T" style assemblies are individually overbraided. If you prefer both leads to be under a single SS overbraird, specify style "2T1-"

To Order See Page A-5

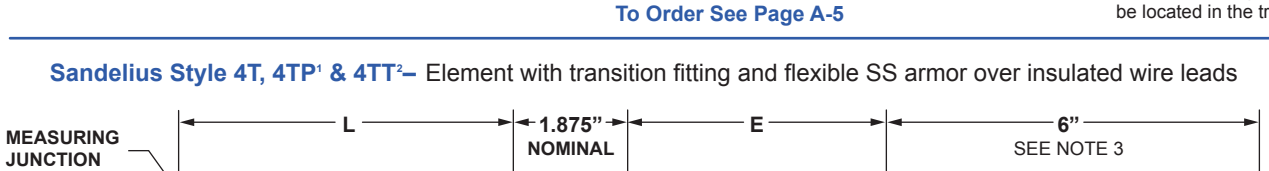
Sandelius Style 3T – Element with smooth (same OD size) transition piece and insulated wire leads. This assembly is commonly used with a weld pad for furnace tube skin temperature measurements (see pg. A-11). Available only in 0.188" OD or larger.



NOTE: Mounting fittings should not be located in the transition area.

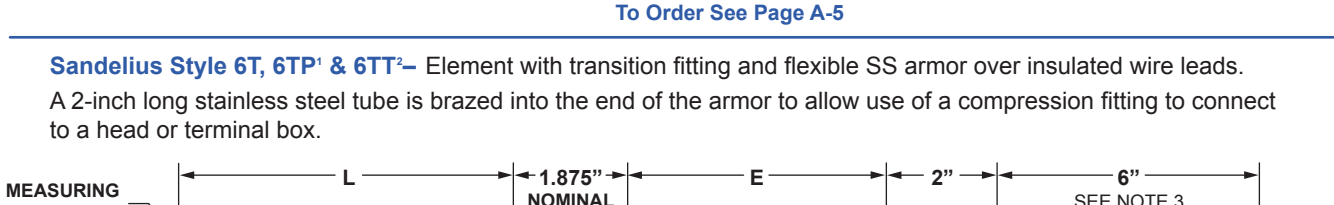
To Order See Page A-5

Sandelius Style 4T, 4TP[1] & 4TT[2]– Element with transition fitting and flexible SS armor over insulated wire leads



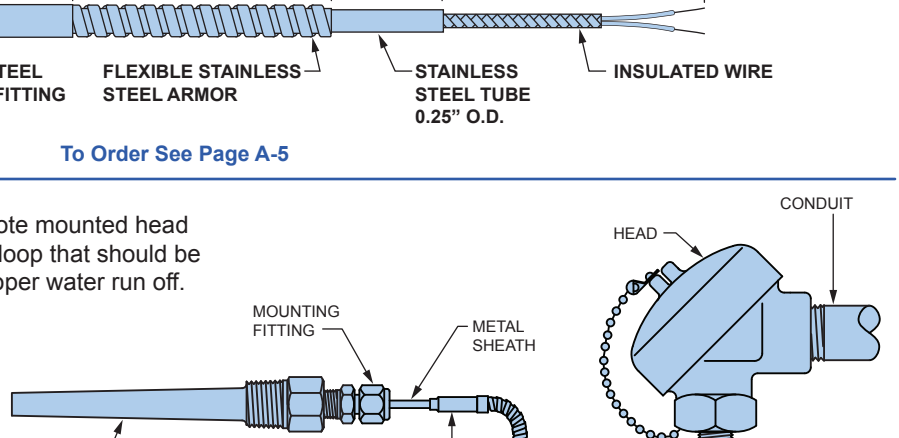
To Order See Page A-5

Sandelius Style 6T, 6TP[1] & 6TT[2]– Element with transition fitting and flexible SS armor over insulated wire leads.
A 2-inch long stainless steel tube is brazed into the end of the armor to allow use of a compression fitting to connect to a head or terminal box.



To Order See Page A-5

Typical Sandelius "T" series thermocouple in a remote mounted head application. Note proper installation includes a drip loop that should be lower than both the head and the thermowell for proper water run off. Shielded PVC insulated wire part numbers "P4" or "P5" are often used in this type of application without the stainless steel armor shown here.



NOTES:
1. Styles 4TP and 6TP have a PVC jacket over the stainless steel armor.
2. Styles 4TT and 6TT have a Teflon jacket over the stainless steel armor.
3. The leadwire may be extended more than the standard 6" beyond the end of the armor. To specify, insert two numbers into the "E Length" section of the part number separated by a '+' sign e.g. (36+12) would mean 36" of armor and 48" of leadwire (12" beyond the armor).

To Order Any "T" Series Assembly Specify

6TP—250K600—G—120—T1—240– –

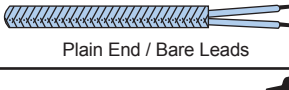
- 6TP — Assembly Style
- 250K600 — Element Pg. A-10
- G — Junction Pg. A-10
- 120 — L - length in inches
- T1 — Lead wire type, see below
- 240 — E - Length in inches
- – — Termination Style, see below
- – — Options if any. Mounting Fittings Pg. A-16 & A-17 Weld Pads Pg. A-11

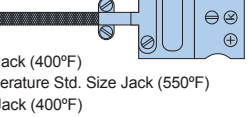
Lead Wire Choices

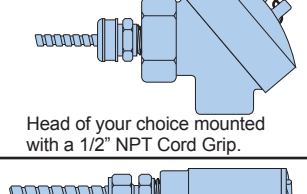
Standard Leadwires are furnished with 20 gauge conductors unless otherwise noted below. Many other gauge sizes and constructions are available. Consult factory for ordering information.

Order Symbol	Conductor Type	Insulation Type Individual Conductors / Overall	Maximum Continuous Operating Temperature	Abrasion Resistance	Moisture Resistance	Available in ANSI Types
T1	Solid	Teflon/Teflon	400ºF	Very Good	Excellent	J, K, E &T
T1S	Stranded	Teflon/Teflon	400ºF	Very Good	Excellent	J & K
G1	Solid	Fiberglass/Fiberglass	950ºF	Fair	Good	J, K, T, E, SX & RX
G1S	Stranded	Fiberglass/Fiberglass	950ºF	Fair	Good	J & K
P1	Solid	PVC/PVC	221ºF	Good	Excellent	JX, KX, TX & EX
P1S	Stranded	PVC/PVC	221ºF	Good	Excellent	JX, KX, EX & TX
P4	Solid	PVC/PVC, twisted pair with aluminum backed tape shield with drain wire	221ºF	Good	Excellent	JX, KX, TX & EX
P4D	Solid	Same as P4 except 2 pair under a single PVC jacket. For use on dual element assemblies	221ºF	Good	Excellent	JX & KX
P5S	18 ga. Stranded	PVC/PVC with metallic overbraid shield under overall PVC jacket	221ºF	Good	Excellent	JX, KX & EX
P5D	18 ga. Stranded	Same as P5S except 2 pair under a single PVC jacket. For use on dual element assemblies	221ºF	Good	Excellent	JX, KX & EX
K1	Solid	Kapton/Kapton	500ºF	Excellent	Excellent	J & K
K1S	Stranded	Kapton/Kapton	500ºF	Excellent	Excellent	J & K

TERMINATION STYLES FOR "T" SERIES ASSEMBLIES

ORDER SYMBOL	DESCRIPTION
Leave Blank	 Plain End / Bare Leads
S	 Spade Lugs
BX	 1/2" NPT Malleable Iron "BX" Type Fitting
X XA XN XS	 Cord Grip - 1/2" NPT X - Standard Plated Grip XA - Aluminum XN - Nylon XS - Stainless Steel

ORDER SYMBOL	DESCRIPTION
M1* M2* M3* M5* M7*	 Standard Plug (400ºF) High Temperature Std. Size Plug (550ºF) Miniature Plug (400ºF) Special 3-Pin Std. Size Plug (400ºF) Ultra-High Temperature Std. Size Plug (800ºF)
F1* F2* F3* F5* F7*	 Standard Jack (400ºF) High Temperature Std. Size Jack (550ºF) Miniature Jack (400ºF) Special 3-Pin Std. Size Jack (400ºF) Ultra-High Temperature Std. Size Jack (800ºF)
MD1* MD2*	 Standard Dual Plug High Temperature Dual Plugs *If mating plug is desired add the suffix "M". Example: MD1M

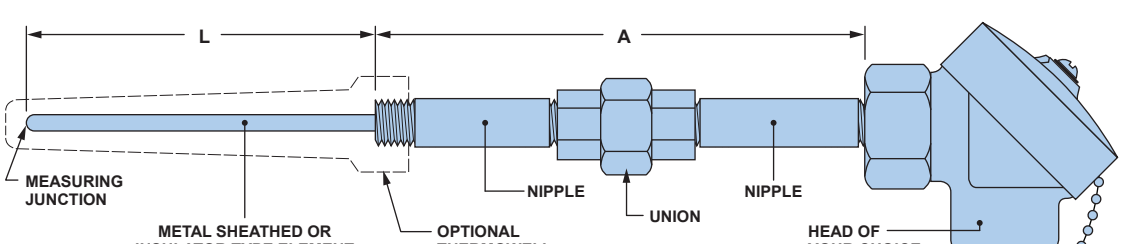
ORDER SYMBOL	DESCRIPTION
X-A46B See pages A-18 & A-19 for available Head choices	 Head of your choice mounted with a 1/2" NPT Cord Grip.
CB14-E44B See pages A-18 & A-19 for available Head choices **CF14-E44B** See pages A-18 & A-19 for available Head choices	 1/2" NPT Compression Fitting Head Mounted with Compression Fitting (Available on Style 6T only) Your choice of heads A-18 & A19 and fittings Brass [PN: CB14] or SS [PN: CF14].

If a plain mating jack or plug is desired add the suffix "M". Examples: M1M, F2M.
If mating jack or plug complete with matching cable clamp is desired, add the suffix "MC". Examples: M1MC, F2MC.

To order any style on this page see below:

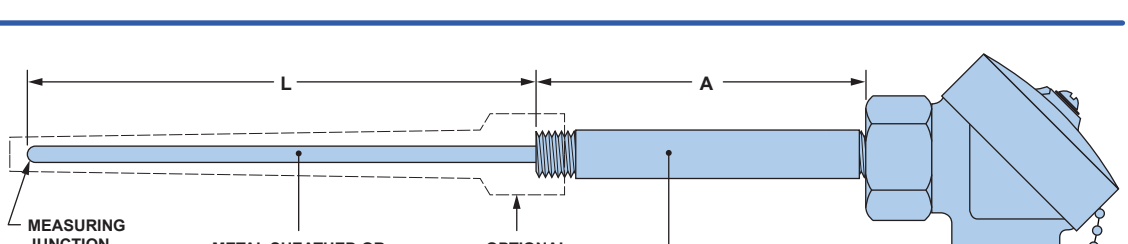
Sandelius Style 1H –

Head Mounted with a Nipple-Union-Nipple (For spring-loading , insert an “S” in front of the style number)



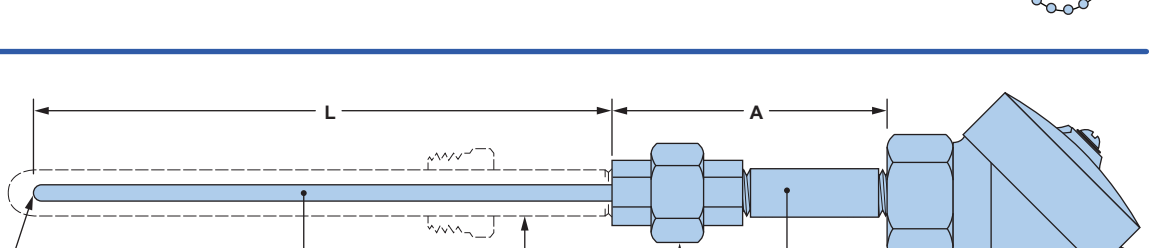
Sandelius Style 2H –

Head Mounted with a Nipple Only (For spring-loading , insert an “S” in front of the style number)



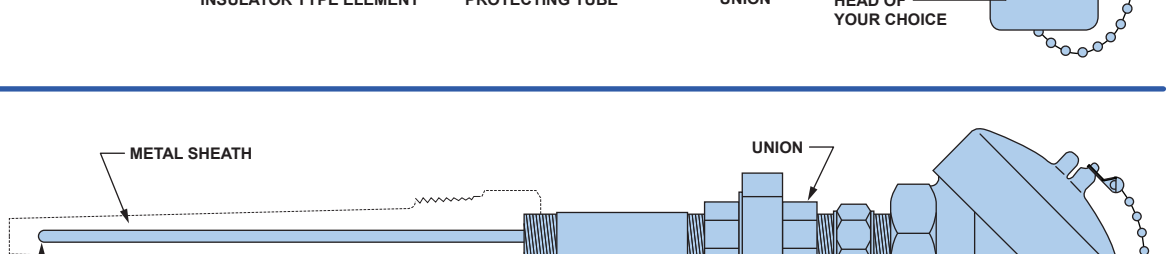
Sandelius Style 3H –

Head Mounted with a Nipple-Union Only (For spring-loading , insert an “S” in front of the style number)



Style 7H –

Nipple-Union-Brazed SS Fitting - Head (For spring-loading , insert an “S” in front of the style number)



To Order Any Style 1H, 2H, 3H or 7H Assembly Specify:

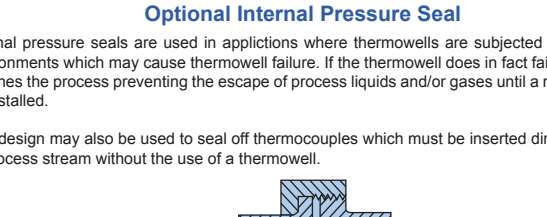
S1H–250K316–G–18–4G6–C46B–(Optional Thermowell)[2]

- See Catalog Section B[1]
- Head Pages A-18 & A-19
- Nominal A Dimension in inches
- Nipple & Union Material
  C–Carbon Steel, G–Galvanized Steel, S–Stainless Steel
- Nipple Sizes
  4– 1/2” NPT; 6– 3/4” NPT, 8– 1” NPT
- L – Length in inches[1]
- Junction Pg. A-10
- Element Pg. A-10 or A-8
- Assembly Style (If spring-loaded is desired, insert a “S” in front of the assembly style).

Optional Internal Pressure Seal

Internal pressure seals are used in applictions where thermowells are subjected to extremely harsh environments which may cause thermowell failure. If the thermowell does in fact fail, the pressure seal confines the process preventing the escape of process liquids and/or gases until a new thermowell can be installed.

This design may also be used to seal off thermocouples which must be inserted directly into a furnace or process stream without the use of a thermowell.

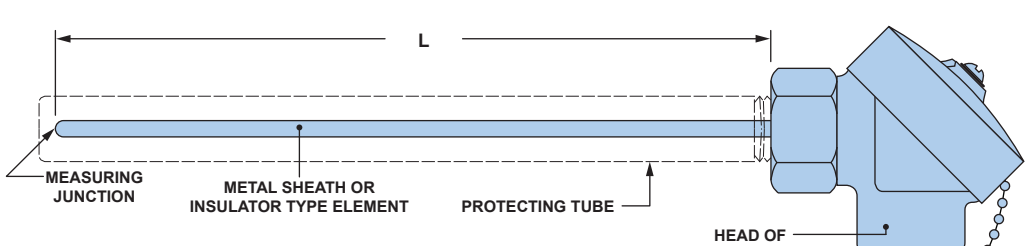


1. To order an assembly complete with a thermowell or protecting tube, simply insert the part number of the thermowell or protecting tube desired from Section B of this catalog. When ordering a complete assembly, the “L” (element) length should be shown as “00” (the element will be precisely matched to the thermowell or protecting tube).
2. When ordered without a thermowell assembly, Assembly Styles 1H, 2H, 3H, 4H and S5H are shipped unassembled to avoid damage in transit.

To order specfiy Sandelius Assembly Style “P1H” and complete the part number as indicated. (Note Assembly Style “P1H” cannot be spring-loaded).

Sandelius Style 4H –

Head Mounted directly with a protecting tube. (For spring-loading insert an “S” in front of the style number.



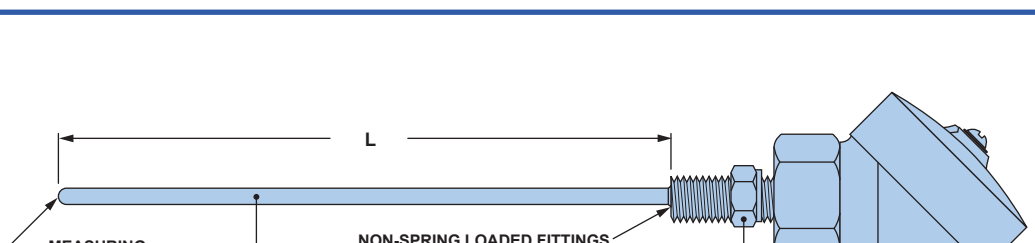
To Order Specify:

4H–250KK316–G–00–A46D–940SB-1/2–18–M316

- Complete Protecting Tube Order Symbol (See Catalog Section B).
- Head Pages A-18 & A-19
- L — length matched to protecting tube
- Junction Pg. A-10
- Element Pg. A-10 or A-8
- Assembly Style (when ordered without a protecting tube, the element and head are shipped unassembled to avoid damage in transit).

Sandelius Style 5H –

Head Mounted with a Double Threaded Fitting (See Note 1 for Spring-Loading Options).



To Order Specify:

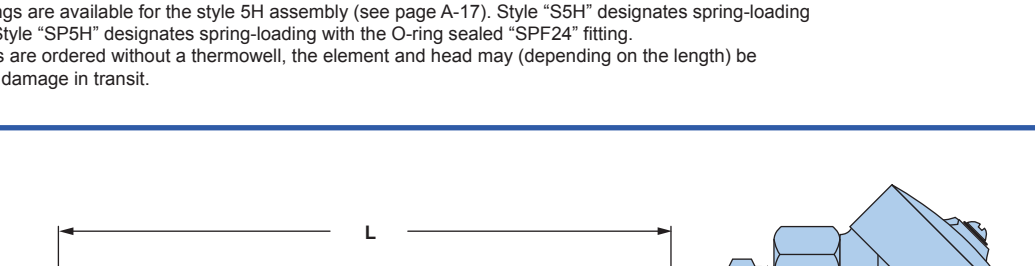
5H–188JJ304–RC–36–A44D

- Head Pages A-18 & A-19
- Length in inches
- Junction Pg. A-10
- Element Pg. A-10
- Assembly Style (For spring-loading, see Note 1 below)

Notes:
1. Two different spring-loaded fittings are available for the style 5H assembly (see page A-17). Style “S5H” designates spring-loading with the standard SF24 fitting. Style “SP5H” designates spring-loading with the O-ring sealed “SPF24” fitting.
2. When spring-loaded assemblies are ordered without a thermowell, the element and head may (depending on the length) be shipped unassembled to avoid damage in transit.

Sandelius Style 6H –

Head Mounted with a Single Threaded Fitting



To Order Specify:

6H–063T304–R–26–CF11–A46B–

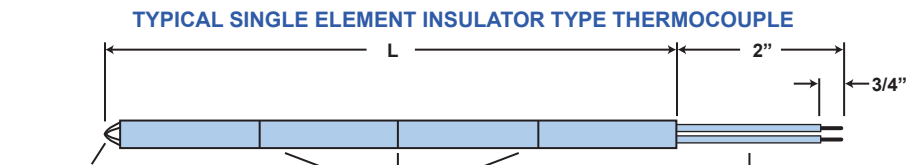
- Options if any. Mounting Fittings Pg. A-16
- Head Pages A-18 & A-19
- Head Mounting Fitting Pg. A-16
- L – Length in inches
- Junction Pg. A-10
- Element Pg. A-10 or A-8
- Assembly Style

INSULATOR TYPE ELEMENTS

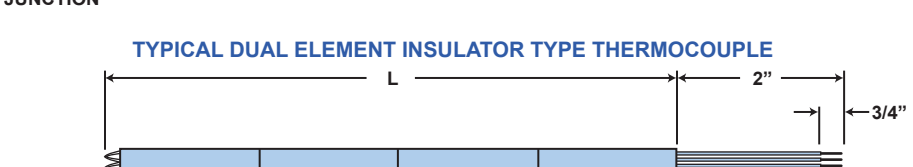
INSULATOR TYPE THERMOCOUPLES

Insulator type thermocouple elements have been used since the turn of the century. When used inside a thermowell or protecting tube they can provide reliable, low cost service in many applications. Extra care should be taken to protect insulator type elements from chemical contamination which can cause erroneous readings to develop. Insulator type thermocouples can be shortened in the field in a matter of moments by simply removing one or more insulators and cutting the conductors to the desired length.

TYPICAL SINGLE ELEMENT INSULATOR TYPE THERMOCOUPLE



TYPICAL DUAL ELEMENT INSULATOR TYPE THERMOCOUPLE



ORDER SYMBOL	WIRE GAUGE	MAXIMUM INSULATOR OD		AVAILABLE CALIBRATION TYPES
		SINGLE ELEMENT	DUAL ELEMENT	
BE20	20	.220”	.220”	E, J, K &T
BE16	16	.260”	.312”	E, J & K
BE14	14	.312”	.312”	E, J, K & T
BE8	8	.445”	.645”	E, J & K

To Order:

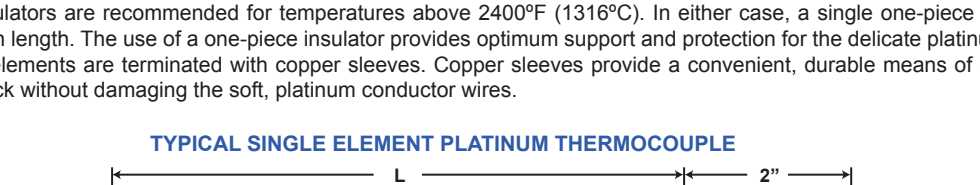
Complete the part number by inserting a single letter calibration symbol for single element or a double letter calibration symbol for dual element and indicate the “L” length in inches.

EXAMPLES: BE14K–18, Type K, single element, L = 18”. BE14KK—18, Type K, dual element, L=18”.

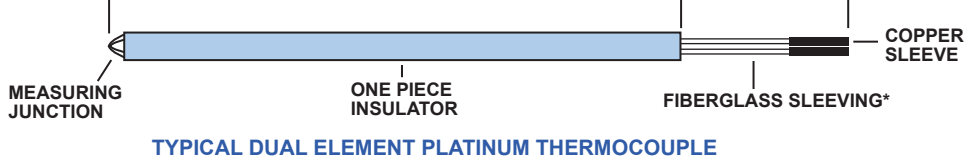
PLATINUM INSULATOR TYPE THERMOCOUPLE ELEMENTS

Platinum insulator type thermocouple elements are available with either Mullite or high purity Alumina insulators. To minimize the possibility of silica contaminiation, Alumina insulators are recommended for temperatures above 2400ºF (1316ºC). In either case, a single one-piece insulator is used on elements 36 inches or less in length. The use of a one-piece insulator provides optimum support and protection for the delicate platinum conductors. As a standard feature, platinum elements are terminated with copper sleeves. Copper sleeves provide a convenient, durable means of connecting platinum elements to a connector block without damaging the soft, platinum conductor wires.

TYPICAL SINGLE ELEMENT PLATINUM THERMOCOUPLE



TYPICAL DUAL ELEMENT PLATINUM THERMOCOUPLE



ORDER SYMBOL	WIRE GAUGE	INSULTAOR MATERIAL	MAXIMUM INSULATOR OD		AVAILABLE CALIBRATION TYPES
			SINGLE ELEMENT	DUAL ELEMENT	
BP24M	24	Mullite	.200	.200	R, S & B
BP24A	24	Alumina	.200	.200	R, S & B

***Fish Spine beads may be substituted for the fiberglass sleeving at no extra charge.**

To Order:

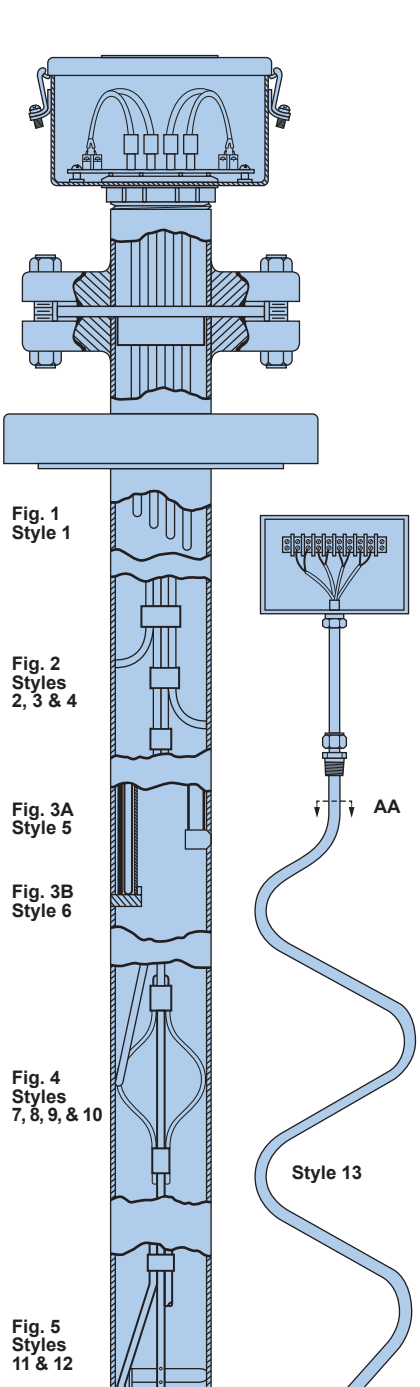
Complete the part number by inserting a single letter calibration symbol for single element or a double letter calibration symbol for dual element and indicate the “L” length in inches.

EXAMPLES: BP24MS—18, Type S, single element, L = 18”. BP24MSS—18, Type S, dual element, L = 18”.

SANDELIUS MULTI-POINT ASSEMBLIES

Any thermocouple assembly with measuring junctions located at more than a single immersion depth is commonly referred to as a multi-point. As the number of variations possible in multi-point assemblies is virtually limitless, they are generally designed and manufactured to meet the requirements of individual applications. As different multi-point designs vary tremendously, careful consideration should be given to such variables as the positive location of measuring junctions and the ease/cost of replacement should a failure ever occur. Some designs allow for replacement of individual elements while others require replacement of the entire assembly whenever individual elements fail. In either case, complete shut-down of the process line may not be required depending on important design considerations. For easy reference, we have assigned style numbers to the most commonly used types of multi-point designs. Other designs can be furnished on request. If you have any questions about multi-point designs or would like assistance in preparing a multi-point specification, please feel free to contact us at your convenience.

The sketch below illustrates how multi-point assemblies which appear identical from outside, can be vastly different on the inside where it counts.



Terminations

Multi-point assemblies are usually terminated in junction boxes as shown here. Available in a variety of styles, materials and classifications junction boxes provide a convenient means of wiring multi-point assemblies in the field. They can be equipped with standard or compensating terminal strips. Swamping resistor networks used to provide average readings are also available.

In other cases, multi-point assemblies can be terminated with flexible leadwire which is routed in the field to a remote mounted junction box or instrument panel.Multi-pin connectors are a more rarely used option but one well worth considering in some applications. Whatever termination style your prefer, Sandelius will gladly produce it for you.

Optional Secondary Seals

When requested secondary seals can be built into multi-point assemblies. A secondary seal prevents the escape of process fluids or gases in the event the portion of the multi-point assembly in the process should develop a leak. Any of several different types of seals are available. They are occasionally used in combination for even greater safety in hazardous applications.

Process Mounting Fittings

Large multi-point assemblies almost always use a flange to connect to the vessel. Smaller assemblies sometimes use threaded bushings, compression type fittings or other means of mounting. Whatever your application requires we will gladly produce it for you.

Sandelius Style 1

Individual Free Hanging Type. Figure 1. Individual sheathed thermocouples are inserted into a common outer protecting tube. This style is commonly used in small diameter tubes where the thermocouples fill the majority of the inside of the outer tube.

Sandelius Style 2

Permanently Bundled Free Hanging Type. Figure 2. The individual thermocouples use a common transition piece and are attached together at regular intervals along their entire length. Individual thermocouples cannot be replaced. This design may be used with or without an outer protecting tube.

Sandelius Style 3

Bundled Free Hanging Type. Similar to Figure 2 . The individual thermocouples are independtly transitioned and bundled together using removable tie wires or clamps. Individual thermocouples may be replaced only after removing the entire multi-point assembly from the vessel. This design may be used with or without a protecting tube.

Sandelius Style 4

Individually Replaceable Bundled Free Hanging Type. Similar to Figure 2. In this design, individual guide tubes are permanently bundled together and independent thermocouples are fed into them. Individual thermocouples may be replaced without removing the entire assembly from the vessel. Note the guide tubes may be open ended allowing the thermocouples to protrude directly into the process or their ends may be welded closed. This design may be used with or without an outer protecting tube.

Sandelius Style 5

Positive Contact Type. Figure 3A. In this design the thermocouples are attached to the protecting tube wall through the use of welded plugs. Exact positioning of each measuring junction is assured. Replacement requires a completely new assembly including the protecting tube. Please note this design requires an outer protecting tube.

Sandelius Style 6

Replaceable Positive Contact Type. Figure 3B. In this design, individual guide tubes are attached to the protecting tube through the use of welded plugs. Individual thermocouples are then fed into the guide tubes assuring correct positioning of the measuring junctions. Individual thermocouples may be replaced without shutting down the process. This design requires the use of an outer protecting tube.

Sandelius Style 7

Full Leaf Spring Type. Figure 4. In this design the thermocouples are assembled around a center support strip. Each measuring junction is attached to the top of one side of a pair of opposing full leaf springs. The springs hold the hot junctions to the wall of the protecting tube. Individual thermocouples cannot be replaced.

Sandelius Style 8

Same as style 7 with the addition of individual guide tubes allowing for the replacement of individual thermocouples.

Sandelius Style 9

Cantivelever Spring Type. Similar to Figure 4. In this design the thermocouples are assembled around a center support strip. Each measuring junction is attached to the top of one side of a pair of opposing cantilever springs. The springs hold the hot junctions to the wall of the protecting tube. Individual thermocouples cannot be replaced.

Sandelius Style 10

Same as style 9 with the addition of individual guide tubes allowing for the replacement of individual thermocouples.

Sandelius Style 11

Bimetallic Strip Type. Figure 5. This design is similar to Style 9 with the exception that temperature activated bimetallic strips are used in place of the springs.

Sandelius Style 12

Same as style 11 with the addition of individual guide tubes allowing for the replacement of individual thermocouples.

Sandelius Style 13

Drawn or swaged multipoints are constructed by drawing or swaging an outer sheath over a thermocouple bundle. The resulting assembly is small (usually 0.25” or less O.D.) tightly packed and flexible. The flexible nature of this design allows the assembly to be snaked around off-sets to measure points which cannot be reached by more traditional straight line designs.

METAL SHEATH TYPE THERMOCOUPLE ELEMENTS

SANDELIUS NUMBERING SYSTEM

125 J 316

SHEATH O.D IN 1000ths OF AN INCH

ORDER SYMBOL	APPROXIMATE FRACTION
020	1/50
032	1/32
040	1/25
063	1/16
125	1/8
188	3/16
250	1/4
313	5/16
375	3/8
500	1/2

CALIBRATION SYMBOL

ORDER SYMBOL*	CONDUCTOR MATERIAL	TEMPERATURE RANGE
E	Chromel / Constantan	-328 - 1652ºF**
J	Iron / Constantan	32 - 1382ºF**
K	Chromel / Alumel	-328 - 2282ºF**
R	Platinum / Platinum 13% Rh	32 - 2642ºF
S	Platinum / Platinum 10% Rh	32 - 2642ºF
B	Platinum 6% Rh / Platinum 30% Rh	1598 - 3092ºF
N	Nicrosil / Nisil	32 - 2282ºF
T	Copper / Constantan	-328 - 662ºF**

* Single letter calibration symbol is used for single element. A double letter calibration symbol is used for dual element. EXAMPLE: 125JJ316 is dual element type J.

** Type E, K & T may be used for cryogenic temperature as low as -328ºF, but must be specifically ordered to insure accuracy in cryogenic range.

SHEATH MATERIAL

ORDER SYMBOL	MATERIAL
200	Nickel 200
304	304SS
304L	304L
310	310SS
310L	310L
316	316SS
316L	316L
321	321SS
347	347SS
400	Monel 400
446	446SS
600	Inconel 600
601	Inconel 601
625	Inconel 625
800	Incoloy 800
276	Hastelloy C-276
277	Hastelloy X
285	Tantalum
337	Titanium Grade 2
928	Pyrosil

MEASURING JUNCTION STYLES

G-GROUNDED JUNCTION

The conductors and sheath material are simultaneously cap welded. This process forms a measuring junction which is an integral part of the end cap and electrically grounded to the sheath. The most common junction style, grounded junctions protect the thermocouple conductors from contamination and offer fast response times.

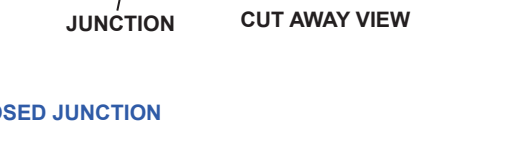
Order Symbol: **G-Single or Dual Element**

R-REMOTE OR UNGROUNDED JUNCTION

The conductors are first junction welded together. Prior to cap welding the sheath, the junction is covered with insulating material to insulate it from the sheath and end cap. Remote junctions protect the thermocouple conductors from both contamination and outside electrical interference. They are used whenever electrical isolation of the element is desirable.

Order Symbol:
R – Single Element
RC* – Dual Element Common
RS* – Dual Element Separate

E-EXPOSED JUNCTION



The sheath material is stripped back slightly and the conductors are welded together to form a measuring junction. The exposed insulation is sealed against moisture penetration. Exposed junctions provide the fastest possible response times but do not offer protection to the thermocouple conductors.

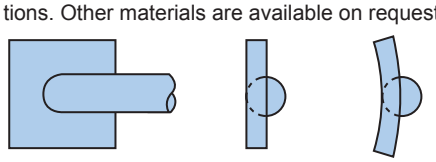
Order Symbol:
E – Single Element
EC* – Dual Element Common
ES* – Dual Element Separate

* When ordering dual element remote or exposed junctions, a “C” indicates common junction (all four conductors welded together forming a common junction); an “S” indicates separate junctions (each thermocouple element independently junctioned and isolated from each other).

FURNACE TUBE TEMPERATURE THERMOCOUPLES

Whenever a thermocouple must be welded in place it is advisable to use a weld pad and weld clips to protect against burn-through of the sheath material during field installation. Sandelius weld pads, weld clips and weld pad covers are available in a wide range of styles and materials.

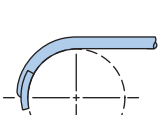
Standard W1, W2 and W3 style weld pads measure 3/4" x 3/4" x 1/8". Inconel 600 or 310SS have proven to be excellent choices for most furnace applications. Other materials are available on request.



Sandelius Style W1D — **Flat** — **Formed**

Material Designation
Add forming information as required

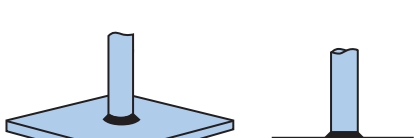
If forming is specified, the thermocouple sheath will lay parallel to the process tube.



Sandelius Style W2B

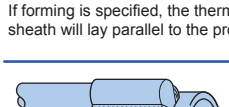
Material Designation
Add forming information

Formed so the thermocouple sheath wraps around the process tube. The amount of arc desired as well as the tube size should be specified on your order. (Shown with a Fig. 1 bend a=90º). Note "L" length of the T/C is measured from the center line of the tube.



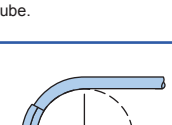
Sandelius Style W3C Tip Mounted Weld Pad

Material Designation



Sandelius Style W5E

Material Designation
Add forming information as required



W6E

Wedge-Shaped Weldment

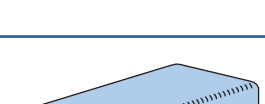
This design offers an alternative to the traditional weld pad for 0.375" or larger diameter sheath sizes. It incorporates a specially shaped weldment to keep the thermocouple junction in contact with the furnace tube surface. (W6E is shown with a Fig. 1 bend a=90º).

Typical Weld Clip

PN: CP710D-1/4
Material
Sheath OD

Material Designations

A=316SS	D=310SS
B=Inconel 600	E=446SS
C=304SS	Y=Other as Specified



Parallel Weld Pad Cover

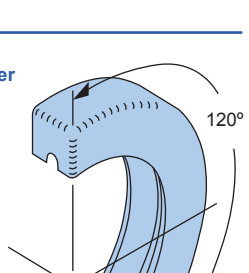
PN: CP720D-1/4-4"
Material
Sheath OD
Furnace Tube OD

Radial Weld Pad Cover

PN: CP725D-1/4-6"
Material
Sheath OD
Furnace Tube OD

Note:
CP725 is 1 3/8" high
CP726 is 3/4" high

All Sandelius weld pad covers are supplied packed with insulation suitable for use up to 2300ºF. Covers should be welded in place with insulation left inside.



TYPICAL WELD PAD INSTALLATION AND EXPANSION LOOPS

Bending and expansion loops are best specified by sending a drawing or sketch with your order. The following are examples of commonly used configurations. Many other configurations are available. Expansion loops are normally designed to open with furnace tube movement.

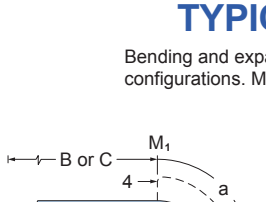


Fig. 1 Junction Bend

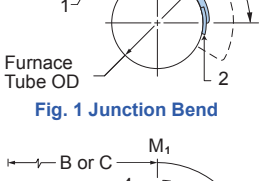


Fig. 2 Junction Bend

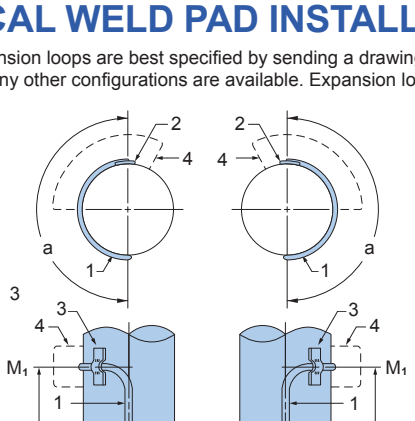


Fig. 3L Junction Bend

Fig. 3R Junction Bend

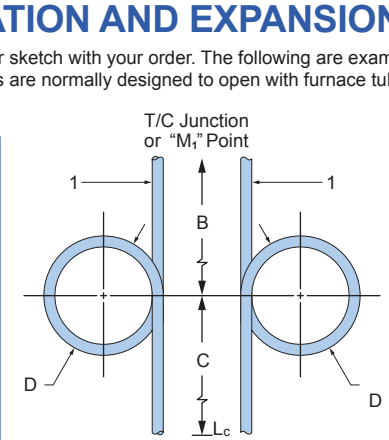
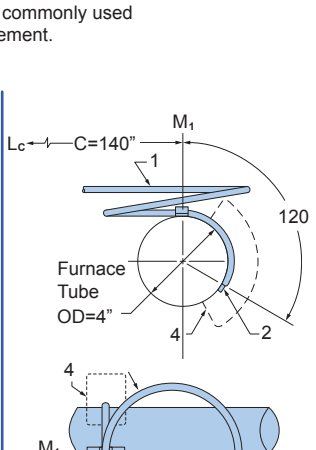


Fig. 4L (Expansion Loop on Left Side)

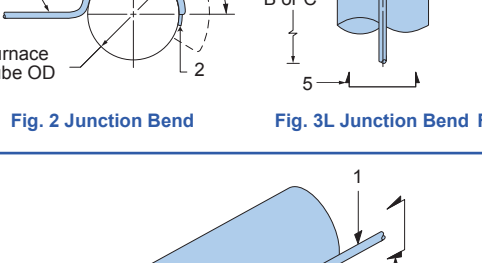
Fig. 4R (Expansion Loop on Right Side)

Expansion Loops



Example A

Junction BendL Fig. 1, a=120º
Tube OD=4"
Expansion Loop: Fig. 4R,
D=12", 4 Coils, B=0, C=140"



Example B

Junction Bend: Fig. 3R, a=90º, Tube OD=6"
Expansion Loop: Fig. 4L, D=8", 1 Coil
B=18", C=90"

Legend

L = The total straight length of the thermocouple sheath before bending as showin in the drawing of each assembly style on pages 2-7. In assemblies including expansion loops and/or bends, this length should be specified as "00" in the part number allowing is to make the necessary calculations.

L_C = The "point of measurement" toward the "cold" or reference end of the sheath. "**L_C**" is constant as shown in the drawing of each assembly style on pages 2-7.

M_1 = The first "point of measurement" back from the "hot" or measuring junction end of the thermocouple. On a straight assembly with no bends $M_1 = L_C$. On assemblies incorporating one of more bends M_1 and subsequent points of measurement will vary with the type of bend as indicated in the figures above.

B = The straight length of sheath between the center of an expansion loop and next measuring point toward the "Hot Junction", usually "M_1". (Used only when an expansion loop is specified. If no expansion loop is specified "B" is left blank).

C = The straight length of sheath between "L_C" and the first "point of measurement" encountered; usually either the center of an expansion loop or M_1.

a = Degrees of arc in a bend.
D = The outside diameter of a circular expansion loop.
1 - Thermocouple sheath
2 - Weld pad
3 - Weld clip
4 - Weld pad cover (Dotted for clarity)
5 - Correct view to determine R (right) or L (left) side orientation of an expansion loop.

Ordering Information

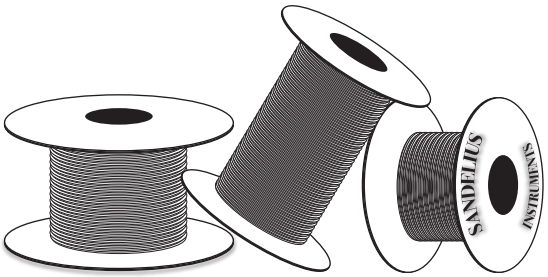
First select a thermocouple assembly from pages 2-7 of this catalog. Complete the part number for the assembly desired and add the weld pad designation to the end of the part number.

Example: 1A-250K310-G-120-S3-W1D formed to fit 4" OD tube.

To order an assembly with an expansion loop, bend or both add a description of the loop and bending required.

Example: 3T-250K600-G-00-P1-6-W2B Junction bend for Fig. 3R (a=180), Expansion loop per Fig. 4L, D=12", 3-Coils, B=15", C=96" (Note in this expample the length is specified as "00" allowing us to calculate the material required).

THERMOCOUPLE WIRE

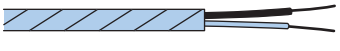
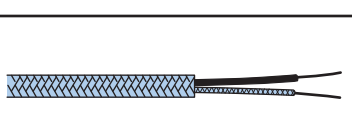
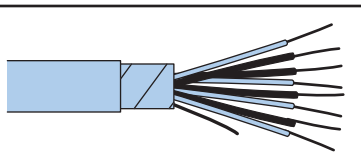


To Order Specify

1. ANSI Calibration from column #1.
2. B&S gauge size from column #2.
3. Insulation type from column #3.
4. Add "SS" if stainless steel overbraid is desired.

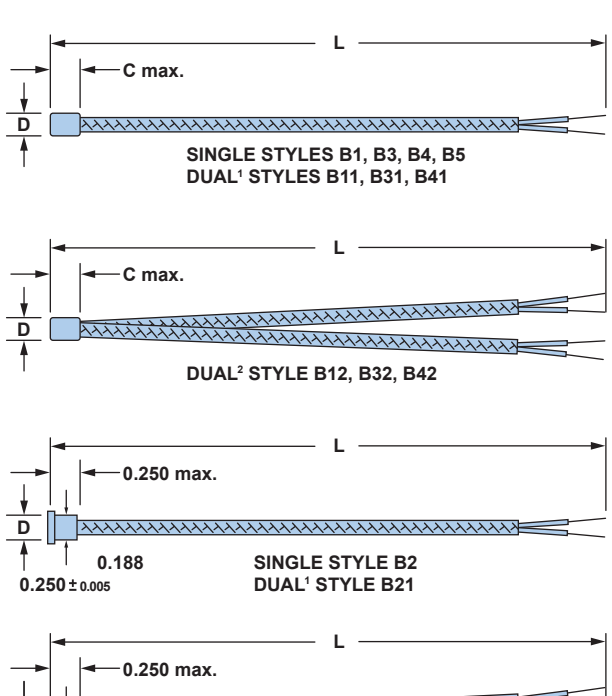
Examples: KX20-P1, J20-G1, K20S-G1-SS, EX20-P6-8

The items listed below represent the most commonly used types of thermocouple and extension wire. If you do not find the item you require, please call as many other gauge sizes and insulation types are available.

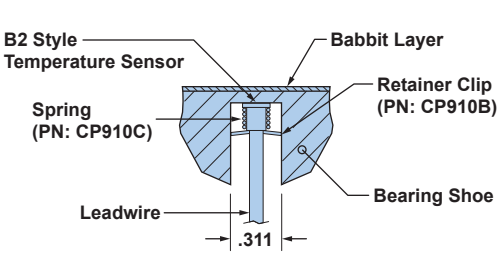
COLUMN #1	#2	#3	PRODUCT	INSULATION TYPE		INSULATION CHARACTERISTICS		
						Continuous Operating Temperature	Physical Properties	
ANSI Calibration	B&S Gauge*	Insulation Type		Conductor Insulation	Overall Jacket		Abrasion Resistance	Moisture Resistance
JX, KX, TX JX, KX, EX, NX TX, SX/RX JX, KX, TX	16 20 20S*	P1		PVC	PVC	221ºF	Good	Excellent
JX, KX JX, KX, TX	16 20	P1UL		Same as P1 except UL listed for PLTC (Power Limited Tray Cable) - 300 Volts				
JX, KX, TX JX, KX, EX, NX TX, SX/RX	16 20	P4		PVC Twisted Pair	Aluminum/ Mylar Shield w/ Drain wire & PVC Jacket	221ºF	Good	Excellent
JX, KX JX, KX, TX	16 20	P4UL		Same as P4 except UL listed for PLTC (Power Limited Tray Cable) - 300 Volts				
J, K, T, E	20S*	K1		Fused Kapton Tape with Color Coding Thread	Fused Kapton Tape	500ºF	Excellent	Excellent
J, K, T	20	K4		Colored Fused Kapton Tape	Fused Kapton Tape	500ºF	Excellent	Excellent
J, K, T, SX/RX, E J, K	20 20S*	T1		Extruded FEP Teflon	Extruded FEP Teflon	400ºF	Excellent	Excellent
J, K, T, E	20	T2		Fused Teflon Tape TFE	Fused Teflon Tape TFE	500ºF	Good	Excellent
JX, KX J, K, E, N, T, SX/RX, BX J, K	16 20 20S*	G1		Impregnated Fiberglass Braid	Impregnated Fiberglass Braid	900ºF	Fair	Good
JX, KX, TX, EX	20	P6-#PR		PVC Twisted Pair	Aluminum/ Mylar Shield w/ Drain wire & PVC Jacket	221ºF	Good	Excellent
JX, KX, TX, EX	20	P7-#PR		PVC Twisted Pair with Aluminum/ Mylar Shield & Drain wire over each pair	Aluminum/ Mylar Shield w/ Drain wire & PVC Jacket	221ºF	Good	Excellent

MINIATURE BEARING TEMPERATURE SENSORS

These sensors are used to provide continuous temperature monitoring of bearing shoes and housings. This information can be used as an early warning of bearing failure or other internal problems. Temperature range is up to 500ºF. Case material: Plated Copper.



NOTES:
1. Dual styles B11, B21, B31 and B41 have both leads under a single overbraid.
2. Dual styles B12, B22, B32 and B42 have two individial (separate) leads.
3. Case style of dual element sensors is determined by the first digit of the style number.



To Order specify:

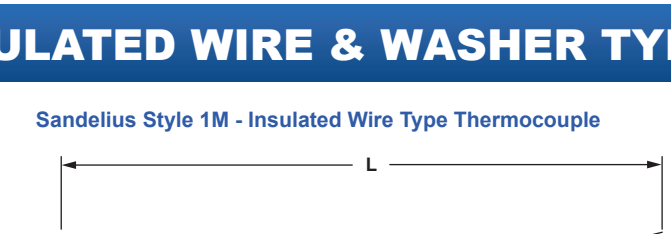
B2–J–24S–G–24–T2–SS

- Case Style
- T/C Type E, J, K, or T. (Use double letter for dual element)
- Wire Gauge add "S" for stranded (24S = 24 ga. stranded) (most common choice)
- G = Grounded Junction; R = Ungrounded Junction
- Length in inches
- Leadwire Insulation
  T2 = Fused Teflon Insulation & Jacket (most common choice)
  T1A = Extruded Teflon Insulation with No Overall Jacket
  Other wire types are available on request
- Add "SS" if stainless steel overbraid is desired

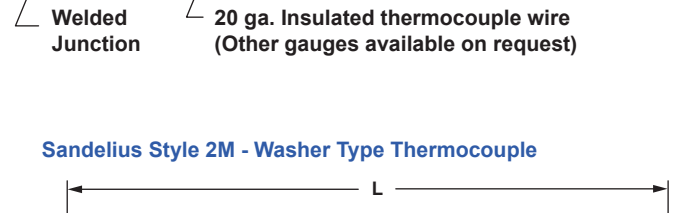
Case Style[3]	"D"	"C"	Available Wire Sizes: S=Single; D=Dual		
			20 ga.	24 ga.	30 ga.
B1	.275±.003	.250 max.	S & D	S & D	S & D
B3	.125±.003	.300 max.	S	S & D	S & D
B4	.250±.003	.300 max.	S & D	S & D	S & D
B5	.080±.003	.300 max.	–	–	S

INSULATED WIRE & WASHER TYPE THERMOCOUPLES

Sandelius Style 1M - Insulated Wire Type Thermocouple



Sandelius Style 2M - Washer Type Thermocouple



To Order a 1M specify:

1M–K–T1–60–M1

- Assembly Style
- Calibration Symbol J, K, T, or E
- Insulation Wire Choice (See pg. A-12)
- Length in inches
- Optional Termination Style (See pg. A-5)

To Order a 2M specify:

2M–3/8x1x1/8–K–T1–60–M1

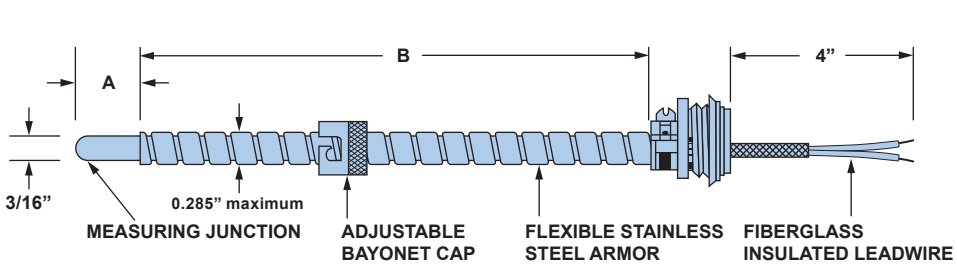
- Assembly Style
- Washer size I.D. x O.D. x Thickness (Note: Unless otherwise specified, washers will be made of stainless steel.) If an eyelet is required, specify a part number or description of the eyelet required.
- Calibration Symbol J, K, T, or E
- Insulation Wire Choice (See pg. A-12)
- Length in inches
- Optional Termination Style (See pg. A-5)

*NOTE:
For use in severe applications where insulated wire does not provide sufficient protection for the thermocouple, washers may be added to metal sheath type thermocouples. To order complete steps 1-3 above and put this information in front of the part number of the sheathed type thermocouple of your choice from pages A-2 through A-7.

THERMOCOUPLES FOR THE PLASTICS INDUSTRY

Sandelius Style 1F – Universally Adjustable Bayonet Type Thermocouple

The bayonet cap on our universally adjustable bayonet type thermocouples is designed to thread onto the specially sized stainless-steel flexible armor. This feature allows the bayonet cap to be adjusted to any immersion depth required. When properly adjusted, the spring action of the compressed flexible armor holds the bayonet cap in position and forces the thermocouple junction to securely bottom out in the hole. Maximum continuous operating temperature is 900ºF (482ºC).



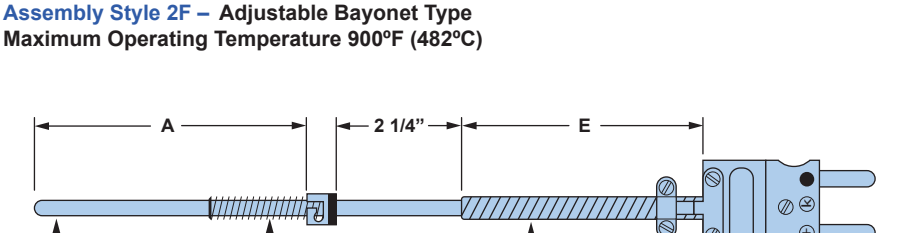
SHOWN WITH OPTIONAL TERMINATION STYLE BX

To Order specify:

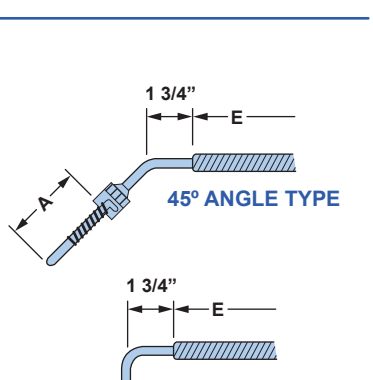
1. Assembly style
2. Calibration symbol J, K, E, or T
3. A - Length in inches
4. Junction style. See page A-10
5. B - Length in inches
6. Termination style. See page A-5

EXAMPLE: 1F–J–1/2–G–36–BX
1 2 3 4 5 6

Assembly Style 2F – Adjustable Bayonet Type
Maximum Operating Temperature 900ºF (482ºC)

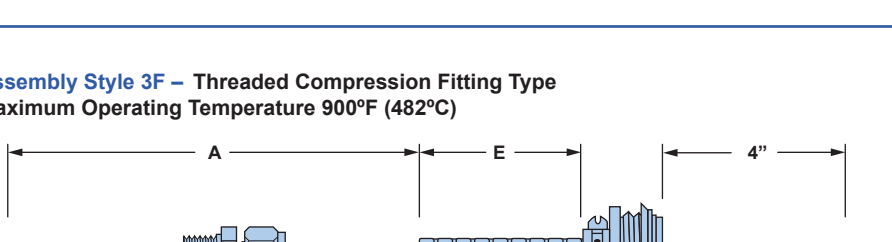


STRAIGHT TYPE



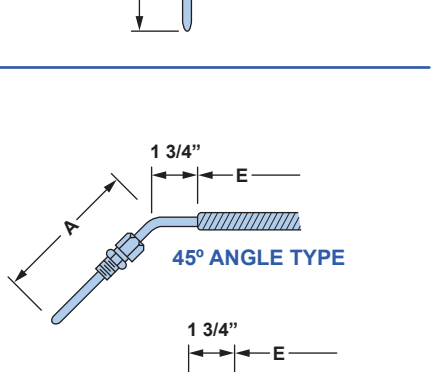
To Order See Below:

Assembly Style 3F – Threaded Compression Fitting Type
Maximum Operating Temperature 900ºF (482ºC)



STRAIGHT TYPE

SHOWN WITH OPTIONAL TERMINATION STYLE BX



To Order See Below:

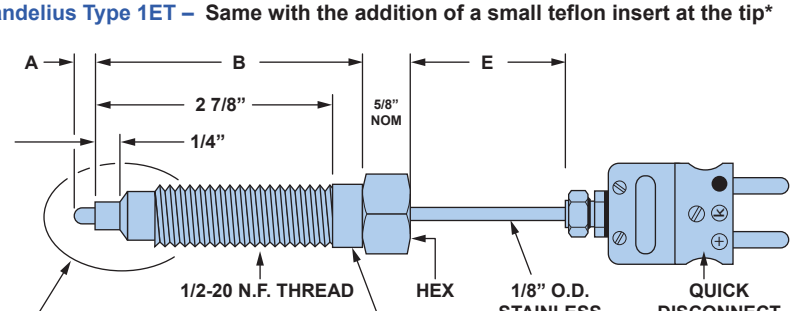
To Order any 2F or 3F Assembly specify:

1. Assembly Style
2. Probe diameter. 125 for 0.125” (1/8“) or 188 for 0.1875” (3/16”)
3. Angle O-Straight 45-45º angle or 90º-90º angle
4. Calibration symbol J, K, E or T
5. A - Length in inches
6. Junction style: G for grounded or R for ungrounded
7. E - Length in inches
8. Termination style. See page A-5

EXAMPLE: 2F–188–0–J–6–G–48–M1
1 2 3 4 5 6 7 8

EXTRUDER BOLT TYPE THERMOCOUPLES

Sandelius Style 1E – Extruder Bolt Type with No Leads
Sandelius Type 1ET – Same with the addition of a small teflon insert at the tip*

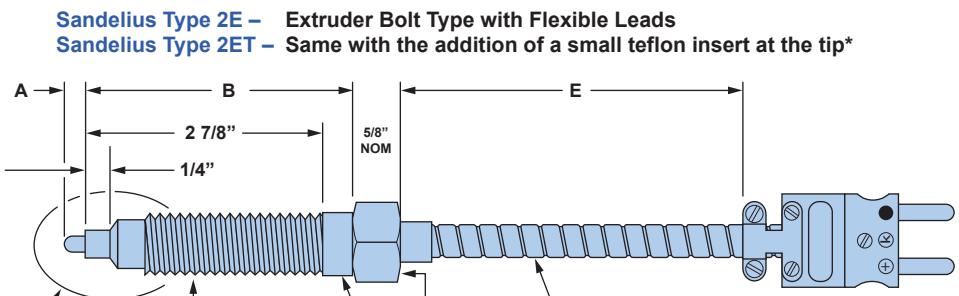


To Order specify:

1. Assembly style
2. A - Length in inches
3. ISA Calibration symbol – J, K, E or T. For dual element use a double calibration. Example: JJ
4. B - Length in inches (Standard B lengths are 3” and 6”. Other lengths are available on request.)
5. Junction style. See page A-10
6. E - Length in inches

EXAMPLE: 1E–1/8–JJ–6–G–0
1 2 3 4 5 6

Sandelius Type 2E – Extruder Bolt Type with Flexible Leads
Sandelius Type 2ET – Same with the addition of a small teflon insert at the tip*

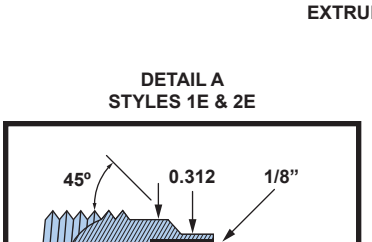


To Order specify:

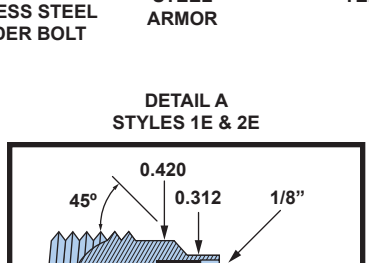
1. Assembly style
2. A - Length in inches
3. ISA Calibration symbol – J, K, E or T. For dual element use a double calibration. Example: JJ
4. B - Length in inches (Standard B lengths are 3” and 6”. Other lengths are available on request.)
5. Junction style. See page A-10
6. E - Length in inches
7. Termination style. See page A-5

EXAMPLE: 2E–1/4–J–3–G–48-M1
1 2 3 4 5 6 7

DETAIL A
STYLES 1E & 2E



DETAIL A
STYLES 1E & 2E

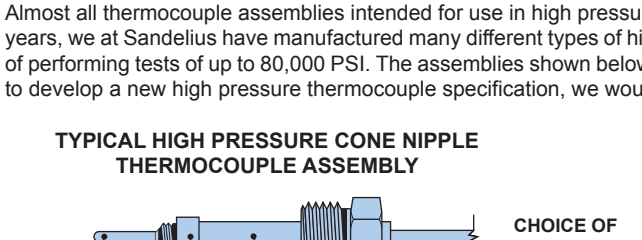


***NOTE:**
The teflon insert used on styles 1ET and 2ET help to prevent plastic from building up on the bolt tip.

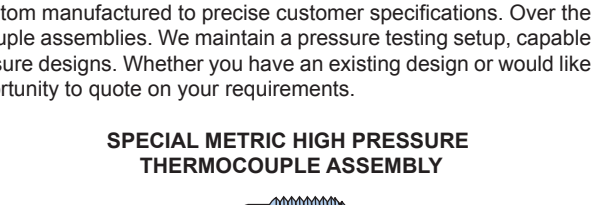
HIGH PRESSURE THERMOCOUPLE ASSEMBLIES

Almost all thermocouple assemblies intended for use in high pressure applications are custom manufactured to precise customer specifications. Over the years, we at Sandelius have manufactured many different types of high pressure thermocouple assemblies. We maintain a pressure testing setup, capable of performing tests of up to 80,000 PSI. The assemblies shown below are typical high pressure designs. Whether you have an existing design or would like to develop a new high pressure thermocouple specification, we would appreciate the opportunity to quote on your requirements.

TYPICAL HIGH PRESSURE CONE NIPPLE
THERMOCOUPLE ASSEMBLY

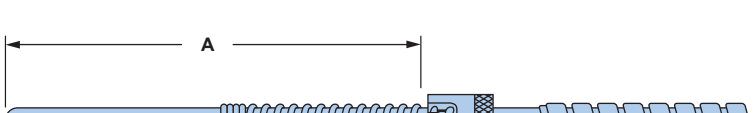


SPECIAL METRIC HIGH PRESSURE
THERMOCOUPLE ASSEMBLY



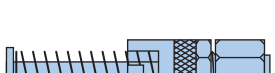
TYPICAL HIGH PRESSURE LENS RING
THERMOCOUPLE ASSEMBLY

BAYONET TYPE FITTINGS AND ADAPTERS



BAYONET FITTING

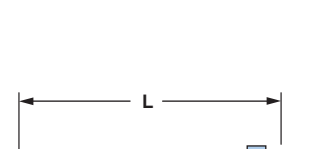
ORDER SYMBOL	DESCRIPTION
FB1	Bayonet Cap with spring stop brazrd to sheath. Can be used on either 1/8" or 3/16" diameter.
FB4	Bayonet Cap with adjustable swage type spring. For use on 1/8" diameter probes.
FB5	Bayonet Cap with adjustable swage type spring. For use on 3/16" diameter probes.



ADJUSTABLE BAYONET FITTING

Order Symbol: **FB2B** (with Brass Ferrule)
FB2N (with Nylon Ferrule)
FB2T (with Teflon Ferrule)

Designed for use on 0.125" diameter sheath material. This fitting incorporates a compression type mounting feature. If nylon or Teflon ferrules are used, the fitting may be re-positioned as needed.

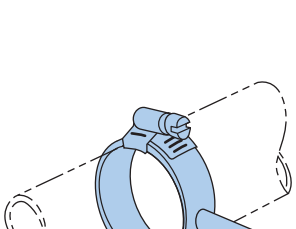


1/8" NPT

STANDARD BAYONET ADAPTER

Order Symbol: **BA–(L)**

Standard Lengths 7/8", 1 1/2", 2 1/2" and 3 1/2". Other lengths and special thread sizes are available on request.



PIPE STRAP BAYONET ADAPTER

Order Symbol: **FP – 4 – 2**
L Length (in inches)
Std. L=2"
Actual Tube or
Pipe O.D. (in inches)

Pipe strap adapters are available to fit any size tube or pipe. They provide an excellent means to achieve surface temperature measurements while allowing for easy replacement of thermocouple probes.

COMPRESSION FITTINGS

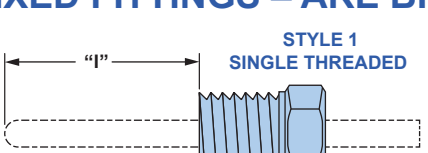
SINGLE THREADED

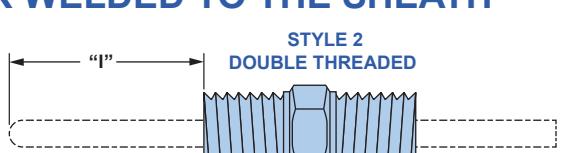
ORDER SYMBOL*	THREAD NPT SIZE	MATERIAL	AVAILABLE TO FIT THESE SHEATH O.D. SIZES
CB11	1/8"	Brass	0.063", 0.125", 0.188", 0.250"
CF11	1/8"	Stainless Steel	0.063", 0.125", 0.188", 0.250"
CB12	1/4"	Brass	0.063", 0.125", 0.188", 0.250", 0.312", 0.375"
CF12	1/4"	Stainless Steel	0.063", 0.125", 0.188", 0.250", 0.312", 0.375"
CB13	3/8"	Brass	0.125", 0.250", 0.312", 0.375"
CF13	3/8"	Stainless Steel	0.125", 0.250", 0.312", 0.375"
CB14	1/2"	Brass	0.125", 0.250", 0.375", 0.500"
CF14	1/2"	Stainless Steel	0.125", 0.188", 0.250", 0.375", 0.500"
CB16	3/4"	Brass	0.250", 0.375", 0.500"
CF16	3/4"	Stainless Steel	0.250", 0.375", 0.500"

Readjustable compression fittings with Teflon sealant ferrules are available upon request. When ordering fittings with Teflon ferrules, simply add a "T" after the order symbol. Example: CF14T-250. When an "1/8" vent hole is required add a "V" after the order symbol. Example CF14V-250.

*When ordering fittings as a part of an assembly, the order symbol alone includes all the information required as the fitting will be sized to match the assembly. When ordering fittings separately, the sheath O.D. size must be included. Example: CB12-250. Other materials available upon request.

FIXED FITTINGS – ARE BRAZED OR WELDED TO THE SHEATH





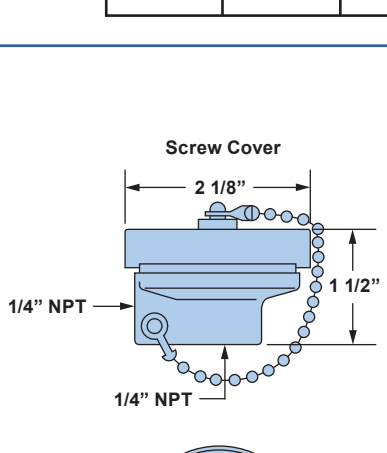
ORDER SYMBOL		THREAD SIZE	MATERIAL	AVAILABLE TO FIT THESE SHEATH O.D. SIZES
STYLE 1	STYLE 2			
F11	F21	1/8" NPT	304SS	0.063, 0.125, 0.188 & 0.250
F12	F22	1/4" NPT	304SS	0.063, 0.125, 0.188, 0.250, 0.313 & 0.375
F14	F24	1/2" NPT	304SS	0.063, 0.125, 0.188, 0.250, 0.313, 0.375 & 0.500
F16	F26	3/4" NPT	304SS	0.063, 0.125, 0.188, 0.250, 0.313, 0.375 & 0.500
F18	F28	1" NPT	304SS	0.063, 0.125, 0.188, 0.250, 0.313, 0.375 & 0.500

SPRING-LOADED FITTINGS

STYLE 1 – SINGLE THREADED

STYLE 2 – DOUBLE THREADED

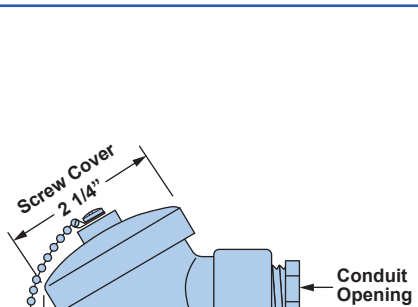
ORDER SYMBOL		THREAD NPT SIZE	MATERIAL	SPRING TYPE	AVAILABLE SHEATH SIZES
STYLE 1	STYLE 2				
SF14	SF24	1/2" NPT	304SS	Adjustable	0.125, 0.188, 0.250, 0.312 & 0.375
SB14	–	1/2" NPT	BRASS	Adjustable	0.125, 0.188, 0.250, 0.312 & 0.375
SPF14	SPF24	1/2" NPT	304SS	Adjustable with Liquid-tight O-Ring	0.125, 0.188 & 0.250



Miniature Weatherproof Thermoset Plastic Head

1/4" NPT x 1/4" NPT with 4 Integral Terminals

Part Number	Ambient Temperature Rating
N22	350° F
W22	800° F



Miniature Aluminum Head (Type M)

Part Number: M44* (1/2" x 1/2" NPT)

(Use "120" Series Terminal Blocks)

Max No. of Terminals: 4 + Ground

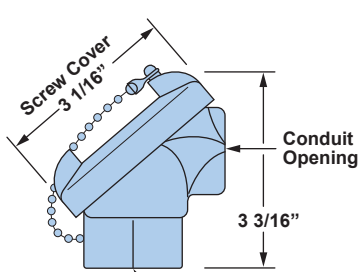
*See note on page A-18

Ceramic Terminal Blocks

Fit Miniature Head Type: M

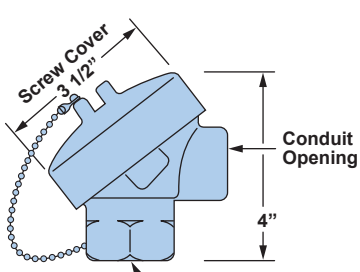
Part Number	Description
CP122	2 - Terminals
CP124	4 - Terminals

TERMINAL HEADS & CONNECTOR BLOCKS



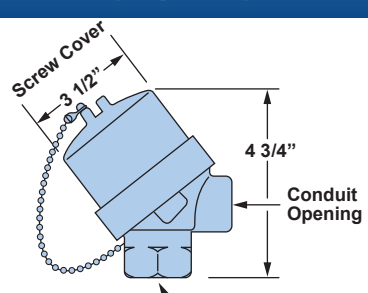
Standard Weatherproof Heads
(Use "162F Series" Ceramic Terminal Blocks)
Max. number of terminals: 6+Ground.

Part Number[1]	Type	Description
P46*	P	Polypropylene
PW46*	PW	White Polypropylene[2] (FDA Compliant)
Q46*	Q	Aluminum
R46*	R	Cast Iron



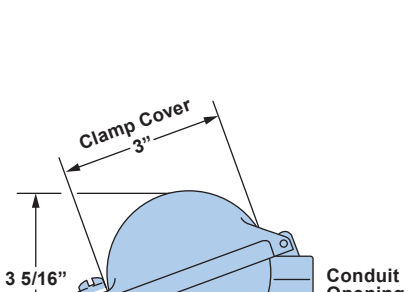
Large Weatherproof Heads
(Use "162 Series" Ceramic Terminal Blocks)
Max. number of terminals: 6+Ground.

Part Number[1]	Type	Description
A46*	A	Aluminum
C46*	C	Cast Iron



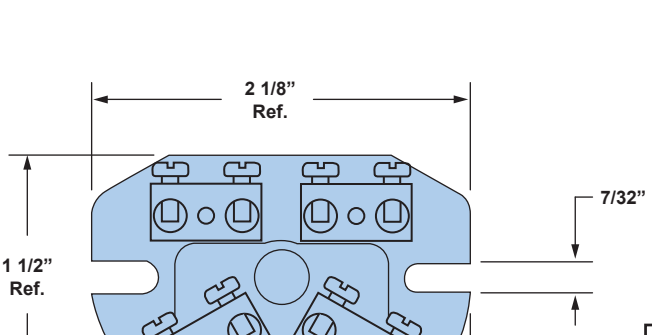
Large Dome Cover Weatherproof Heads
(Use "162 Series" Ceramic Terminal Blocks)
Max. number of terminals: 6+Ground.

Part Number[1]	Type	Description
D46*	D	Cast Iron



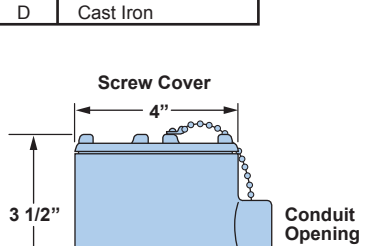
Weatherproof Aluminum Head
(Use "162 Series" Terminal Blocks)
Max No. of Terminals: 6 + Ground

Part Number[1]	Type	Description
H44*	H	1/2" x 1/2" NPT
H46*	H	1/2" x 3/4" NPT



163 Series Ceramic terminal blocks
Fits All Heads, must be used for 8g- wire
CP129 (3/8" spacing) is standard in E &
CP129 (3/8" spacing) is standard in E &

Part Number	Number of Terminals
CP163B	2
CP163D	4



Large Explosion Proof Heads
(Standard Terminal Block is CP129)
Max No. of Terminals: 6 + Ground

Part Number[1]	Type	Description
E46*	E	Aluminum
F46*	F	Cast Iron/Aluminum

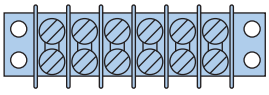
To Order Any Head On This Page

C 4 6 B
- B — Connector block if required. B – 2 Terminals C – 3 Terminals D – 4 Terminals F – 6 Terminals
- Conduit Opening (See table A below)
- Process Opening (See table A below)
- Head Type
- If a tapped internal ground screw is required insert a "G" in front of the part number.

Table A -Connection Sizes (All heads on this page)

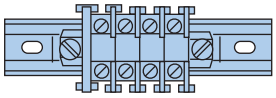
NPT SIZE	ORDER CODES	Available on Head Types	
		PROCESS	CONDUIT
1/2	4	All	All
3/4	6	All except H+P	All
1	8	A B C D E F & R	E & F

Notes:
* To order heads complete with terminal block add suffix to specify the number of terminals required B=2 terminals, C=3 terminals, etc.
1. Unless otherwise noted, all head part numbers shown are for heads with 0.5" NPT process openings and 0.75" NPT conduit openings. See Table A for other available sizes.
2. PW series heads may be specially ordered with molded-in terminals. To order insert an "M" before the number of terminals required. Example: PW46MF would have 6 molded-in terminals.
3. Type E & F explosion proof heads are approved for Class 1, Groups B, C, & D; Class 2, Groups E, F & G; Class 3, All Groups.
4. Type F & T explosion proof heads have cast iron bodies with aluminum covers.
5. Aluminum & Cast Iron heads are available with epoxy coating add an "X" after the type designation. Example: QX46D.
6. Some NPT sizes are achieved through the use of reducing bushings.



CP129 & CP130 Terminal Strips
CP129 (3/8" spacing) is standard in E & F type heads.
CP130 (7/16" spacing) available with compensated terminals is commonly used in junction boxes.

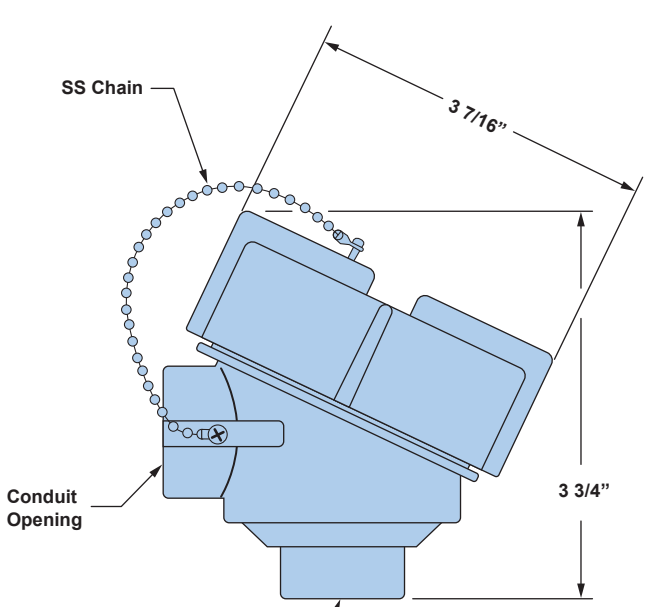
To Order Specify
CP130–12–K
- K — Type of Optional Compensated Terminals (Available on CP130 only)
- 12 — Number of Terminals (20 max.)
- CP130 — Part Number



CP140 Tubular Clamp Type Terminal Strip
Commonly used in junction boxes. May be specified as an option for E & F type heads.

To Order Specify
CP140–10
- 10 — Number of Terminals
- CP140 — Part Number

TERMINAL HEADS & CONNECTOR BLOCKS



To Order Specify

AE–46–D

- Standard Terminal Block
  B – 2 Terminal Block (CP162B)
  C – 3 Terminal Block (CP162C)
  D – 4 Terminal Block (CP162D)
  F – 6 Terminal Block (CP162F)
  Leave blank if no Terminal Block
- Connection Code (See Table B)
- Basic Part Number (See Table A)

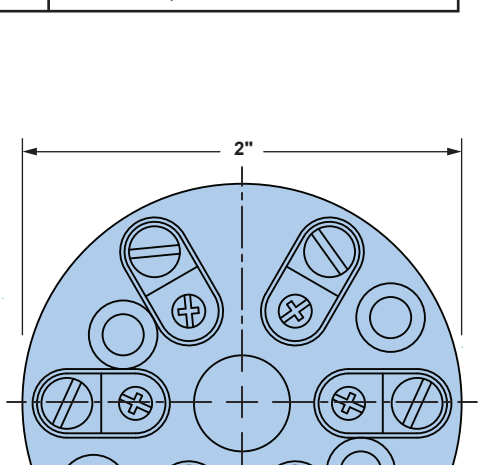
TABLE A - Basic Part Numbers	
Part Number	**Material**
AE	Aluminum, Explosion Proof
AEX	Epoxy Coated Aluminum, Explosion Proof
SE	316SS, Explosion Proof

Table B – Connection Code		
Code	**Process Opening**	**Conduit Opening**
44	1/2" NPT	1/2" NPT
45	1/2" NPT	M20 x 1.5
46	1/2" NPT	3/4" NPT
66	3/4" NPT	3/4" NPT

FM/CSA APPROVALS:
CLASS 1, DIV. 1, GROUPS B, C & D and
Dust Ignitionproof for Class II, Div. 1,
Group E, F and G, Class III
Type 4X and IP68

Ex II 2 G Ex d IIC Gb Ta, IP68
II 2 D Ex tb IIIC Db Ta, IP68

IECEx Approvals:
Ex d IIC Gb
Ex tb IIIC Db



Part Number	Number of Terminals
CP162B	2
CP162C	3
CP162D	4
CP162E	5
CP162F	6

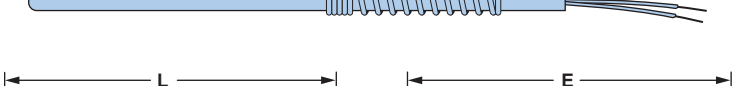
REVISIONS			Sandelius Instruments, Inc. 713.861.1100 www.sandelius.com		
NO.	DATE	BY	TERMINAL BLOCK		
1.					
2.					
3.			DRAWN BY TJM	SCALE NTS	MATERIAL Noted
4.			CHK'D	DATE 2/17/16	DRAWING NUMBER CP163
5.			TRACED	APP'D	

SANDELIUS R.T.D. ASSEMBLIES

Sandelius offers a complete line of quality RTD assemblies available in both “standard” and “cut-away” configurations. In the standard configuration the leads are epoxy sealed where they exit the sheath. This results in a more rugged and moisture resistant probe. Standard configuration probes must be ordered to the exact lengths required as they cannot be shortened in the field. The cut-away configuration has leadwire passing through a hollow sheath to the RTD bulb. The resulting assembly can be shortened to any length down to a 3-inch minimum by carefully cutting off a section of the hollow sheath and adjusting the wire length to suit. While not quite as rugged as our standard RTD configuration cut-away assemblies offer the advantage of eliminating the need to stock a different spare for each probe length used in your plant.

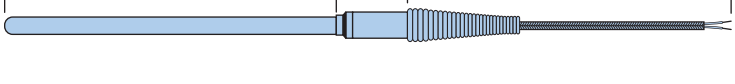
Style R1A – Epoxy sealed RTD probe
Style CR1A[1]– Cut-to-length RTD probe

Style SR1A – Epoxy sealed RTD probe with spring
Style SCR1A[1]– Cut-to-length RTD probe with spring



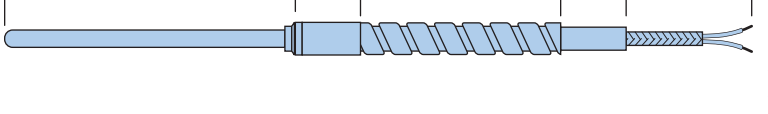
Style R1T – RTD probe with transition fitting and leadwire

Style R2T – RTD probe with transition fitting and SS overbraid

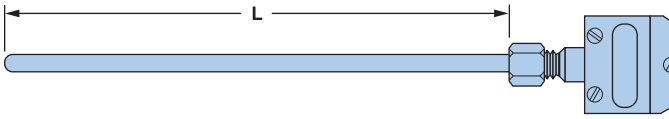


Style R4T – RTD probe with transition fitting and SS armor
Style R4TP – Same as R4T with PVC coated SS armor
Style R4TT – Same as R4T with Teflon coated armor

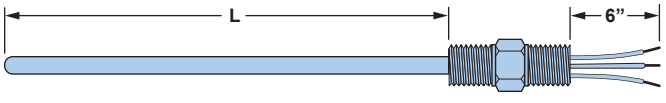
Style R6T – RTD probe with transition fitting and SS armor
A 2-inch SS tube is brazed into the end of the armor to allow the use of a compression fitting to connect a head or transmitter
Style R6TP– Same as R6T with PVC coated armor
Style R6TT– Same as R6T with Teflon coated armor



Style R5B – RTD probe with standard 3-pole plug



Style R5H – RTD probe with 1/2” x 1/2” npt SS mounting Fitting brazed to sheath
Style RW5H – RTD probe with 1/2” x 1/2” npt SS mounting Fitting welded to sheath



Style SR5H – RTD probe with spring loaded 1/2” x 1/2” npt SS mounting fitting
Style SCR5H[1]– Same as SR5H with cut-to-length probe
Style SPR5H – RTD probe with liquid tight spring-loaded 1/2” x 1/2” npt SS mounting fitting

To Order specify:

SR1A–4A3EL–L22–E4–OPTIONS

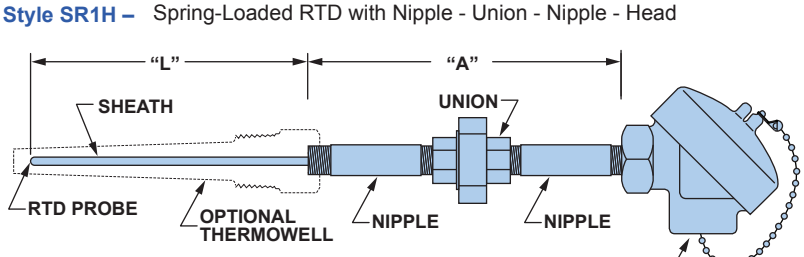
Assembly style above	Element Pg. A-21	L – Length (in inches)	E – Length (in inches)	Heads pgs. A-18 & A-19 Fittings pgs. A-16, A-17 Terminations pg. A-5 Copper Tip, see note 4

NOTES:

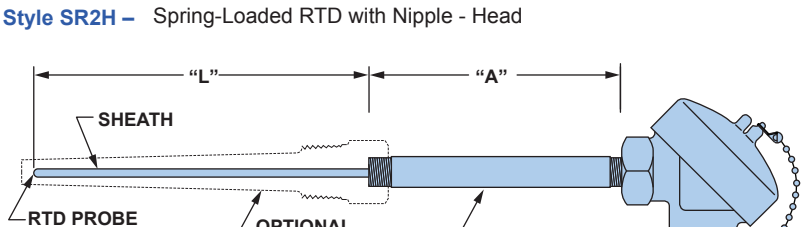
1. Cut-to-length RTDs are not available in the “M” high temperature range.
2. Standard leadwire insulation on RTD probes are as follows:
   “L” Range – Teflon “K” Range – Kapton “F” Range – Fiberglass
   “M” Range – Teflon “C” Range – PVC
3. If your application requires bending in the field, an “M” series RTD probe should be specified. We do not recommend field bending of any other RTD series.
4. Most 0.215 & 0.25” diameter RTD probes can be supplied with a copper insert tip for faster response and better tip sensitivity. To order specify CP909B at the end of the part number.

SANDELIUS R.T.D. ASSEMBLIES

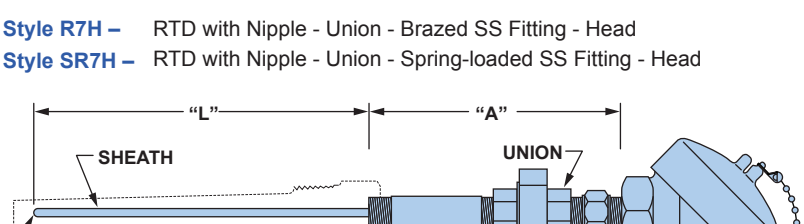
Style R1H – RTD with Nipple - Union - Nipple - Head
Style SR1H – Spring-Loaded RTD with Nipple - Union - Nipple - Head



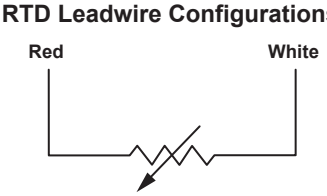
Style R2H – RTD with Nipple - Head
Style SR2H – Spring-Loaded RTD with Nipple - Head



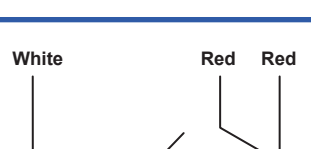
Style R7H – RTD with Nipple - Union - Brazed SS Fitting - Head
Style SR7H – RTD with Nipple - Union - Spring-loaded SS Fitting - Head



RTD Leadwire Configurations

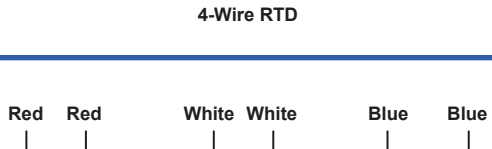


2-Wire RTD



3-Wire RTD

4-Wire RTD



Special 4-Wire with Compensation Loop

To Order specify:

SR7H–4A3EL–L16–4G6–C46C–(Optional Thermowell*)

- Assembly Style
- Element See Below
- L – Length in inches
- Thread Size: 4 – 1/2" NPT; 6 – 3/4" NPT; 8 – 1" NPT
- Nipple & Union Material: C – Carbon Steel; G – Galvanized Steel; S – Stainless Steel
- Head See Pages A-18 & A-19
- Nominal A Length in inches — See Catalog Section B-2

*To order an assembly complete with a thermowell simply insert the part number of the thermowell from Sandelius catalog Section B. When ordering an assembly complete with a thermowell, the "L" length may be shown as "00" as we will size the element to fit the thermowell.

HOW TO SPECIFY RTD ELEMENTS

4 A 3 E L

Sheath Diameter	Sheath Material	Number of Wires per Element	RTD Type	Temperature Range[2 3] / Construction
2 – 1/8"	A – 316SS	2 – Two Wire	E - Platinum 100 @ 0° C. α = 0.00385 – Single	L – -328°[4] -500° F with Teflon wire
3 – 3/16"	B – Inconel 600	3 – Three Wire	EE - Platinum 100 @ 0° C. α = 0.00385 – Dual	K – -328°[4] -700° F with Kapton wire
4 – 1/4"	C – 304SS	4 – Four Wire	A - Platinum 100 @ 0° C. α = 0.003916 – Single	M – -328°[4] -1000° F MgO with Teflon leads
6 – 3/8"		5 – Four Wire Special Compensation Loop	AA - Platinum 100 @ 0° C. α = 0.003916 – Dual	C – -20° F -200° F with PVC wire (Recommended for cooling water)
7 – 0.215"			B - Platinum 100 @ 0° C. α = 0.003902 – Single	F – 50°-700° F with Fiberglass wire
			P - Platinum 100 @ 0° C. α = 0.003926 – Single	H – -328°[4]-1200° F MgO with Teflon leads, H range comes standard with Inconel 600 sheath material
			R - Platinum 100 @ 0° C. α = 0.003911 – Single	
			W - Platinum 100 @ Sama Curve – Single	
			N - Nickel 120 @ 0° C. Single	
			C - Copper 100 @ 25° C – Single	
			Y - Other (Specify at end of part number)	

Notes:

1. Alpha = 0.00385 is the DIN 43760 standard and is the most commonly used.
2. Not all items for which a part number can be made are available in actual fact.
3. The temperature ranges shown are for platinum RTDs.
4. Sandelius RTDs are normally manufactured for use at temperatures above -140° F. If an RTD is intended for use at temperatures below -140° F, this information must be specified on the order so the necessary modifications can be incorporated. (In very special cases, temperatures as low as -434° F are possible).

THERMOWELLS

www.SANDELIUS.com

OVER 55 YEARS OF THERMOWELL EXPERIENCE

THERMOWELLS IN EACH CATEGORY ARE AVAILABLE
IN STRAIGHT, TAPERED AND STEPPED STYLES.

INDEX

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Web: www.sandelius.com
Email: info@sandelius.com

Mailing Address:
PO Box 30098
Houston, Texas 77249-0098

MATERIAL DESIGNATIONS FOR SANDELIUS THERMOWELLS

ORDER CODE	MATERIAL	ORDER CODE	MATERIAL	ORDER CODE	MATERIAL
M304	304 Stainless Steel	MF5	Alloy Steel A182-F5	M601	Inconel 601
M304L	304L Stainless Steel	MF9	Alloy Steel A182-F9	M602	Inconel 602
M304H	304H Stainless Steel	MF11	Alloy Steel A182-F11	M617	Inconel 617
M309	309 Stainless Steel	MF22	Alloy Steel A182-F22	M625	Inconel 625
M310	310 Stainless Steel	M6061	Aluminum 6061-T6	M686	Inconel 686
M316	316 Stainless Steel	M360	Brass 360	M718	Inconel 718
M316L	316L Stainless Steel	M1018	Carbon Steel C-1018	M750	Inconel X-750
M316H	316H Stainless Steel	MA105	Carbon Steel A105	MPVDF	Kynar
M317	317 Stainless Steel	M276	Hastelloy C-276	M400	Monel 400
M317L	317L Stainless Steel	M277	Hastelloy X	M405	Monel 405
M317H	317H Stainless Steel	M278	Hastelloy B-3	M500	Monel K-500
M321	321 Stainless Steel	M279	Hastelloy B-2	M200	Nickel 200
M347	347 Stainless Steel	M160	Haynes HR 160	MTFEM	Teflon, PTFE Mechanical Grade
M347H	347H Stainless Steel	M800	Incoloy 800	MTFEV	Teflon, PTFE Virgin Grade
M410	410 Stainless Steel	M800H	Incoloy 800H	M152	Titanium Grade 2
M446	446 Stainless Steel	M800HT	Incoloy 800HT	M155	Titanium Grade 5
M2205	2205 Duplex Stainless Steel	M825	Incoloy 825	MZ702	Zirconium R60702
MA20	Alloy 20 Stainless Steel	M600	Inconel 600	MY99	Other Material, Specify

OPTIONAL FEATURES

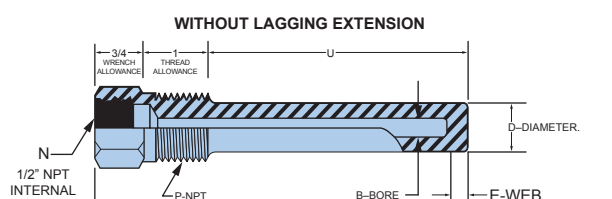
The following are some of the optional features available on Sandelius thermowells. To order a thermowell with any of the listed options simply add the suffix (or suffixes by dashes) at the end of the thermowell part number. If an optional requirement must be in compliance with a precise specification or procedure, please reference this on your order. Consult factory for special requirements not listed below.

SUFFIX	OPTIONAL FEATURE
BC	Brass plug with stainless steel chain
SC	Stainless steel plug and chain
TAOS	Tantalum over sheath (Available on 420 series flanged type and 520 series Van Stone type
	Pressure Testing Options
PT(xxxx) PT(xxxx) X(x)	Internal Hydrostatic Pressure Test at stated pressure (psi). Example PT1000 = Internal Pressure Test at 1,000 psi. If there is a specific time requirement, add an “X” then add the time required in minutes. Example: PT2000 X 15 = Internal Pressure Test at 2000 psi for 15 minutes
EP(xxxx) EP(xxxx) X(x)	External Hydrostatic Pressure Test at stated pressure (psi). Example EP1000 = External Pressure Test at 1,500 psi. If there is a specific time requirement, add an “X” then add the time required in minutes. Example: EP2500 X 15 = External Pressure Test at 2500 psi for 15 minutes
	Weld Checking & Performance Options
DB	Dye Penetrant Check – both root and final pass of flange weld
DC	Dye Penetrant Check – final cover pass of flange weld
DR	Dye Penetrant Check – root pass of flange weld
RX	Radiographic examination (X-Ray) of flange weld
PW	Post weld heat treatment
QW	Qualified welder
WP	Weld procedure specification
UT	Ultrasonic Shear Wave Test
	Material Testing Options
MT	Material Test Reports
NA	NACE MR-01-75. *Thermowell must be made of a NACE recognized material.*
YNA	NACE MR-01-03. *Thermowell must be made of a NACE recognized material.*
PM	Positive material identification
	Cleaning Options
CO	Clean for Oxygen service
CC	Clean for Chlorine service
	Special Certifications
CR	Canadian Registration Number (Canadian province must be specified on order).
	Special Coatings, Stellite or Alloy Welded Tips
Consult Factory	Many types of coatings can be applied to thermowells to add corrosion and/or wear resistance (See page B-12 of this catalog). Thermowells can also be fitted with special welded-on alloy tips made of Stellite or other materials. The number of possible variations is virtually limitless. If you have a special design you need manufactured or would like to investigate possible new, special designs that may improve service life in your application, please call us. We will be glad to work with you.

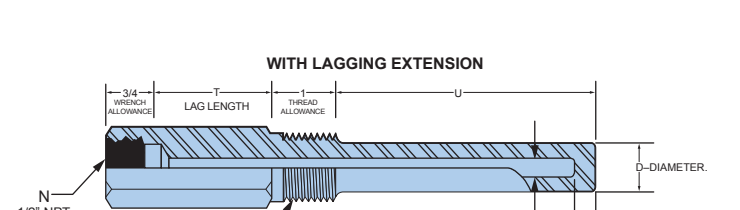
SCREWED TYPE THERMOWELLS

120 SERIES THERMOWELLS - THREADED WITH STRAIGHT SHANK

WITHOUT LAGGING EXTENSION



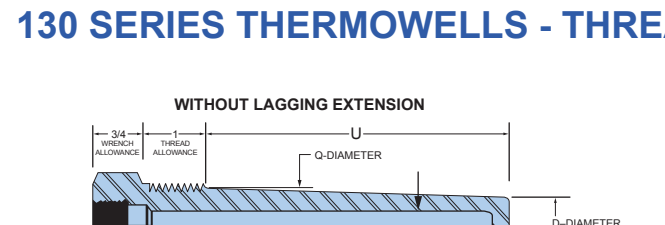
WITH LAGGING EXTENSION



PART NUMBER	B BORE	D	AVAILABLE P-NPT SIZES
122A	0.260	1/2	1/2, 3/4 or 1
122B	0.260	5/8	1/2, 3/4 or 1
122D*	0.260	49/64	3/4 or 1
122E	0.260	7/8	3/4 or 1
122F	0.260	1	1
122G	0.260	1 1/16	1
123B	0.290	5/8	1/2, 3/4 or 1
123D	0.290	49/64	3/4 or 1
123E	0.290	7/8	3/4 or 1
123F	0.290	1	1
123G	0.290	1 1/16	1
124D*	0.385	49/64	3/4 or 1
124E	0.385	7/8	3/4 or 1
124F	0.385	1	1
124G	0.385	1 1/16	1
125D	0.515	49/64	3/4 or 1
125E	0.515	7/8	3/4 or 1
125F	0.515	1	1
125G	0.515	1 1/16	1
126E	0.703	7/8	3/4 or 1
126F	0.703	1	1
126G	0.703	1 1/16	1

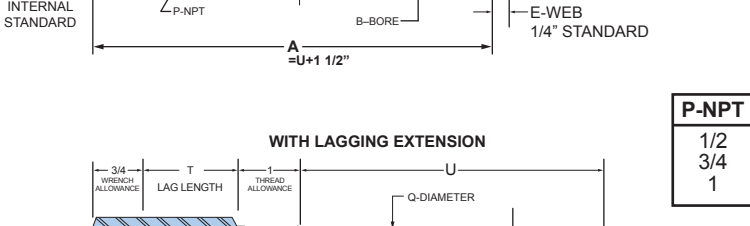
130 SERIES THERMOWELLS - THREADED WITH TAPERED SHANK

WITHOUT LAGGING EXTENSION



P-NPT	Q
1/2	5/8
3/4	7/8
1	1 1/16

WITH LAGGING EXTENSION



PART NUMBER	B BORE	D	AVAILABLE P-NPT SIZES
132A	0.260	1/2	1/2, 3/4 or 1
132B*	0.260	5/8	3/4 or 1
132C	0.260	3/4	3/4 or 1
132D	0.260	49/64	3/4 or 1
132E	0.260	7/8	1
133B	0.290	5/8	3/4 or 1
133C	0.290	3/4	3/4 or 1
133D	0.290	49/64	3/4 or 1
133E	0.290	7/8	1
134C	0.385	3/4	3/4 or 1
134D*	0.385	49/64	3/4 or 1
134E	0.385	7/8	1
135D	0.515	49/64	3/4 or 1
135E	0.515	7/8	1
136F	0.703	1	1

* – Items preceded by an asterisk are the most commonly ordered sizes. In the absence of universally recognized thermowell standards, these items may be considered to be standard sizes.

TO ORDER ANY 120 or 130 SERIES THERMOWELL SPECIFY:

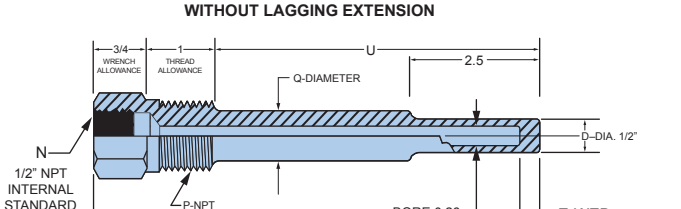
132B–3/4–18–M316–

- Part Number
- "P" Process Connection
- "U" Insertion Length (inches)
- Materials. See pg. B-2
- "T" Dimension (if any)

SCREWED TYPE THERMOWELLS

140 SERIES THERMOWELLS – THREADED WITH STEPPED SHANK

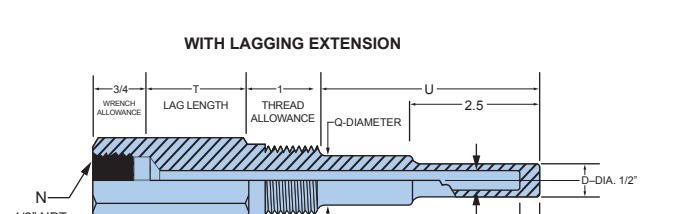
WITHOUT LAGGING EXTENSION



PART NUMBER	B BORE	Q	AVAILABLE P-NPT SIZES
142B	0.260	5/8	1/2, 3/4 or 1
142C*	0.260	3/4	3/4 or 1
142E*	0.260	7/8	3/4 or 1

* – Items preceded by an asterisk are the most commonly ordered sizes. In the absence of universally recognized thermowell standards, these items maybe considered to be “standard sizes”.

WITH LAGGING EXTENSION



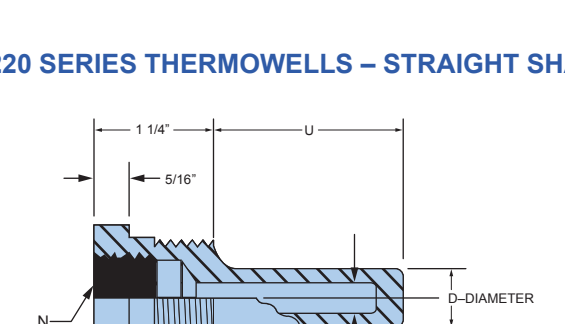
TO ORDER ANY 140 SERIES THERMOWELL SPECIFY:

142C–3/4–9–M316–T1-1/2

- 142C – Part Number
- 3/4 – “P” Process Connection
- 9 – “U” Insertion Length (inches)
- M316 – Materials. See pg. B-2
- T1-1/2 – “T” Dimension (if any)

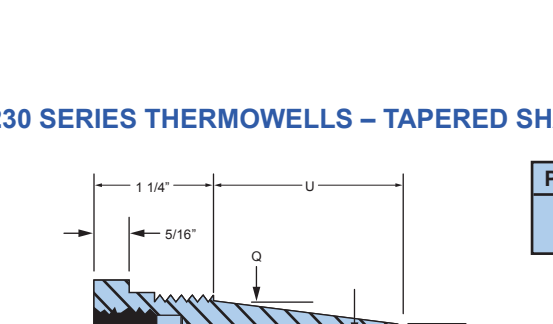
200 SERIES LIMITED SPACE THERMOWELLS

220 SERIES THERMOWELLS – STRAIGHT SHANK



PART NUMBER	B BORE	D	AVAILABLE P-NPT SIZES
222A*	0.260	1/2	3/4 or 1
222B	0.260	5/8	3/4 or 1
222D	0.260	49/64	3/4 or 1
224D	0.385	49/64	3/4 or 1
224E	0.385	7/8	3/4 or 1

230 SERIES THERMOWELLS – TAPERED SHANK



P-NPT	Q
3/4	7/8
1	1 1/16

PART NUMBER	B BORE	D	AVAILABLE P-NPT SIZES
232A*	0.260	1/2	3/4 or 1
232B	0.260	5/8	3/4 or 1
232C	0.260	3/4	3/4 or 1
234C	0.385	3/4	3/4 or 1
234D	0.385	49/64	3/4 or 1

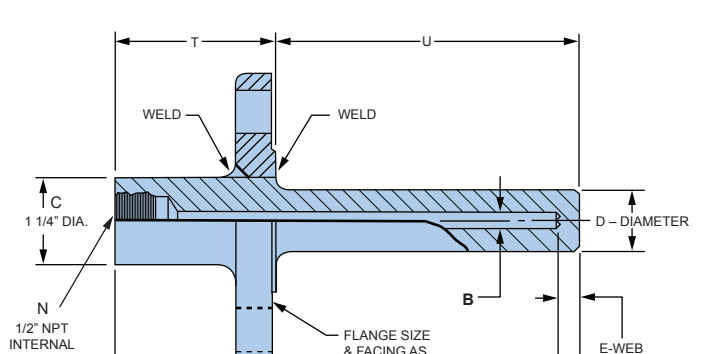
TO ORDER ANY 220 or 230 SERIES THERMOWELL SPECIFY:

222A–3/4–2-1/2–M304

- 222A – Part Number
- 3/4 – “P” Process Connection
- 2-1/2 – “U” Insertion Length (inches)
- M304 – Material See Pg. B-2

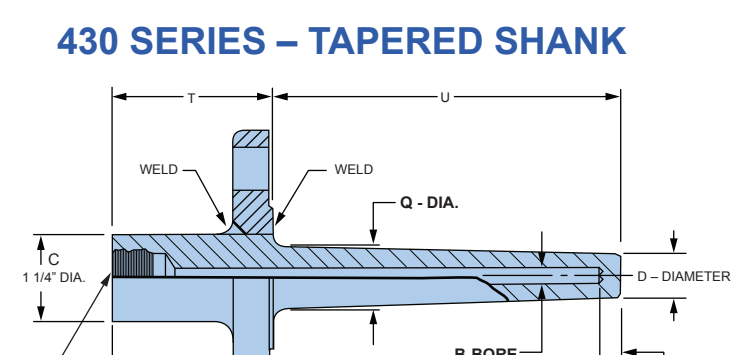
FLANGED TYPE THERMOWELLS

420 SERIES – STRAIGHT SHANK



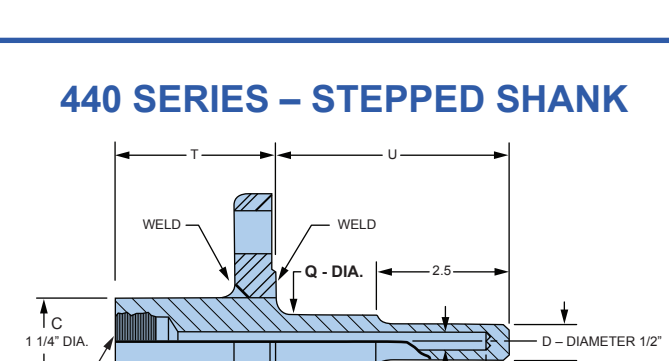
PART NUMBER	B BORE	D	FLANGE
422B	0.260	5/8	Any
422C*	0.260	3/4	Any
422D	0.260	49/64	Any
422E	0.260	7/8	Any
422F	0.260	1	Any
422G	0.260	1 1/16	Any
424C	0.385	3/4	Any
424D	0.385	49/64	Any
424E*	0.385	7/8	Any
424F	0.385	1	Any
424G	0.385	1 1/16	Any

430 SERIES – TAPERED SHANK



PART NUMBER	B BORE	Q	D	FLANGE
432CA	0.260	3/4	1/2	Any
432EB*	0.260	7/8	5/8	Any
432EC	0.260	7/8	3/4	Any
432ED	0.260	7/8	49/64	Any
432FB	0.260	1	5/8	Any
432FC	0.260	1	3/4	Any
432FD	0.260	1	49/64	Any
432GB	0.260	1 1/16	5/8	Any
432KC	0.260	1 1/4	3/4	Any
434EC	0.385	7/8	3/4	Any
434ED	0.385	7/8	49/64	Any
434FB	0.385	1	5/8	Any
434FC	0.385	1	3/4	Any
434FD*	0.385	1	49/64	Any
434GC	0.385	1 1/16	3/4	Any
434KE	0.385	1 1/4	7/8	Any

440 SERIES – STEPPED SHANK



PART NUMBER	B BORE	Q	FLANGE
442B	0.260	5/8	Any
442C	0.260	3/4	Any
442E*	0.260	7/8	Any

Items preceded by an asterisk are the most commonly ordered sizes. In the absence of universally recognized thermowell standards, these items may be considered to be “standard sizes”.

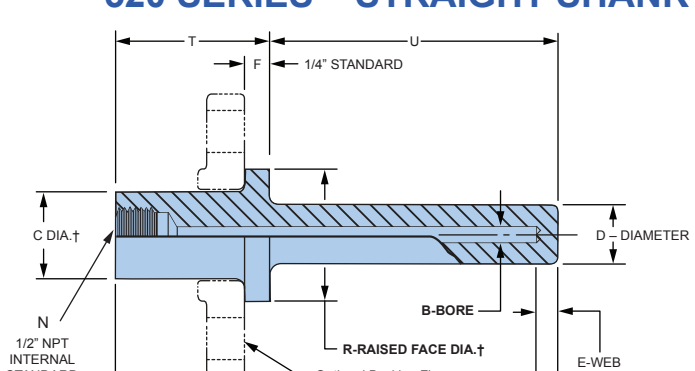
TO ORDER ANY FLANGED TYPE THERMOWELL SPECIFY:

FP 422C–18–M304–T2-1/4–1-1/2” 150#RF

- Flange size, pressure rating and facing (Unless otherwise specified, flamge material will be the same as the well material.)
- “T” Dimension (inches). The most commonly used “T” is 2 1/4”.
- Material (see pg. B-2)
- “U” Insertion Length (inches)
- Part Number
- Prefix Part Number with “FP” if Full Penetration weld is required

VAN STONE TYPE THERMOWELLS

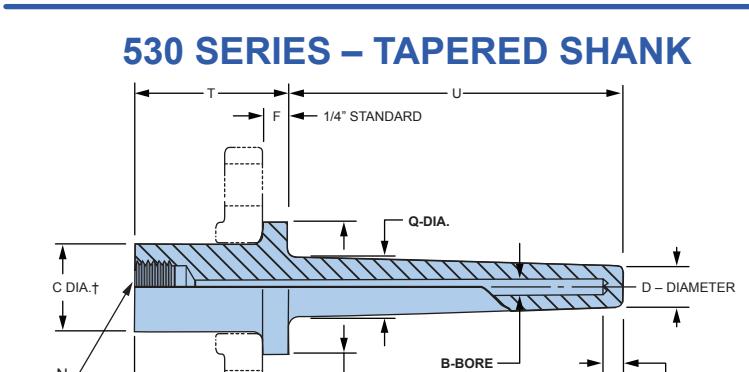
520 SERIES – STRAIGHT SHANK



PART NUMBER	B BORE	D
522C*	0.260	3/4
522E	0.260	7/8
523C	0.290	3/4
523E	0.290	7/8
524C	0.385	3/4
524E*	0.385	7/8
525C	0.515	3/4
525E	0.515	7/8

† See table below for "C" & "R" dimensions of common flange sizes.

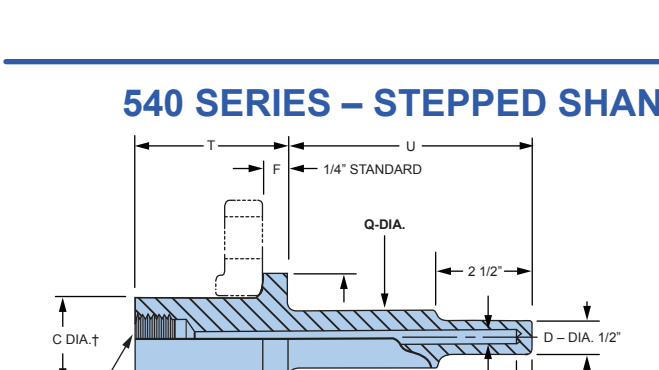
530 SERIES – TAPERED SHANK



PART NUMBER	B BORE	Q	D
532CA	0.260	3/4	1/2
532EB*	0.260	7/8	5/8
532EC	0.260	7/8	3/4
532ED	0.260	7/8	49/64
532FB	0.260	1	5/8
532FC	0.260	1	3/4
532FD	0.260	1	49/64
534EC	0.385	7/8	3/4
534ED*	0.385	7/8	49/64
534FC	0.385	1	3/4
534FD	0.385	1	49/64

† See table below for "C" & "R" dimensions of common flange sizes.

540 SERIES – STEPPED SHANK



PART NUMBER	B BORE	Q
542B	0.260	5/8
542C	0.260	3/4
542E*	0.260	7/8

† PIPE SIZE	C	R
0.75	1.050	1 11/16
1	1.315	2
1.25	1.660	2 1/2
1.5	1.900	2 7/8
2	2.375	3 5/8

* Items preceded by an asterisk are the most commonly ordered sizes. In the absence of universally recognized thermowell standards, these items may be considered to be "standard" sizes.

TO ORDER ANY 500 SERIES THERMOWELL SPECIFY:

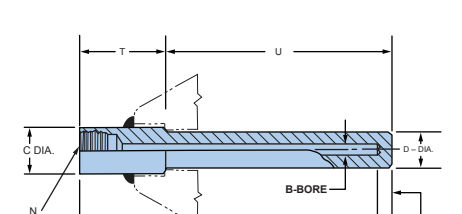
522C–1–16–M316–T2-1/4

- 522C — Part Number
- 1 — Pipe Size
- 16 — "U" Insertion Length (inches)
- M316 — Material See Pg. B-2
- T2-1/4 — "T" Dimension (inches). Standard "T" is 2 1/4".

NOTE: Van Stone type wells are designed to fit standard lap joint backing flanges. Unless specifically requested, bcking flanges are not included with your order. If backing flanges are desired, specify pressure rating and material.

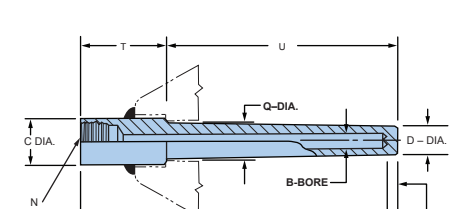
SOCKET WELD TYPE THERMOWELLS

620 SERIES– STRAIGHT SHANK



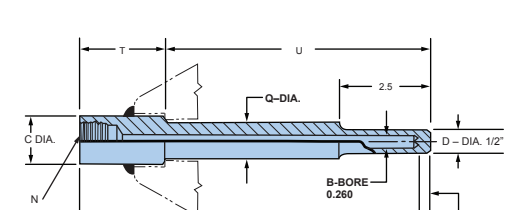
PART NUMBER	B BORE	D
622C	0.260	3/4
622D	0.260	49/64
622E-1	0.260	7/8
624C	0.385	3/4
624D	0.385	49/64
624E-1	0.385	7/8
625C	0.515	3/4
625D	0.515	49/64
625E-1	0.515	7/8

630 SERIES– TAPERED SHANK



PART NUMBER	B BORE	D
632B	0.260	5/8
632C	0.260	3/4
632D	0.260	49/64
634C	0.385	3/4
634D	0.385	49/64

640 SERIES– STEPPED SHANK



PART NUMBER	B BORE	D
642B	0.260	5/8
642C	0.260	3/4
642E-1	0.260	7/8

TO ORDER ANY SOCKET WELD TYPE THERMOWELL SPECIFY:

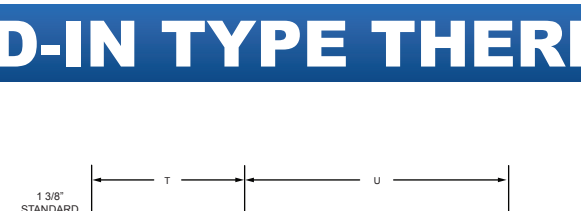
632C–3/4–10 1/2–M310–T1 3/4

- 632C – Part Number
- 3/4 – "C" Pipe Size
- 10 1/2 – "U" Insertion Length (inches)
- M310 – Material See Pg. B-2
- T1 3/4 – "T" Dimensions in inches

C – PIPE SIZE	C – ACTUAL SIZE	Q 630 Series
3/4	1.050	13/16
1	1.315	1

NOTE: It is good practice to check the ID of socket weld fittings to confirm the thermowell shank will pass through it. Part numbers followed by a "-1" are recommended for a 1" pipe size only (due to ID size limits of 3000# fittings).

WELD-IN TYPE THERMOWELLS



TO ORDER ANY WELD-IN TYPE THERMOWELL SPECIFY:

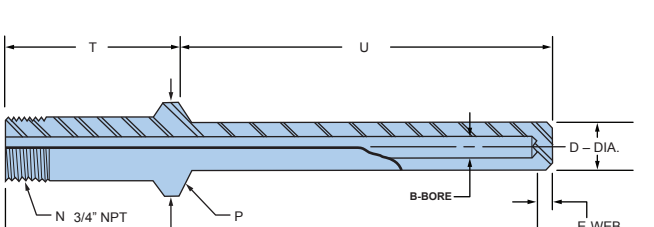
334E–12–M316–T4

- 334E – Part Number
- 12 – "U" Insertion Length (inches)
- M316 – Material See Pg. B-2
- T4 – "T" Dimensions in inches

PART NUMBER	B BORE	D
332A	0.260	1/2
332B	0.260	5/8
332C	0.260	3/4
332D	0.260	49/64
332E	0.260	7/8
333B	0.290	5/8
333C	0.290	3/4
333D	0.290	49/64
333E	0.290	7/8
334C	0.385	3/4
334D	0.385	49/64
334E	0.385	7/8
335D	0.515	49/64
335E	0.515	7/8
335F	0.515	1

GROUND JOINT TYPE THERMOWELLS

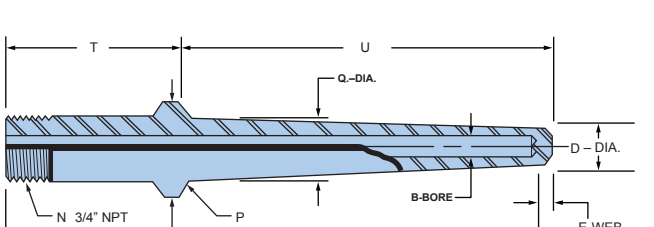
720 SERIES – STRAIGHT SHANK



PART NUMBER	B BORE	D
722B	0.260	5/8
722C	0.260	3/4
722E	0.260	7/8
724C	0.385	3/4
724E	0.385	7/8
725E	0.515	7/8

P RADIUS	O DIAMETER
1	1 3/8
1 1/4	1 3/4

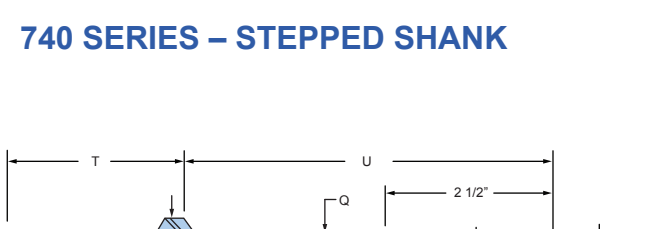
730 SERIES – TAPERED SHANK



PART NUMBER	B BORE	D
732B	0.260	5/8
732C	0.260	3/4
732E	0.260	7/8
734C	0.385	3/4
734E	0.385	7/8
735E	0.515	7/8

P RADIUS	O DIAMETER	Q
1	1 3/8	1
1 1/4	1 3/4	1 1/4

740 SERIES – STEPPED SHANK



PART NUMBER	B BORE	Q
742B	0.260	5/8
742C	0.260	3/4
742E	0.260	7/8

P RADIUS	O DIAMETER
1	1 3/8
1 1/4	1 3/4

TO ORDER ANY GROUND JOINT THERMOWELL SPECIFY:

732C–1–10–M316–T2-7/8

- Part Number
- "P" Process Connection Radius
- "U" Insertion Length (inches)
- Material See Pg. B-2
- "T" Dimensions in inches (Most commonly used "T" is 2 7/8").

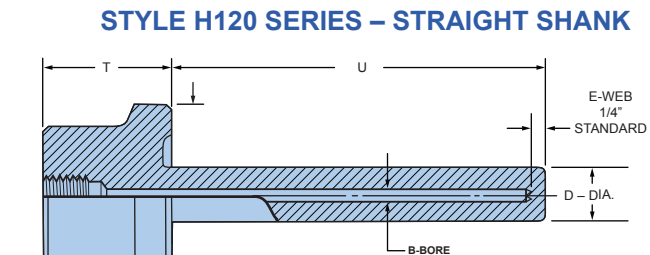
CLAMP JOINT TYPE THERMOWELLS

Sandelius manufactures a complete line of clamp joint type thermowells. They can be supplied with matching hubs, rings and clamps or installed into existing Grayloc* hub type connectors using Grayloc rings and clamps. Clamp joint type thermowells are available in your choice of one or two piece constructions. In the one piece construction (Style H1), the entire thermowell including the hub is machined from a single piece of solid bar. The two piece construction (Style H2) is similar to standard flanged thermowells in that the mounting hub is welded to the thermowell stem.

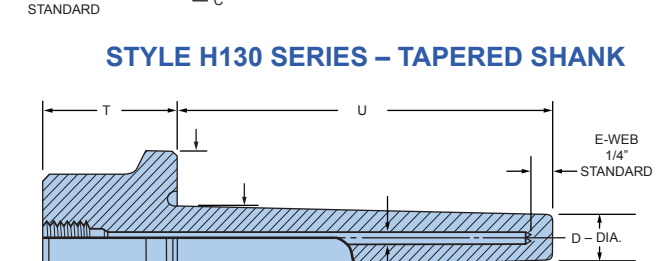
The most commonly used sizes are 1", 1 1/2" and 2", however they are available with any standard hub size. Shank and bore sizes other then those shown below are available on request.

TYPICAL STYLE H1 ONE PIECE THERMOWELLS

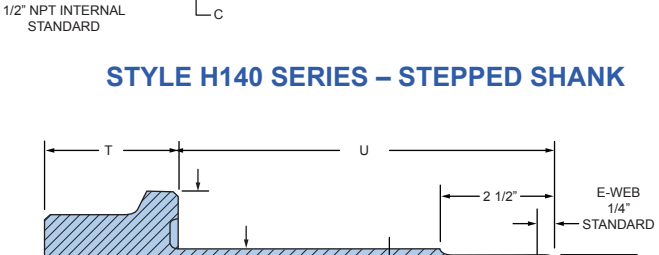
STYLE H120 SERIES – STRAIGHT SHANK



STYLE H130 SERIES – TAPERED SHANK

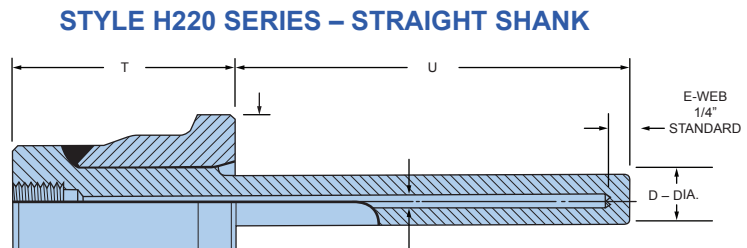


STYLE H140 SERIES – STEPPED SHANK

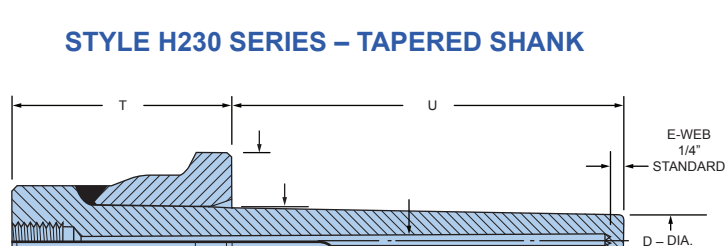


TYPICAL STYLE H2 TWO PIECE WELDED THERMOWELLS

STYLE H220 SERIES – STRAIGHT SHANK



STYLE H230 SERIES – TAPERED SHANK



STYLE H240 SERIES – STEPPED SHANK

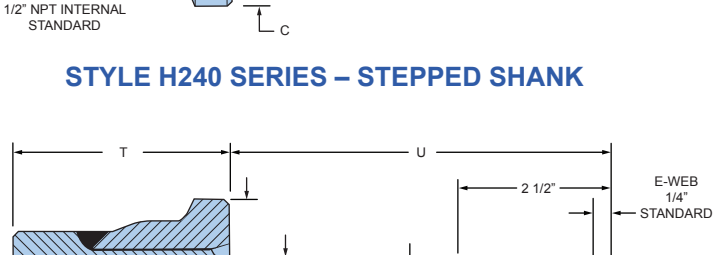


TABLE A

Designation	"D" Dia.
A	1/2"
B	5/8"
C	3/4"
D	49/64"
E	7/8"
F	1"

TABLE B: HUB SIZES

Pipe Size	Hub Designation	"C" Dim.	Seal Ring	Ring ID	Clamp Size
1"	1GR7	2	7	0.906	1
	1GR11	2	11	1.125	1
1 1/2"	1½GR11	3 1/8	11	1.125	1 1/2
	1½GR14	3 1/8	14	1.610	1 1/2
2"	2GR14	3 5/8	14	1.610	2
	2GR20	3 5/8	20	2.063	2

TABLE C — SEAL RINGS

Standard Seal Ring Material	Service Temperature Range
Carbon Steel – Teflon Coated	-50º to 350ºF
Carbon Steel – MOS_2 Coated	-50º to 350ºF
17-4 PH Stainless Steel – Teflon Coated	-452º to 450ºF
17-4 PH Stainless Steel – MOS_2 Coated	-452º to 450ºF

To Order Clamp Joint Type Thermowells Specify:

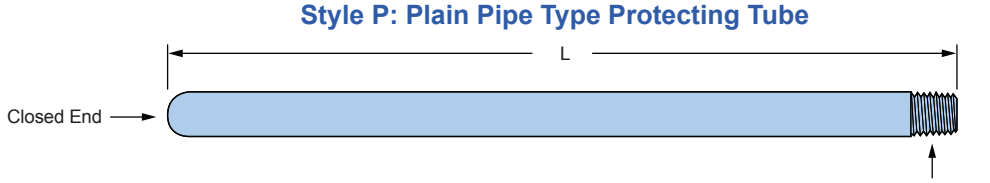
HI–3–2–FC–1GR11–U12–M304–T1-3/4

- H1= Solid One Piece Construction
  H2= Welded Two Piece Construction
- 2 = Straight Shank
  3 = Tapered SDhank
  4 = Stepped Shank
- Bore Size: 2=0.260", 4=0.385"
- "D" Diameter. See Table A.
  (Use double letter for tapered or stepped shank
- Hub Designation. See Table B.
- "U" Insertion Length (inches)
- Material (See page B-2.)
- "T" Length (inches)

*Grayloc is a registered trademark of Gray Tool Company

METAL PROTECTING TUBES

Style P: Plain Pipe Type Protecting Tube



Style B: Pipe Type Protecting Tube with Mounting Bushing

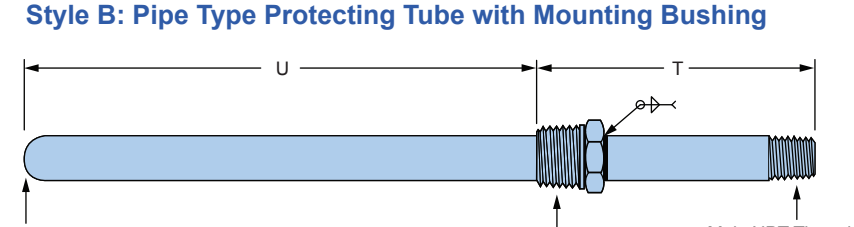


Table 1

PART NUMBER	A.S.A PIPE SCHEDULE
905	5
910	10
940	40
980	80
916	160
955	XXH

Style F: Pipe Type Protecting Tube with Flange

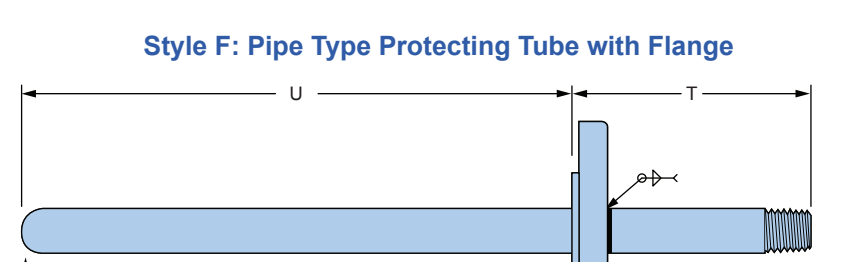


Table 2

PIPE SIZE	OUTSIDE DIAMETER	WALL THICKNESS OF A.S.A. PIPE SCHEDULES					
		5	10	40	80	160	XXH
1/8	0.405	0.035	0.049	0.068	0.095	—	—
1/4	0.540	0.049	0.065	0.088	0.119	—	—
3/8	0.675	0.049	0.065	0.091	0.126	—	—
1/2	0.840	0.065	0.083	0.109	0.147	0.187	0.294
3/4	1.050	0.065	0.083	0.113	0.154	0.218	0.308
1	1.315	0.065	0.109	0.133	0.179	0.250	0.358
1 1/4	1.660	0.065	0.109	0.140	0.191	0.250	0.382
1 1/2	1.900	0.065	0.109	0.145	0.200	0.281	0.400
2	2.375	0.065	0.109	0.154	0.218	0.343	0.436

Table 3

BUSHING SIZE	ORDER CODE
1/2	B4
3/4	B6
1	B8
1 1/4	B10
1 1/2	B12
1 3/4	B14
2	B16

• Unless otherwise specified, carbon steel bushings are furnished.

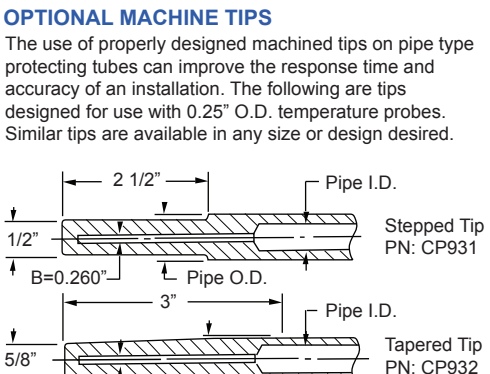
TO ORDER ANY 900 SERIES PIPE TYPE PROTECTING TUBE SPECIFY:

940 S B–1/2–24–M316SS–T6–B12–CP931

- Optional machined tip Same material as pipe (Leave blank if not required.)
- Mounting bushing from Table 3 or flange size, pressure rating, facing and material.
- "T" Dimensions in inches (if applicable).
- Material (See page B-2).
- "U" Insertion Length or "L" for Plain Tubes
- Pipe size, from Table 2.
- Style letter from diagrams above.
- Insert "S" for seamless pipe or "W" for welded pipe.
- Specify part numeber from Table 1

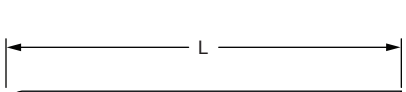
OPTIONAL MACHINE TIPS

The use of properly designed machined tips on pipe type protecting tubes can improve the response time and accuracy of an installation. The following are tips designed for use with 0.25" O.D. temperature probes. Similar tips are available in any size or design desired.

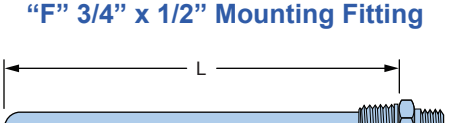


CERAMIC PROTECTING TUBES

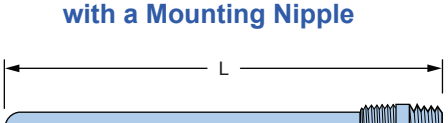
Typical Ceramic Tube, Plain End



Typical Ceramic Tube with "F" 3/4" x 1/2" Mounting Fitting



Typical Ceramic Tube with a Mounting Nipple



Ceramic and Structured Silicon-Carbide Protecting Tubes

ALUMINA PART NO.	MULLITE PART NO.	STRUCTURED SILICON-CARBIDE PART NO.	I.D.**	O.D.**	MOUNTING FITTING**
AL250-(L)	ML250-(L)	HR0203-(L)	1/4"	3/8"	None – Plain End
AL250N-(L)	ML250N-(L)	HR0203N-(L)	1/4"	3/8"	1/2" NPT Close Steel Nipple*
N/A	N/A	HR0305-(L)	3/8"	5/8"	None – Plain End
N/A	N/A	HR0305-(L)	3/8"	5/8"	3/4" NPT Close Steel Nipple
AL437-(L)	ML437-(L)	N/A	7/16"	11/16"	None – Plain End
AL437N-(L)	ML437N-(L)	N/A	7/16"	11/16"	3/4" NPT Close Steel Nipple*
AL437F-(L)	ML437F-(L)	N/A	7/16"	11/16"	3/4" x 1/2" NPT Steel Hex Fitting*
AL500-(L)	ML500-(L)	HR0406-(L)	1/2"	3/4"	None – Plain End
AL500N-(L)	ML500N-(L)	HR0406N-(L)	1/2"	3/4"	1" NPT Close Steel Nipple*
N/A	N/A	HR0408-(L)	1/2"	1"	None – Plain End
N/A	N/A	HR0408N-(L)	1/2"	1"	1 1/4" NPT Close Steel Nipple*
AL750-(L)	ML750-(L)	N/A	3/4"	1"	None – Plain End
AL750N-(L)	ML750N-(L)	N/A	3/4"	1"	1 1/4" NPT Close Steel Nipple*
N/A	N/A	HR0610-(L)	3/4"	1 1/4"	None – Plain End
N/A	N/A	HR0610N-(L)	3/4"	1 1/4"	1 1/2" NPT Close Steel Nipple*
AL-1000-(L)	ML-1000-(L)	N/A	1"	1 1/4"	None – Plain End
AL-1000N-(L)	ML-1000N-(L)	N/A	1"	1 1/4"	1 1/4" NPT Close Steel Nipple*

* All standard mounting fittings are carbon steel. Stainless steel fittings may be specified by adding an "S" to the part number. Example: AL437NS-24.
** Tubes and fittings shown in the table are typical. Additional sizes and special mounting fittings are available on request.

To Order specify part number – "L" length in inches; Example: AL437N-36

SILICON-CARBIDE PROTECTING TUBES

Typical Silicon-Carbide Tube; Plain End

Typical Silicon-Carbide Tube with Collar

Standard Silicon-Carbide Protecting Tubes

PART NUMBER	I.D.	O.D.	MOUNTING FITTINGS*	NORMALLY AVAILABLE LENGTHS
SCO814	1"	1 3/4"	None*	Up to 48"
SCO814C	1"	1 3/4"	3" Dia. x 1" Thick Collar	Up to 48"

*Note: Various types of mounting fittings can be cemented to Silicon-Carbide tubes on request.

To Order Silicon-Carbide tubes specify part number and length in inches.
Ex: SCO814C-24.

CORROSION, EROSION & COATINGS

It is often necessary to put thermowells into extremely corrosive and/or erosive environments. In such cases, the proper selection of materials becomes critical to the success of the installation.

CHEMICAL CORROSION RESISTANCE

While various coatings can help ward off the effects of chemically corrosive environments, thermowells made entirely of corrosive resistant materials are the best choice in corrosive applications. Page 2 of this catalog lists over 50 different currently available materials from which Sandelius thermowells can be manufactured. Included are many grades of stainless steel, alloy steel, Incoloy, Inconel, Monel, Nickel, Kynar, Teflon, titainum and zirconium. Each is effective in various operating environments.

If a solid material that will resist the operating environment can not be found, a protective coating or sleeve are the only remaining choices to protect against corrosives. Corrosive resistant coatings are usually applied to flanged or Van Stone-type thermowells (pgs. B-5 & B-6) with the coating covering the entire "U" length and flange face. The more popular corrosive resistant coatings are FEP and PTFE Teflon. Many other coatings are also available on request. Tantalum is normally used as an oversheath.

WEAR RESISTANCE

To date the best method available for slowing the effects of erosion (wearing away caused by particulate bombardments, common in such operations as decoking) is a carefully selected hard facing material applied over a suitable base material. There are a great many hard facing materials and methods of applying them available today. Because wear-resistant thermowell technology has been an area of specialization with Sandelius for many years, we make every effort to keep up-to-date on new coatings and application methods as they are developed. We would be happy to work with you to determine which of many available products would be best to try in your particular application. The following is a brief list of some of the more popular wear-resistant coatings in use today.

Aluminum Oxide	Colmonoy No. 6	Stellite No. 6	Wallex No. 6
Boron Nitride	Colmonoy No. 75	Stellite No. 12	Wallex No. 50
Ceramics	Stellite No. 1	Wallex No. 1	Wallex No. 55

HOW TO SPECIFY COATINGS

After determining which coating is the best choice for your application, it is important to specify it correctly. We cannot stress this point strongly enough. For example, it is obvious that a 0.020 inch thick coating of sprayed Stellite No. 6 is not equivalent to a 0.060 inch thick coating of T.I.G. welded Stellite No. 1. Yet both can truthfully be referred to as "Stellite" coatings.
Your order should include all the information necessary to insure you will receive the exact coating you require. The following 6 points should be included in all specifications for coated thermowells. If you would like assistance in making the best selections, please call us at anytime.

1. The exact material of the coating desired.

Many otherwise excellent specifications fail on this simple point. A common example of this problem is the use of the name "Stellite" without additional information. There are at least 14 different "Stellite" alloys available, each of which has its own advantages. Simply specifying "Stellite" without additional information allows the supplier to choose which Stellite alloy to use; there is a good chance of not getting the best one for your applicatopn. By simply specifying the full name i.e., "Stellite No. 1", this problem is completely avoided.

2. Method of Application

Some of the more commonly used methods of applying coatings are: Spray Gun or Flame Spray, Gas Tungsten Arc, Submerged-Arc, Open-Arc, OxyAcetylene Disposition, Shielded Metal-Arc Disposition, Plasma Arc and Diffusion Coating. The method of application is an important variable.

3. The Portion of the Thermowell to be Coated

Wear-resistant coatings add significant cost to a thermowell. To avoid financial waste, they need only be applied to the portion of the thermowell that is subjected to wear. This is especially important in long thermowells; only the tips of which are actually being subjected to wear.

4. The Thickness of the Coating

Depending on the type, coatings can be anywhere from a few thousandths of an inch to a 1/4" or more in thickness. Often the same coating can be applied in any number of different thicknesses. Both the effectiveness and the cost of the coating are determined in part by its thickness (thicker coatings are not always better). To avoid confusion, specify the thickness desired as a thickness "per side". It is easy to think of a thermowell, which starts as 1" O.D. and is coated to a finish O.D. of 1 1/8" as having a 1/8" thick coating. However, in fact the coating is only 1/16" thick "per side" thus adding a total of 1/8" to the O.D. of the thermowell.

5. The Finish Requirements of the Coating

Metallic coatings such as Stellite and Colmonoy can be left "as applied", machined smooth or even polished. In most cases a smooth or polished finish will provide superior wear-resistance in service than "as applied" coating. Desired finishes should be specified using standard RMS designations:

RMS 32 is equivalent to a very smooth machine finish.
RMS 16 is a lightly polished finish
RMS 8 is a highly polished "mirror" finish

We recommend a minimum or RMS 32 finish be specified on all machineable coatings.

6. The Finished O.D. of the Coated Thermowell

As coatings are applied over a base material, it is easy to become confused if the actual finished size is not specified as a finished size. For example, an order calling for a 3/4" O.D. thermowell with a 1/16" per side coating can be interpreted in either of 2 ways. First, if could be interpreted to mean the final O.D. of the finished thermowell is 3/4" or second, it could be interpreted to mean the thermowell is to be 3/4" O.D. before the coating is applied resulting in a finished O.D. of 7/8". It is important your specificaiton be clear on all points.

Sandelius