

# THERMOCOUPLE ASSEMBLIES

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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.

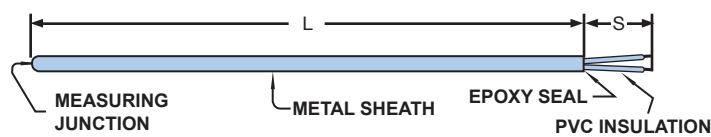
### RUSH DELIVERY REQUIREMENTS

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.

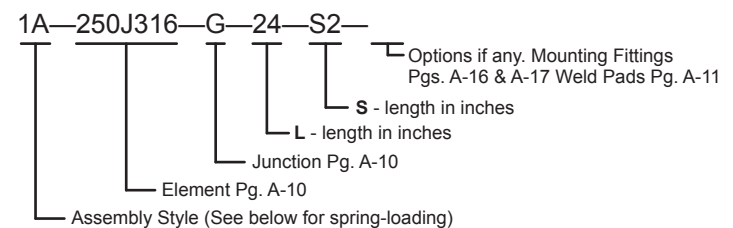
#### Sandelius Style 1A

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



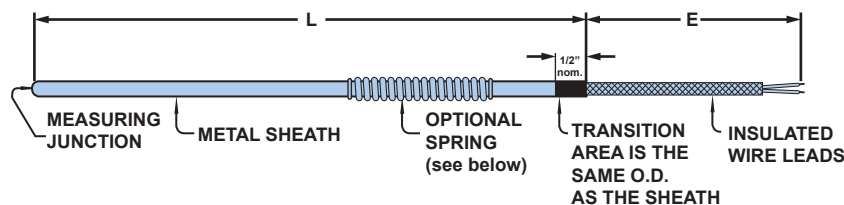
Maximum recommended "S" length: 0.188" O.D. or larger 4 inches  
0.125" O.D. or smaller 1 inch

#### To Order Specify

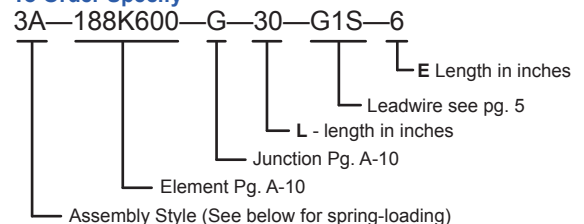


#### Sandelius Style 3A - Element with Insulated Leads

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



#### 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 temperatures of over 1500° 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.

# METAL SHEATH TYPE ELEMENTS

## METAL SHEATH TYPE THERMOCOUPLE ELEMENTS SANDELIUS NUMBERING SYSTEM

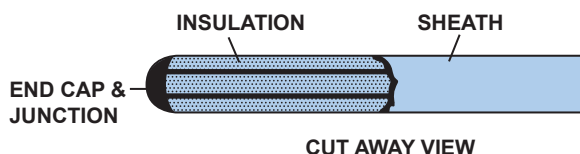
SHEATH O.D. IN 1000ths OF AN INCH		CALIBRATION SYMBOL			SHEATH MATERIAL	
ORDER SYMBOL	APPROXIMATE FRACTION	ORDER SYMBOL*	CONDUCTOR MATERIAL	TEMPERATURE RANGE	ORDER SYMBOL	MATERIAL
020	1/50	E	Chromel / Constantan	-328 - 1652°F**	200	Nickel 200
032	1/32	J	Iron / Constantan	32 - 1382°F**	304	304SS
040	1/25	K	Chromel / Alumel	-328 - 2282°F**	304L	304L
063	1/16	R	Platinum / Platinum 13% Rh	32 - 2642°F	310	310SS
125	1/8	S	Platinum / Platinum 10% Rh	32 - 2642°F	310L	310L
188	3/16	B	Platinum 6% Rh / Platinum 30% Rh	1598 - 3092°F	316	316SS
250	1/4	N	Nicrosil / Nisil	32 - 2282°F	316L	316L
313	5/16	T	Copper / Constantan	-328 - 662°F**	321	321SS
375	3/8				347	347SS
500	1/2				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

\* 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 -328°F, but must be specifically ordered to insure accuracy in cryogenic range.

## MEASURING JUNCTION STYLES

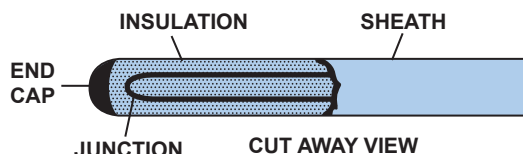
### G-GROUNDED JUNCTION



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

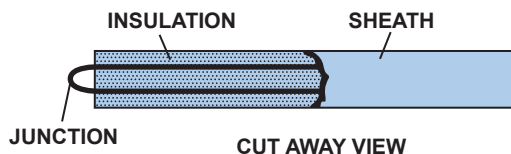
### R-REMOTE OR UNGROUNDED JUNCTION



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.

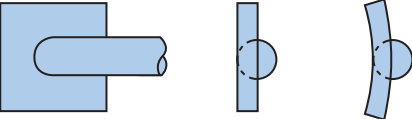
Order Symbol: E – Single Element  
EC\* – Dual Element Common  
ES\* – Dual Element Separate

\* 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

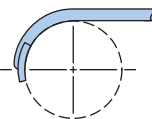
Whenever a thermocouple must be welded in place it is advisable to use a weld pad and weld clips to protect against burn-through of the sheath material during field installation. Sandelius weld pads, weld clips and weld pad covers are available in a wide range of styles and materials.

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.



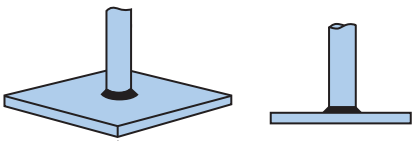
**Sandelius Style W1D**  
Material Designation  
Add forming information as required

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

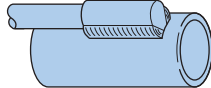


**Sandelius Style W2B**  
Material Designation  
Add forming information

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  $a=90^\circ$ ). 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

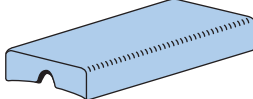


**Sandelius Style W5E**  
Material Designation  
Add forming information as required

**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  $a=90^\circ$ ).

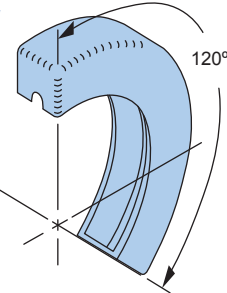


**Typical Weld Clip**  
PN: CP710D-1/4  
Material  
Sheath OD



**Parallel Weld Pad Cover**  
PN: CP720D-1/4-4"  
Material  
Sheath OD  
Furnace Tube OD

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

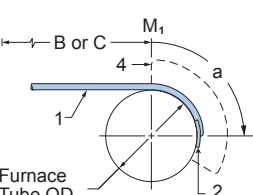


**Radial Weld Pad Cover**  
PN: CP725D-1/4-6"  
Material  
Sheath OD  
Furnace Tube OD

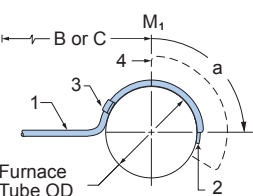
Note:  
CP725 is 1 3/8" high  
CP726 is 3/4" high

## TYPICAL WELD PAD INSTALLATION AND EXPANSION LOOPS

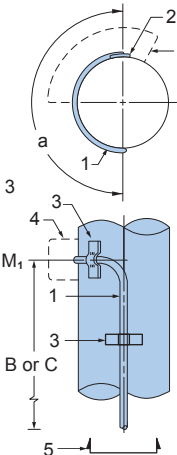
Bending and expansion loops are best specified by sending a drawing or sketch with your order. The following are examples of commonly used configurations. Many other configurations are available. Expansion loops are normally designed to open with furnace tube movement.



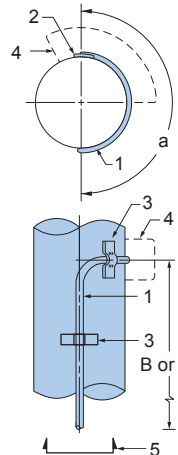
**Fig. 1 Junction Bend**



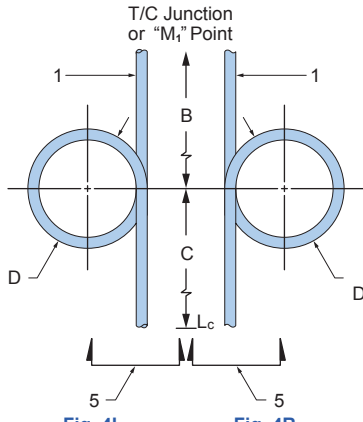
**Fig. 2 Junction Bend**



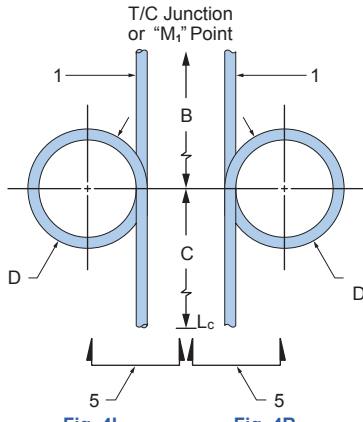
**Fig. 3L Junction Bend**



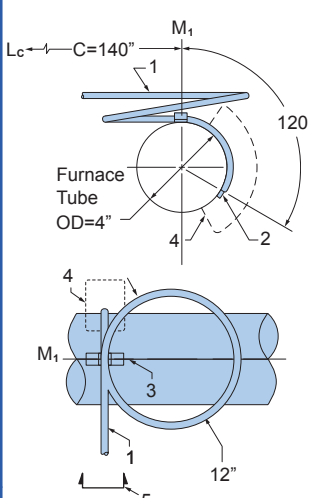
**Fig. 3R Junction Bend**



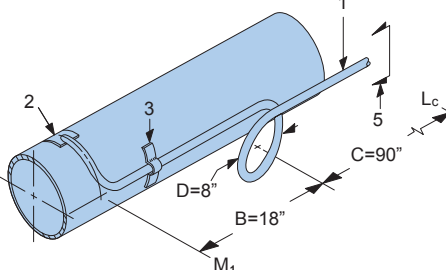
**Fig. 4L**  
(Expansion Loop on Left Side)



**Fig. 4R**  
(Expansion Loop on Right Side)



**Example A**  
Junction Bend Fig. 1,  $a=120^\circ$   
Tube OD=4"  
Expansion Loop: Fig. 4R,  
D=12", 4 Coils, B=0, C=140"



**Example B**  
Junction Bend: Fig. 3R,  $a=90^\circ$ , 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 shown 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 us to make the necessary calculations.

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

**M<sub>1</sub>** = 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 or 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<sub>1</sub>". (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<sub>c</sub>" 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.

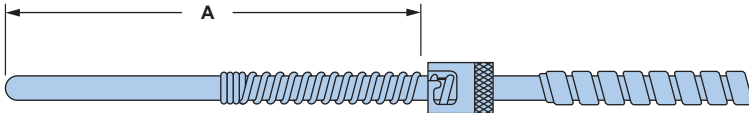
**Example:** 1A-250K310-G-120-S3-W1D formed to fit 4" OD tube.

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 ( $a=180^\circ$ ), Expansion loop per Fig. 4L, D=12", 3-Coils, B=15", C=96" (Note in this example the length is specified as "00" allowing us to calculate the material required).

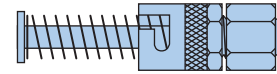
# ACCESSORIES

## BAYONET TYPE FITTINGS AND ADAPTERS



**BAYONET FITTING**

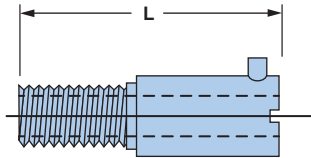
ORDER SYMBOL	DESCRIPTION
FB1	Bayonet Cap with spring stop brazed to sheath. Can be used on either 1/8" or 3/16" diameter.
FB4	Bayonet Cap with adjustable swage type spring. For use on 1/8" diameter probes.
FB5	Bayonet Cap with adjustable swage type spring. For use on 3/16" diameter probes.



**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.

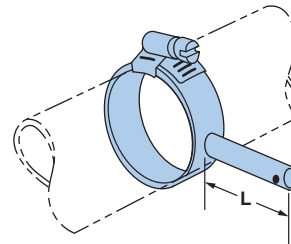


1/8" NPT

**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.



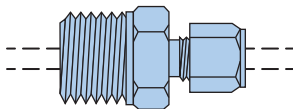
**PIPE STRAP BAYONET ADAPTER**

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**



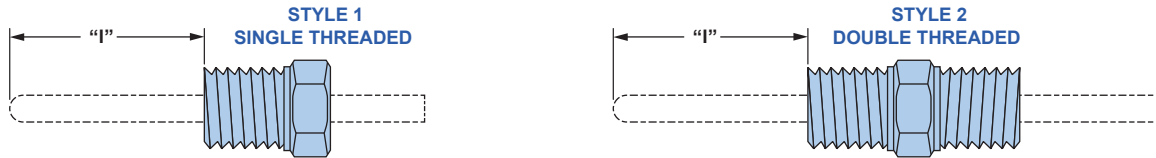
ORDER SYMBOL*	THREAD NPT SIZE	MATERIAL	AVAILABLE TO FIT THESE SHEATH O.D. SIZES
CB11	1/8"	Brass	0.063", 0.125", 0.188", 0.250"
CF11	1/8"	Stainless Steel	0.063", 0.125", 0.188", 0.250"
CB12	1/4"	Brass	0.063", 0.125", 0.188", 0.250", 0.312", 0.375"
CF12	1/4"	Stainless Steel	0.063", 0.125", 0.188", 0.250", 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 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.

# ACCESSORIES

## FIXED FITTINGS – ARE BRAZED OR WELDED TO THE SHEATH

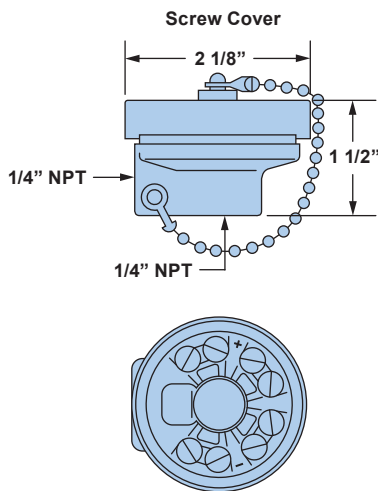


ORDER SYMBOL		THREAD SIZE	MATERIAL	AVAILABLE TO FIT THESE SHEATH O.D. SIZES
STYLE 1	STYLE 2			
F11	F21	1/8" NPT	304SS	0.063, 0.125, 0.188 & 0.250
F12	F22	1/4" NPT	304SS	0.063, 0.125, 0.188, 0.250, 0.313 & 0.375
F14	F24	1/2" NPT	304SS	0.063, 0.125, 0.188, 0.250, 0.313, 0.375 & 0.500
F16	F26	3/4" NPT	304SS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



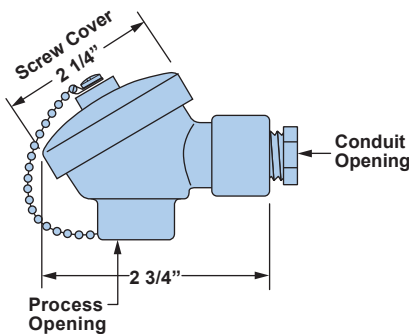
ORDER SYMBOL		THREAD NPT SIZE	MATERIAL	SPRING TYPE	AVAILABLE SHEATH SIZES
STYLE 1	STYLE 2				
SF14	SF24	1/2" NPT	304SS	Adjustable	0.125, 0.188, 0.250, 0.312 & 0.375
SB14	-	1/2" NPT	BRASS	Adjustable	0.125, 0.188, 0.250, 0.312 & 0.375
SPF14	SPF24	1/2" NPT	304SS	Adjustable with Liquid-tight O-Ring	0.125,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



### Miniature Weatherproof Thermoset Plastic Head

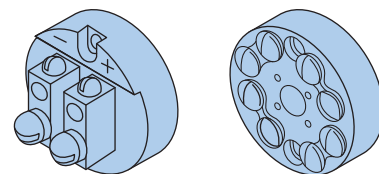
1/4" NPT x 1/4" NPT with 4 Integral Terminals

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