

# Thermocouples

## Mineral Insulated (MI)

Watlow's mineral insulated (MI) thermocouples are fast-responding, durable, and capable of handling high temperatures.

Manufactured with best-in-class XACTPAK®, Watlow's trademark for metal sheathed, mineral insulated (MI) thermocouple material, XACTPAK responds fast because the protective metal outer sheath allows use of smaller diameter thermocouple conductors. The rock hard compacted MgO insulation further enhances the sensor's ability to "read" temperature by transferring heat quickly to the measuring junction.

The XACTPAK protecting sheath and compacted insulation outperform bare wire thermocouples in most applications.

### Performance Capabilities

- Easily handles temperatures up to 2200°F (1200°C)
- Meets or exceeds initial calibration tolerances per ASTM E 230

### Features and Benefits

#### Special mineral insulation

- Protects thermocouple from moisture and thermal shock
- Permits operation in high temperature, high pressure environments

#### Diameters as small as 0.020 in. (0.50 mm)

- Ideal when physical space or extremely fast response are critical

#### Flexibility of the XACTPAK material

- Allows forming and bending of the thermocouple, without risk of cracking, to meet design requirements

#### Outer sheath

- Protects wires from oxidation and hostile environments

#### Wide range of sheath materials, diameters, and calibrations

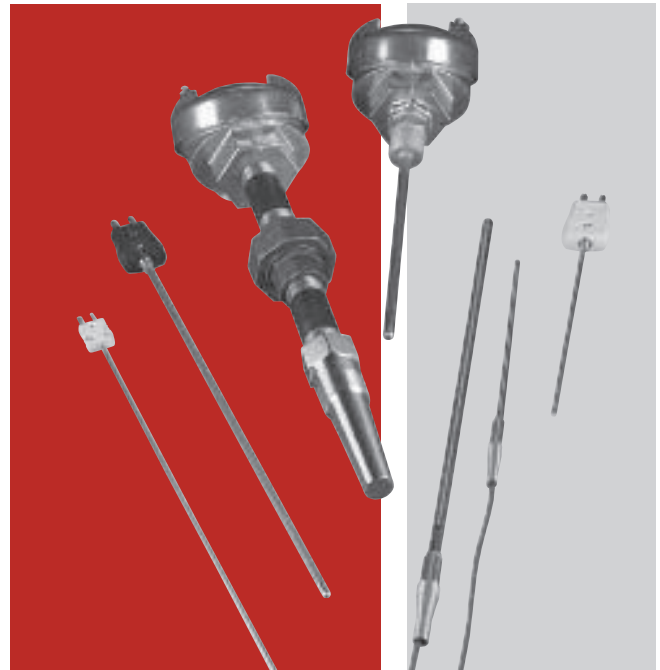
- Meet specific requirements

#### In-house manufacturing of XACTPAK material

- Rigid quality control procedures
- Ensures high standards are met
- Single source reliability

#### Custom capabilities

- Include options such as special lead lengths, lead wires and terminations



### Typical Applications

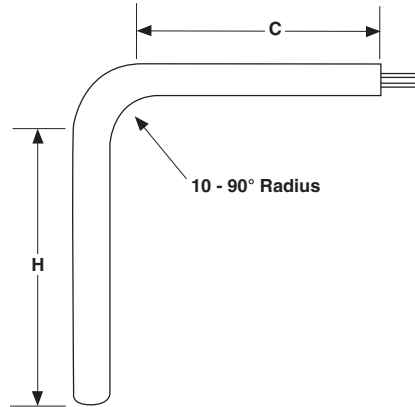
- Heat treating
- Furnaces/kilns
- Turbines
- Bearing temperature
- Power stations
- Steam generators
- Diesel engines
- Nuclear reactors
- Atomic research
- Jet engines and test cells
- Rocket engines
- Semiconductor manufacturing
- Refineries/oil processing
- Catalytic reformers
- Food processing

# Thermocouples

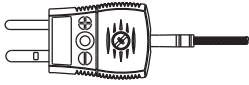
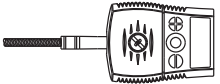
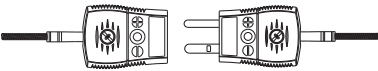



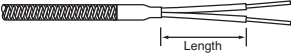
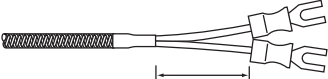
## Mineral Insulated

### Bends

Diameter in.	Standard Bend Radius in.	Minimum "H" Dimension in.	Minimum "C" Dimension in.
0.063	$\frac{3}{16}$	$\frac{1}{2}$	$1\frac{1}{2}$
0.090	$\frac{1}{4}$	$\frac{3}{4}$	$1\frac{1}{2}$
0.125	$\frac{3}{8}$	1	2
0.188	$\frac{1}{2}$	1	2
0.250	$\frac{3}{4}$	2	2
0.313	$1\frac{1}{4}$	2	2
0.375	$1\frac{1}{2}$	3	2
0.500	2	4	2



### Lead Terminations

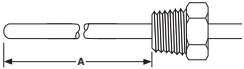
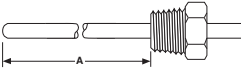

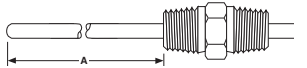
Termination	Code	Length
 Standard Male Plug	A	—
 Standard Female Jack	B	—
 Standard Male Plug with Mating Connector	C	—
 Miniature Male Plug	F	—
 Miniature Female Jack	G	—
 Miniature Male Plug with Mating Connector	H	—
 Split Leads	T	$1\frac{1}{2}$
 #8 Spade Lugs	U	$1\frac{1}{2}$

# Thermocouples

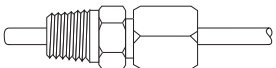
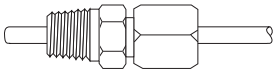
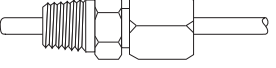
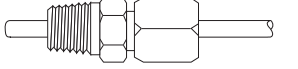
## Mineral Insulated

### Fitting Options

#### Fixed Fittings

Fitting Type	Material	Sheath Size in.	NPT Thread Size in.	Hex Size in.	Length in.	Code
 <p><b>Fixed Single Thread 1/8 NPT</b> Customer Specified</p>	303 SS	0.063 to 0.250	1/8	7/16	1 1/16	A
 <p><b>Fixed Single Thread 1/4 NPT</b> Customer Specified</p>	303 SS	0.125 to 0.250	1/4	9/16	7/8	B
 <p><b>Fixed Single Thread 1/2 NPT</b> Customer Specified</p>	303 SS	0.125 to 0.250	1/2	7/8	1	D
 <p><b>Fixed Double Thread 1/2 NPT</b> Customer Specified</p>	303 SS	0.125 to 0.250	1/2	7/8	1 3/4	F

#### Compression Fittings

Fitting Type	Material	Sheath Size in.	NPT Thread Size in.	Hex Size in.	Length in.	Code
 <p><b>Non-Adjustable Compression Brass</b></p>	Brass	0.125	1/8	1/2	1	J
		0.188	1/8	1/2	1 1/8	J
		0.250	1/8	1/2	1 3/16	J
 <p><b>Non-Adjustable Compression SS</b></p>	303 SS	0.063	1/8	1/2	1 1/4	L
		0.125	1/8	1/2	1 1/4	L
		0.188	1/8	1/2	1 5/16	L
		0.250	1/8	1/2	1 5/16	L
 <p><b>Adjustable Compression TFE Gland</b></p>	303 SS	0.063	1/8	1/2	1 1/4	G
		0.125	1/8	1/2	1 1/4	G
		0.188	1/8	1/2	1 1/4	G
		0.250	1/4	7/8	2 7/16	X
 <p><b>Adjustable Compression Lava Gland</b></p>	303 SS	0.063	1/8	1/2	1 1/4	Q
		0.125	1/8	1/2	1 1/4	Q
		0.188	1/8	1/2	1 1/4	Q
		0.250	1/4	7/8	2 7/16	V

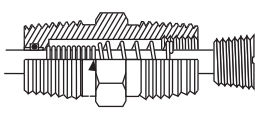
**Compression Fittings:** Compression fittings are shipped finger-tight on the sheath allowing field installation. Once non-adjustable fittings are deformed, they cannot be relocated. Adjustable fittings come with Tetrafluorethylene (TFE) sealant or lava sealant glands.

# Thermocouples

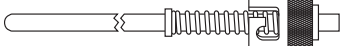
## Mineral Insulated

### Fitting Options (Continued)

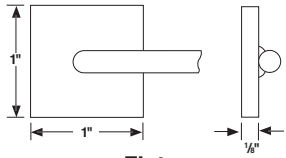
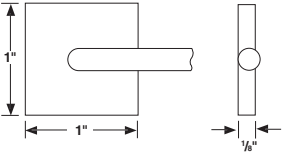
#### Adjustable Spring Loaded

Fitting Type	Material	Sheath Size in.	NPT Thread Size in.	Hex Size in.	Length in.	Code
	316 SS	0.250	1/2	7/8	2	H

#### Bayonet Lockcap and Spring

Fitting Type	Material	Sheath Size in.	Length in.	Code
	Plated Steel	0.125	1 5/8	W
	Plated Steel	0.188	1 5/8	W

#### Weld Pads

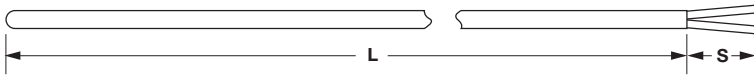
Weld Pad Type	Material	Code
 <p><b>Flat</b></p>	304 SS*	2
 <p><b>Milled Slot</b></p>	304 SS	5

\*Alloy 600 available on special order and recommended for use with alloy 600 sheath.

# Thermocouples

## Mineral Insulated

### Cut and Stripped Style AB



Watlow's Style AB thermocouple allows self termination of the thermocouple. Style AB is simply a section of XACTPAK material, junctioned and stripped and is the most basic of all the mineral insulated thermocouple styles.

Its XACTPAK mineral insulation construction protects the thermocouple from moisture, thermal shock, high temperatures and high pressure.

### Performance Capabilities

- Maximum temperature depends on sheath material, calibration and other variables

### Features and Benefits

#### Cold end stripped and sealed with epoxy

- Inhibits moisture penetration

#### Dual element style

- Allows two instruments to run from the same element, reducing costs

## Ordering Information

### Part Number

①	②	③ Sheath O.D.	④	⑤ Fittings, Weld Pads	⑥	⑦ Sheath Material	⑧ ⑨ Sheath Length "L" (whole in.)	⑩ Sheath Length "L" (fract. in.)	⑪ Junction	⑫ Calibration	⑬ Strip Length "S" (whole in.)	⑭ Strip Length "S" (fract. in.)	⑮
A	B		0		0								0

③ Sheath O.D. (in.)	
B =	0.020
C =	0.032
D =	0.040
E =	0.063
G =	0.125
H =	0.188
J =	0.250

⑤ Fittings, Weld Pads	
0 =	None
<b>Notes:</b> If required, enter code from pages 63 to 64. If none, enter "0". Weld pads only available for 0.063 diameter and larger.	

⑦ Sheath Material	
A =	304 SS
F =	316 SS
Q =	Alloy 600 (Type K)

⑧ ⑨ Sheath Length "L" (whole in.)	
Available lengths: 01 to 99, for lengths over 99 inches contact factory	

⑩ Sheath Length (fractional in.)	
0 =	0
4 =	1/2

⑪ Junction			
	Grounded	Ungrounded	Exposed
Single	G	U	E
Dual*	H	W (isolated)	D (isolated)

\*Only available for 0.063 diameter and larger.

⑫ Calibration					
	E	J	K	N	T
Standard limits	E	J	K	N	T
Special limits	2	3	4	—	8

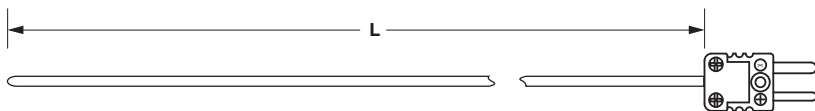
⑬ Strip Length "S" (whole in.)	
0, 1, 2 and 3 - 1 in. max. on 0.040 and smaller	

⑭ Strip Length "S" (fractional in.)	
0 =	0
1 =	1/8
2 =	1/4
3 =	3/8
4 =	1/2
5 =	5/8
6 =	3/4
7 =	7/8

# Thermocouples

## Mineral Insulated

### Mini Plug or Jack Termination Style AC



## Ordering Information

### Part Number

①	②	③	④	⑤	⑥	⑦	⑧ ⑨	⑩	⑪	⑫	⑬ ⑭	⑮
		Sheath O.D.	Connector Type	Fittings, Weld Pads		Sheath Material	Sheath Length "L" (whole in.)	Sheath Length "L" (fract. in.)	Junction	Calibration		
A	C				0						00	0

③ Sheath O.D. (in.)	
B =	0.020
C =	0.032
D =	0.040
E =	0.063
G =	0.125

④ Connector Type	
F =	Miniature plug
G =	Miniature jack
H =	Miniature plug with mating connector

**Note:** Miniature plugs and jacks 400°F (200°C) (0.125 in. max. O.D.)

⑤ Fittings, Weld Pads	
0 =	None

**Notes:** If required, enter code from pages 63 to 64. If none, enter "0". Weld pads only available for 0.063 and 0.125 diameters.

⑦ Sheath Material	
A =	304 SS
F =	316 SS
C =	PFA coated over SS (available on G diameter)
Q =	Alloy 600 (Type K)

⑧ ⑨ Sheath Length "L" (whole in.)	
Available lengths: 01 to 99, for lengths over 99 inches contact factory. Maximum length for PFA coating is 48 in.	

⑩ Sheath Length "L" (fractional in.)	
0 =	0
4 =	1/2

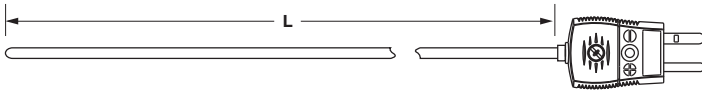
⑪ Junction			
	Grounded	Ungrounded	Exposed
Single	G	U	E

⑫ Calibration					
	E	J	K	N	T
Standard limits	E	J	K	N	T
Special limits	2	3	4	—	8

# Thermocouples

## Mineral Insulated

### Standard Plug or Jack Termination Style AC



## Ordering Information

### Part Number

①	②	③	④	⑤	⑥	⑦	⑧ ⑨	⑩	⑪	⑫	⑬ ⑭	⑮
A	C	Sheath O.D.	Connector Type	Fittings, Weld Pads	0	Sheath Material	Sheath Length "L" (whole in.)	Sheath Length "L" (fract. in.)	Junction	Calibration	00	0

③ Sheath O.D. (in.)	
D =	0.040
E =	0.063
G =	0.125
H =	0.188
J =	0.250

④ Connector Type	
A =	Standard plug
B =	Standard jack
C =	Standard plug with mating connector
<b>Note:</b> If required	

⑤ Fittings, Weld Pads	
0 =	None
<b>Notes:</b> Standard plug and jacks 425°F (218°C). Weld pads only available for 0.063 diameter and larger.	

⑦ Sheath Material	
A =	304 SS
F =	316 SS
C =	PFA coated over SS (available on G, H, J diameters)
Q =	Alloy 600 (Type K)

⑧ ⑨ Sheath Length "L" (whole in.)	
Available lengths: 01 to 99, for lengths over 99 inches contact factory. Maximum length for PFA coating is 48 inches.	

⑩ Sheath Length "L" (fractional in.)	
0 =	0
1 =	1/8
2 =	1/4
3 =	3/8
4 =	1/2
5 =	5/8
6 =	3/4
7 =	7/8

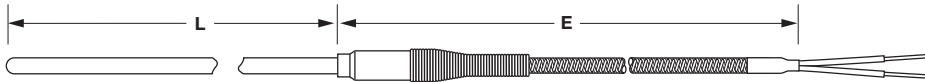
⑪ Junction			
	Grounded	Ungrounded	Exposed
Single	G	U	E
Dual*	H	W (isolated)	D (isolated)
* Only available for 0.063 diameter and larger.			

⑫ Calibration					
	E	J	K	N	T
Standard limits	E	J	K	N	T
Special limits	2	3	4	—	8

# Thermocouples

## Mineral Insulated

### Metal Transitions with Spring Strain Relief Style AF



## Ordering Information

### Part Number

①	②	③	④	⑤	⑥	⑦	⑧ ⑨	⑩	⑪	⑫	⑬ ⑭	⑮
	Style	Sheath O.D.	Lead Wire Const.	Fittings, Weld Pads	Lead Wire Term.	Sheath Material	Sheath Length "L" (whole in.)	Sheath Length "L" (fract. in.)	Junction	Calibration	Lead Wire Length "E" (whole ft)	Special Rqmts.
A	F											

②	Style
F =	Metal transition with strain relief and 300°F (149°C)

③	Sheath O.D. (in.)
B =	0.020
C =	0.032
D =	0.040
E =	0.063
G =	0.125
H =	0.188
J =	0.250

④ Lead Wire Construction				
		Standard	Overbraid	Flex Armor
Fiberglass	Solid	A	J	R
FEP	Solid	C	L	T
Fiberglass	Stranded*	B	K	S
FEP	Stranded*	D	M	U

\*Stranded lead wire available only for sheath O.D. 0.063 and larger.

⑤	Fittings, Weld Pads
0 =	None

**Note:** If required, enter code from pages 63 to 64. If none, enter "0".

⑥	Lead Wire Termination
A =	Standard male plug
B =	Standard female jack
C =	Standard plug with mating connector
F =	Miniature male plug
G =	Miniature female jack
H =	Miniature plug with mating connector
T =	Standard, 1½ in. split leads
U =	1½ in. split leads with #8 spade lugs

⑦	Sheath Material
A =	304 SS
F =	316 SS
C =	PFA coated over SS (available on G, H and J diameter)
Q =	Alloy 600 (Type K)

⑧ ⑨	Sheath Length "L" (whole in.)
Available lengths: 01 to 99, lengths over 99 inches contact factory. Maximum length for PFA coating is 48 inches.	

⑩	Sheath Length "L" (fractional in.)
0 =	0
4 =	½

⑪ Junction			
	Grounded	Ungrounded	Exposed
Single	G	U	E
Dual*	H	W (isolated)	D (isolated)

⑫	Calibration				
	E	J	K	N	T
Standard limits	E	J	K	N	T
Special limits	2	3	4	—	8

⑬ ⑭	Lead Wire Length "E" (whole feet)
Available lengths: 01 to 30, for lengths over 30 contact factory	

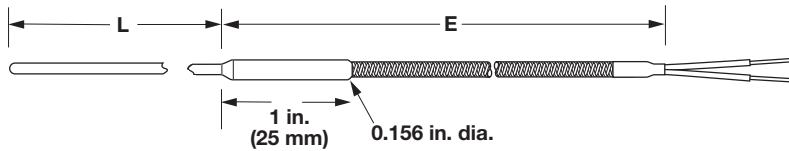
⑮	Special Requirements
0 =	0
H =	High temperature 1000°F (538°C) potting
M =	500°F (260°C)



# Thermocouples

## Mineral Insulated

### Miniature Transitions Style AQ



Note: 300°F (149°C) potting standard

## Ordering Information

### Part Number

①	②	③	④ Lead Wire Const.	⑤	⑥ Lead Wire Term.	⑦	⑧ ⑨ Sheath Length "L" (whole in.)	⑩ Sheath Length "L" (fract. in.)	⑪	⑫	⑬ ⑭ Lead Wire Length "E" (whole in.)	⑮
A	Q	Sheath O.D.		0		Sheath Material			Junction	Calibration		Special Rqmts.
A	Q			0								

② Style	
Q =	Miniature metal transition with 300°F (149°C)

③ Sheath O.D. (in.)	
B =	0.020
C =	0.032
D =	0.040
E =	0.063

④ Lead Wire Construction	
A =	Fiberglass Solid
C =	FEP Solid

⑥ Lead Wire Termination	
A =	Standard male plug
B =	Standard female jack
C =	Standard plug with mating connector
F =	Miniature male plug
G =	Miniature female jack
H =	Miniature plug with mating connector
T =	Standard, 1½ in. split leads
U =	1½ in. split leads with #8 spade lugs

⑦ Sheath Material	
A =	304 SS
F =	316 SS
Q =	Alloy 600 (Type K)

⑧ ⑨ Sheath Length "L" (whole in.)	
Available lengths: 01 to 99, for lengths over 99 inches contact factory	

⑩ Sheath Length "L" (fractional in.)	
0 =	0

⑪ Junction		
	Grounded	Ungrounded
Single	G	U

⑫ Calibration		
	J	K
Standard limits	J	K
Special limits	3	4

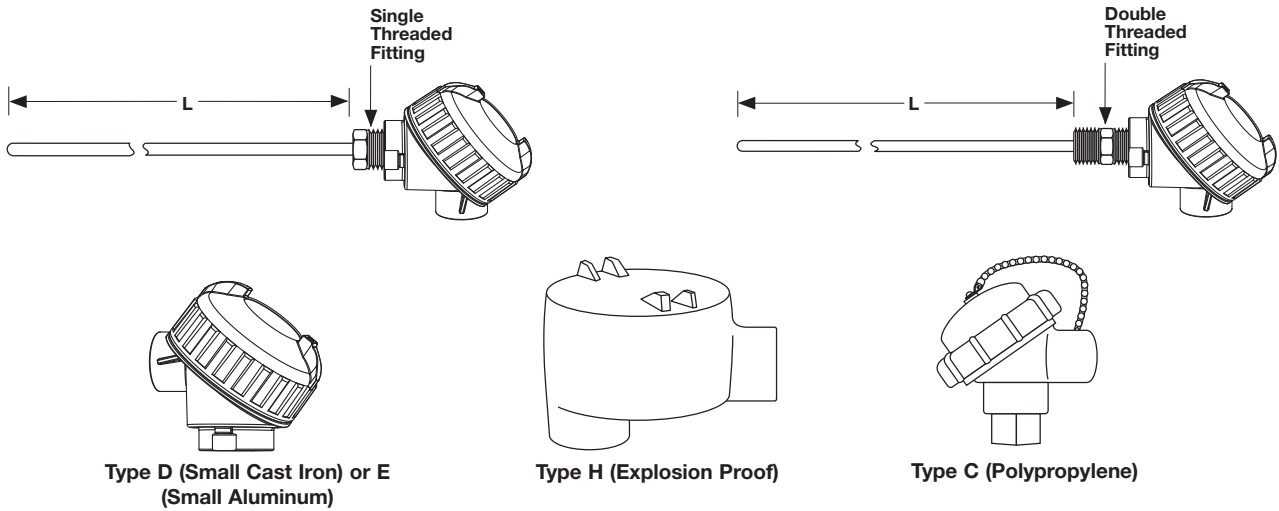
⑬ ⑭ Lead Wire Length "E" (whole feet)	
Available lengths: 01 to 30	

⑮ Special Requirements	
0 =	0
M =	500°F (260°C) potting
X =	Special requirements, contact factory

# Thermocouples

## Mineral Insulated

### Connection Head Style AR



## Ordering Information

### Part Number

①	②	③ Sheath O.D. (in.)	④ Connection Head	⑤ Head Mounting Fittings	⑥	⑦ Sheath Material	⑧ ⑨ Sheath Length "L" (whole in.)	⑩ Sheath Length "L" (fract. in.)	⑪ Junction	⑫ Calibration	⑬ ⑭	⑮
A	R				0						00	0

③ Sheath O.D. (in.)	
G =	0.125
H =	0.188
J =	0.250

④ Connection Head	
C =	Polypropylene
D =	Small cast iron
E =	Small aluminum
H =	Explosion proof

⑤ Head Mounting Fittings	
0 =	Single threaded 303 SS
F =	Double threaded 303 SS ½ in. NPT
H* =	Spring loaded double threaded 316 SS ½ in. NPT
*0.250 in. diameter only	

⑦ Sheath Material	
A =	304 SS
F =	316 SS
Q =	Alloy 600 (Type K)

⑧ ⑨ Sheath Length "L" (whole in.)	
Available lengths: 01 to 99, for lengths over 99 inches contact factory	

⑩ Sheath Length "L" (fractional in.)	
0 =	0
1 =	1/8
2 =	1/4
3 =	3/8
4 =	1/2
5 =	5/8
6 =	3/4
7 =	7/8

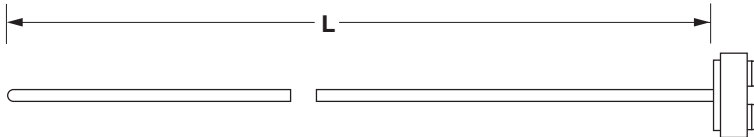
⑪ Junction			
	Grounded	Ungrounded	Exposed
Single	G	U	E
Dual	H	W (isolated)	D (isolated)

⑫ Calibration					
	E	J	K	N	T
Standard limits	E	J	K	N	T
Special limits	2	3	4	—	8

# Thermocouples

## Mineral Insulated

### Wafer Head Style AS



The Style AS thermocouple features a “wafer” head, which allows quick access to terminal screws for wiring. This thermocouple is an economical choice because the termination is attached directly to the XACTPAK sheath.

### Performance Capabilities

- Cold end termination temperature rating up to 1000°F (540°C)

### Features and Benefits

#### Termination directly to sheath

- Allows quick hookup and disassembly

#### Terminal head

- Available in a wide range of materials in both single and dual configurations

## Ordering Information

### Part Number

①	②	③ Sheath O.D. (in.)	④ Cold End Term.	⑤ Fittings, Weld Pads	⑥	⑦ Sheath Material	⑧ ⑨ Sheath Length “L” (whole in.)	⑩ Sheath Length “L” (fract. in.)	⑪ Junction	⑫ Calibration	⑬ ⑭	⑮
A	S		C		0						00	0

③ Sheath O.D. (in.)	
G =	0.125
H =	0.188
J =	0.250

④ Cold End Termination	
C =	Ceramic 1000°F (540°C), 1 1/8 in. diameter x 5/8 in. thick

⑤ Fittings, Weld Pads	
0 =	None
<b>Note:</b> If required, enter code from pages 63 to 64. If none, enter “0”.	

⑦ Sheath Material	
A =	304 SS
F =	316 SS
Q =	Alloy 600 (Type K)

⑧ ⑨ Sheath Length “L” (whole in.)	
Available lengths: 01 to 99, for lengths over 99 inches contact factory	

⑩ Sheath Length L (fractional in.)	
0 =	0
1 =	1/8
2 =	1/4
3 =	3/8
4 =	1/2
5 =	5/8
6 =	3/4
7 =	7/8

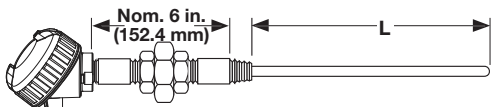
⑪ Junction			
	Grounded	Ungrounded	Exposed
Single	G	U	E
Dual	H	W (isolated)	D (isolated)

⑫ Calibration					
	E	J	K	N	T
Standard limits	E	J	K	N	T
Special limits	2	3	4	—	8

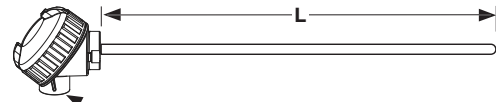
# Thermocouples

## Mineral Insulated

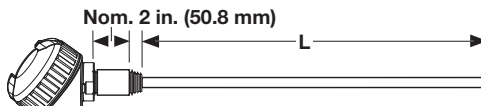
For Use With Thermowells  
Style AT



3/4 in. (19 mm) NPT  
**Type 1** - 6 inch N-U-N typical (2 each 1/2 x 3 inch steel pipe nipples and 1 each malleable union)



3/4 in. (19 mm) NPT  
**Type 4** - Connection Head Only with 1/2 inch NPT process connection



3/4 in. (19 mm) NPT  
**Type 3** - 1/2 x 3 inch steel pipe nipple typical

## Ordering Information

### Part Number

①	②	③ Sheath O.D. (in.)	④ Connection Head	⑤ Cold End Config.	⑥	⑦ Sheath Material	⑧ ⑨ Sheath Length "L" (whole in.)	⑩ Sheath Length "L" (fract. in.)	⑪ Junction	⑫ Calibration	⑬ 0	⑭ Spring- Loading	⑮ 0
A	T	J			0						0		0

③ Sheath O.D. (in.)	
J =	0.250

④ Connection Head	
C =	Polypropylene (1/2 in. NPT thermocouple opening only)
D =	Small cast iron
E =	Small aluminum
H =	Explosion proof (1/2 in. NPT and 3/4 in. NPT thermocouple opening only)

⑤ Cold End Configuration	
1 =	Type 1, 6 in. nipple-union-nipple
3 =	Type 3, 3 in. nipple
4 =	Type 4, no extensions

**Note:** Steel nipple and unions are standard.

⑦ Sheath Material	
A =	304 SS
F =	316 SS
Q =	Alloy 600 (Type K)

⑧ ⑨ Sheath Length "L" (whole in.)	
Available lengths: 01 to 99, for lengths over 99 inches contact factory	

⑩ Sheath Length "L" (fractional in.)	
0 =	0
1 =	1/8
2 =	1/4
3 =	3/8
4 =	1/2
5 =	5/8
6 =	3/4
7 =	7/8

⑪ Junction			
	Grounded	Ungrounded	Exposed
Single	G	U	E
Dual	H	W (isolated)	D (isolated)

⑫ Calibration					
	E	J	K	N	T
Standard limits	E	J	K	N	T
Special limits	2	3	4	—	8

⑭ Spring-Loading	
Y =	Yes
N =	No

**Note:** For a complete sensor, add thermowell part number to the 15-digit AT part number. For sheath length, use "AR" (as required) and the factory will determine correct length.