



Thermo-Couple Products

Number One In High Temperature Measurement



Thermo-Couple Products

热电偶温度测量元件

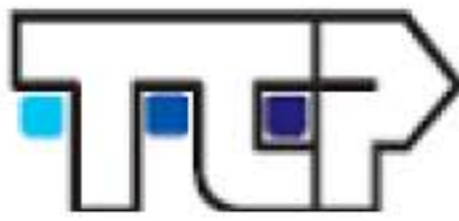
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Thermo-Couple Products Co.



Thermo-Couple Products

Number One In High Temperature Measurement



TCP Is Number One In High Technology Temperature Measurement

As a leader in the manufacturing of temperature sensors for over 40 years, TCP has succeeded in building strong work relationships with our customers.

Our long history of working has yielded many innovative new ideas. By relentless pursuing solutions for the marketplace, TCP has developed several significant innovations. Several of our "*firsts*" include: Subminiature thermocouple connectors and color coded ceramic connectors. TCP also designed and patented the exclusive "*knife edge*" design which is used in our "*Tube -Temp*" thermocouple. The Tube-Temp is the most accurate measurement device for fired heater and industrial boiler tubes on the market today.

TCP believes that no project is too large or too small. Difficult applications are always welcome. Whether it's a standard job or a custom job, TCP will meet your needs.

Providing quality products has been and remains a cornerstone at TCP. We closely follow testing and inspection procedures. In fact, TCP is one of the few temperature companies to perform X-ray inspection on all of our welded junctions. We offer not only hard film, but real time video X-ray as well. Our quality program meets standards that are recognized worldwide. In 1993, TCP passed an extensive audit to become ISO-9002 registered.

TCP is easily accessible through direct calls to our factory or through our distributors. Both our sales personnel and our distributors can offer you technical support. With over 50 sales locations throughout the world TCP offers global sales support.

When you select TCP, you will receive a commitment to quality and service. Our sales and engineering departments work closely together to make sure that our customer's specifications are clearly met in the product's design. *Call us today.*





Selection Guide To Thermocouples

What Is A Thermocouple?

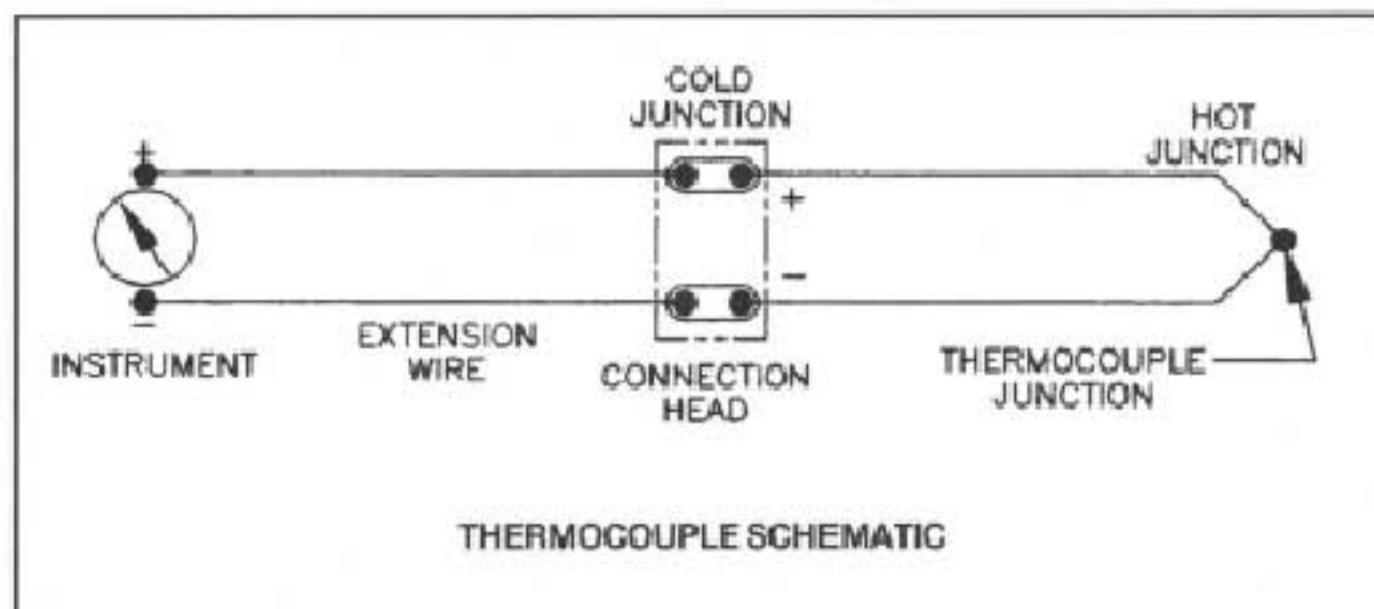
A thermocouple is a device that is used for measuring temperature. It basically consists of two dissimilar metals that are joined to form a junction which when heated produce a thermoelectric voltage. This voltage changes as the temperature increases or decreases.

How Do I Begin To Choose The Correct Thermocouple For My Application?

Before selecting the correct thermocouple option, you should know the following information:

1. Temperature ranges (high and low limits) that are to be measured.
2. The environment or atmosphere that the thermocouple will be exposed to. This is important because the metals used in thermocouple construction react differently in different environments. Metals that work well in one environment, will quickly fail in another environment at the same temperature.
3. Physical space limitation, method of installation and type of instrument connection desired (termination option-see page 256).
4. Response Time. Response time is the time required to reach the temperature being sensed. Response time is greatly influenced by the type of junction selected (grounded, ungrounded, and exposed). The diameter of the thermocouple also has a significant effect on response time. A smaller diameter results in a quicker response, but is not as durable as a larger diameter.

IMPORTANT: When ordering thermocouples, be certain that the calibration type (K, J, T, etc.) corresponds to that of the instrument being used. You can find this information on the face of the instrument.



Why Are Thermocouples Protected With Mineral Insulation And/Or Special Sheath Material?

If temperatures in excess of 800°F are to be measured, then mineral insulated thermocouples should be used. (See TCP's Mineral Insulated Thermocouples on page 45). The mineral insulation helps protect the wire up to 2100°F. To measure temperatures in excess of 2100°F, special insulation and sheath material must be used. (See TCP's High Temperature Thermocouples on page 56). The High Temperature Section has thermocouples that are capable of reaching 3800°F.

When Do You Use A Protection Tube Or Thermowell?

If the environment is corrosive or harsh, it is recommended that the thermocouple element be placed in a thermowell or protection tube. These wells and protection tubes can be made out of many different materials: Carbon Steel, 304SS, 316SS, 446SS, Monel, Inconel, etc. (See page 120 for recommended material).

Limits Of Error For Thermocouples

Calibration	Type of Thermocouple	Temperature Range	Limits of Error	
			Standard	Special
J	Iron/Constantan	32°F to 530°F	±4°F	±2°F
		530°F to 1400°F	±.75%	±.4%
K	Chromel/Alumel	32°F to 530°F	±4°F	±2°F
		530°F to 2300°F	±.75%	±.4%
T	Copper/Constantan	-328°F to +32°F	±2°F or ±1.5%	—
		32°F to 260°F	±2°F	±1°F
		260°F to 700°F	±.75%	±.4%
E	Chromel/Constantan	-328°F to +32°F	±3°F	—
		32°F to 500°F	±1%	±2°F
		500°F to 1600°F	±.5%	±.4%
R	Platinum 13% Rhodium/Platinum	32°F to 1100°F	±2.5°F	±1°F
		1100°F to 2700°F	±2.5%	±.1%
S	Platinum 10% Rhodium/Platinum	32°F to 1100°F	±2.5°F	±1°F
		1100°F to 2700°F	±2.5%	±.1%
B	Platinum 30% Rhodium/Platinum 6% Rhodium	1600°F to 3100°F	±.5%	—

Chromel and alumel are registered trademarks of Hoskins Manufacturing Co.
Table courtesy of ASTM E230.



Selection Guide To Wire Calibration

Thermocouple Wire Names And Symbols

Calibration Type	Type of Thermocouple	Temperature Range	Comments
J	Iron (+) Constantan (-)	32 - 1400°F (0 - 760°C)	Reducing atmosphere recommended. Iron leg subject to oxidation at elevated temperatures - use larger gauge to compensate.
K	Chromel (+) Alumel (-)	32 - 2300°F (0 - 1260°C)	Well suited for oxidizing atmospheres. Most commonly used calibration type.
T	Copper (+) Constantan (-)	-328 - 700°F (-200 - 371°C)	Most stable at cryogenic temperature ranges. Excellent in oxidizing and reducing atmospheres within temperature range.
E	Chromel (+) Constantan (-)	-328 - 1600°F (-200 - 871°C)	Highest output of base metal thermocouples. Not subject to corrosion at cryogenic temperatures.
R	Plat. 13% Rhod. (+) Platinum (-)	32 - 2700°F (0 - 1482°C)	Oxidizing atmosphere recommended. Easily contaminated, requires protection.
S	Plat. 10% Rhod. (+) Platinum (-)	32 - 2700°F (0 - 1482°C)	Laboratory standard, highly reproducible. Easily contaminated, requires protection.
B	Plat. 30% Rhod. (+) Plat. 6% Rhod. (-)	1600 - 3100°F (871 - 1704°C)	Easily contaminated, requires protection.

Notes: Only Iron and Alumel wires are magnetic. Chromel & Alumel are registered trademarks of Hoskins Manufacturing Co.

Limits Of Error For Thermocouples

Calibration	Type of Thermocouple	Temperature Range	Limits of Error	
			Standard	Special
J	Iron/ Constantan	32°F to 530°F	±4°F	±2°F
		530°F to 1400°F	±.75%	±.4%
K	Chromel/ Alumel	32°F to 530°F	±4°F	±2°F
		530°F to 2300°F	±.75%	±.4%
T	Copper/ Constantan	-328°F to +32°F	±2°F or ±1.5%	—
		32°F to 260°F	±2°F	±1°F
		260°F to 700°F	±.75%	±.4%
E	Chromel/ Constantan	-328°F to +32°F	±3°F	—
		32°F to 500°F	±1%	±2°F
		500°F to 1600°F	±.5%	±.4%
R	Platinum 13% Rhodium/ Platinum	32°F to 1100°F	±2.5°F	±1°F
		1100°F to 2700°F	±2.5%	±.1%
S	Platinum 10% Rhodium/ Platinum	32°F to 1100°F	±2.5°F	±1°F
		1100°F to 2700°F	±.25%	±.1%
B	Platinum 30% Rhodium/ Platinum 6% Rhodium	1600°F to 3100°F	±.5%	—

Chromel and alumel are registered trademarks of Hoskins Manufacturing Co.

Table courtesy of ASTM E230.



Selection Guide To Sheath Material

How To Select Sheath Material

Code	Sheath Material
304	304 Stainless Steel
310	310 Stainless Steel
316	316 Stainless Steel
446	446 Stainless Steel
600	Inconel 600
Other Options Available	

Place code in ordering box.

Sheath Material Description

Ordering Box Example

The sheath serves to isolate and protect the wires and insulation from contamination and mechanical damage. There is no sheath material which is appropriate for all conditions. Temperature, corrosiveness, strength, service life and cost must be considered when selecting a sheath material.

304 Stainless Steel - Maximum Temperature: 1650°F (900°C). Most common low temperature sheath material. Lowest cost corrosion resistant material available. Used extensively in chemical, food, beverage, and other industries where corrosion resistance is required.

310 Stainless Steel - Maximum Temperature: 2100°F (1150°C). Very good heat and oxidation resistance. The mechanical and corrosion resistance is better than 304SS.

316 Stainless Steel - Maximum Temperature: 1650°F (900°C). Similar to 304SS with very good corrosion resistance. This alloy is also used extensively in the food and chemical industries.

446 Stainless Steel - Maximum Temperature: 2100°F (1150°C). A stainless steel with good corrosion resistance, heat and oxidation resistance. Excellent for sulphur bearing environment.

Inconel 600 - Maximum Temperature: 2200°F (1175°C). Most commonly used high temperature sheath material. Good corrosion resistance and very good heat and oxidation resistance. Not intended to be used in a sulfur bearing environment.

Note: Other sheath materials are available.



Selection Guide To Thermowell/Protection Tube Material

How To Select Thermowell/Protection Tube Material

Code	Material
S	Carbon Steel
M	Monel
C	304 Stainless Steel
H	316 Stainless Steel
D	446 Stainless Steel
N	Nickel
A	Inconel 600

Place code in ordering box. Material Description

Ordering Box Example

General Material Application Data		
Material	Recommended Maximum Temperature	Remarks
Carbon Steel	1000°F (540°C)	Satisfactory in any except corrosive atmospheres.
Monel (67% Nickel, 30% Copper)	900°F (480°C)	Used where high strength and resistance to corrosion are required, such as sea water, dilute sulfuric acid and strong caustic solutions.
304SS (18% Chromium, 8% Nickel)	1600°F (870°C)	Resistant to oxidation and corrosion. Generally used in wet-process applications such as steam lines, oil refineries and chemical solutions. Resists nitric acids well, halogen acids poorly, and sulfur acids moderately.
316SS (18% Chromium, 8% Nickel, 2% Molybdenum)	1600°F (870°C)	Superior to 304 SS in corrosion resistance. Resists pitting in phosphoric and acetic acids.
446SS (28% Chromium, Iron)	2000°F (1090°C)	Excellent resistance to oxidation and corrosion at high temperatures. Used extensively in general-purpose alloy tubes. Highly resistant to sulfur attack.
Nickel	2000°F (1090°C)	Resistant to attack by many chemicals at high temperatures. Principally used for hot caustic and molten-salt baths. Should <u>not</u> be used where sulfur is present.
Inconel 600 (80% Nickel, 15% Chromium)	2100°F (1150°C)	For general high-temperature use. Has greater mechanical strength than 446SS. Should <u>not</u> be used where sulfur is present.

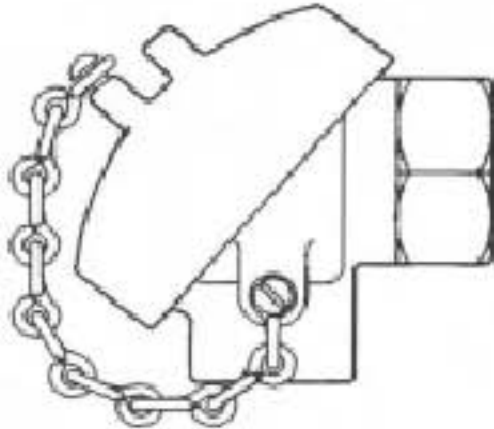
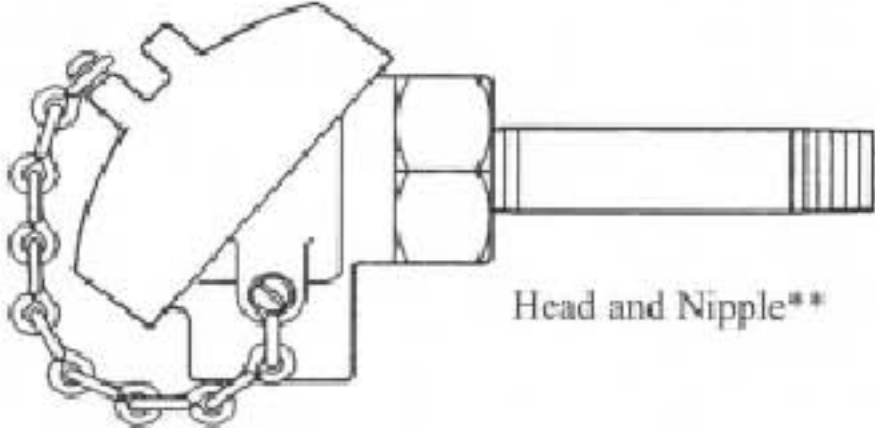
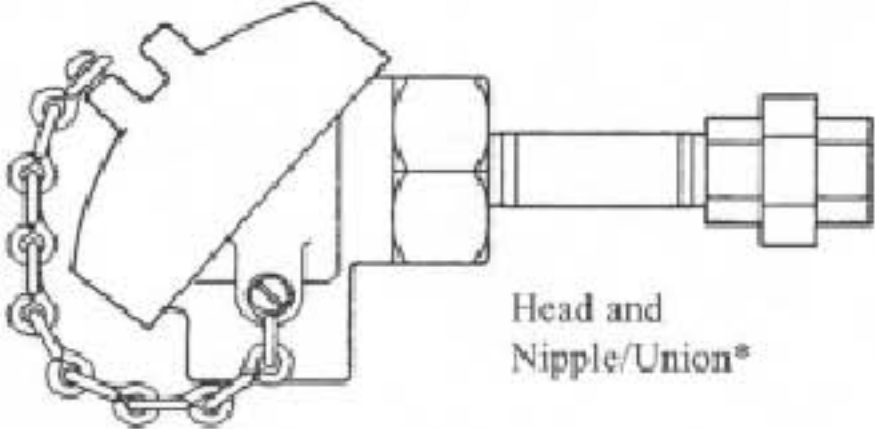
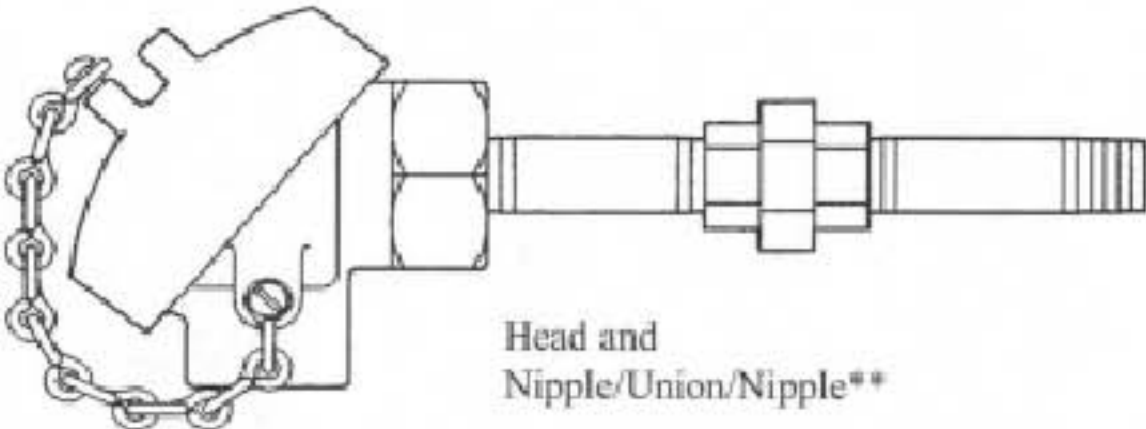
Note: Only specific options are offered in each catalog section.

See pages 101-106 for additional application information.



Selection Guide To Extension Configuration

How To Select Extension Configuration

Extension Configuration	Code
 Head*	1
 Head and Nipple**	2
 Head and Nipple/Union*	3
 Head and Nipple/Union/Nipple**	4
* For use with Protection Tube Assemblies only. ** For use with Thermowell Assemblies only.	

Junction Box

1017 Series

A cast metal weatherproof junction box provided with mounted terminal strips for connection of thermocouple leadwires. Terminal strips are numerically identified as to circuits. Available in cast iron or cast aluminum with standard conduit threaded inlets. Aluminum furnished unless otherwise specified. Cast iron junction boxes have rust resistant finish.

Please specify material, conduit inlets sizes and location.



1017 —

Code	Number of Terminal Strips	Internal Box Dimensions		
		L	W	D
6	(2) 6 Point	6"	4"	4"
12	(2) 12 Point	10"	6"	4"

Code	Material
AL	Cast Aluminum
CI	Cast Iron

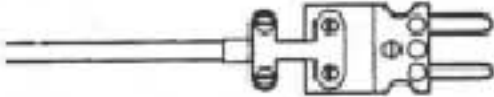
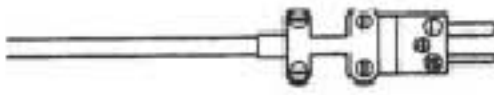
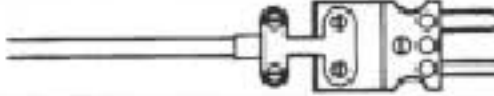
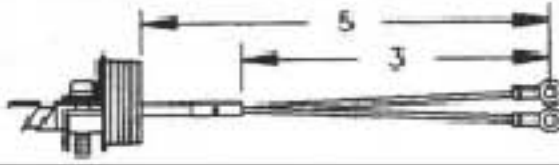
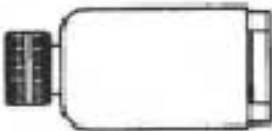
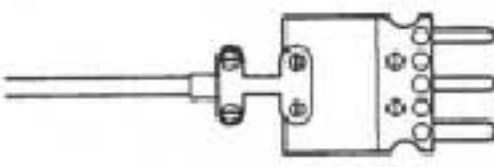
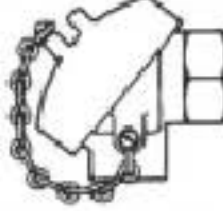
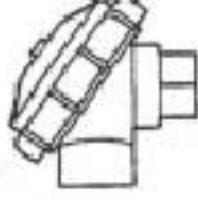
Code	Other Pertinent Data
0	None
999	Consult factory for special request

1017-12-CI-0
Ordering Example



Selection Guide To Termination Style

How To Select Termination Style

Termination Style	Description	Code	See Page
	111 Standard Plug	10	156
	131 Miniature Plug	20	157
	109 Standard High Temp Plug (Ceramic)	30	156
	Standard 3 Inch Pig Tail (Bare Wire End)	40	—
	3 Inch Pig Tail With #6 Ring Terminal and BX Connector	41	—
	Dust Cover (1020D)	50	163
	Waterproof Cover (1020W)	51	163
	Fiberglass Head (1016)	60	164
	Ceramic Head (1015)	61	164
	151 Standard RTD Plug (3 Wire)	70	157
	Cast Aluminum Head (1018 Series)	AL	166
	Cast Iron Head (1018 Series)	CI	166
	Polypropylene Head (1028 Series)	P	167



Introduction To Industrial Thermocouple Assemblies

Head Assembly

Explosion-proof gasketed screw-cover head in either cast aluminum or cast iron, with a simplex or duplex terminal block as required.

Extension Assembly

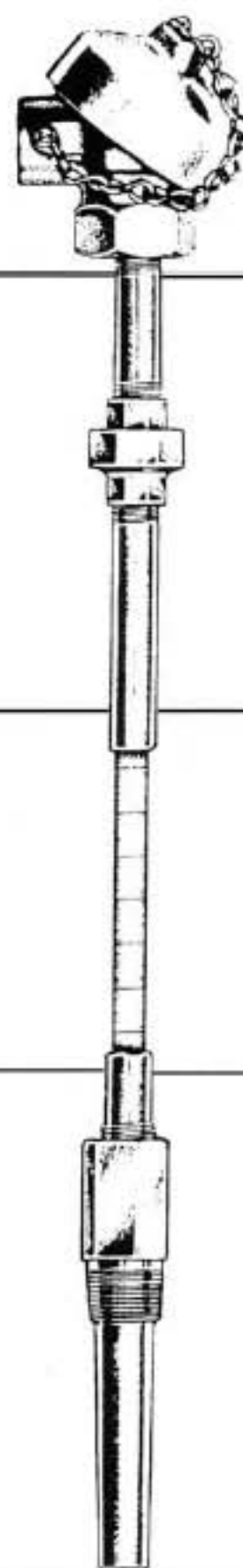
Nipples and union in 1/2" standard weight steel. Standard lengths are 4" and 6", with 3", 5", 7" and 8" also available.

Thermocouple Element

Available in all calibrations and junctions. Choice of metallic sheath or ceramic insulated element.

Thermowell or Protection Tube

Assemblies are available with either Thermowells, Protection Tubes, or Uniwell Designs.



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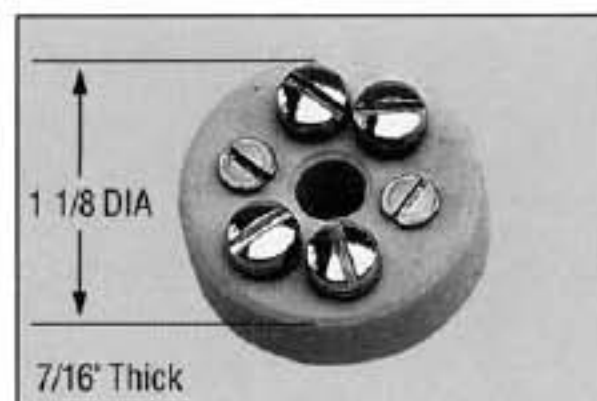
Ceramic Terminal Head

1015 Series or Single Or Duplex Thermocouple Applications

A high-temperature binding screw type terminal similar to the Series 1016, but capable of withstanding temperatures up to 1000°F. The four separate binding screws permit usage in duplex applications. Single thermocouples may be wired by connecting both the thermocouple and extension wire to the same binding post or linking across each pair of binding screws thus providing separate thermocouple and extension wire binding posts. The stainless steel base allows attachment to sheathed thermocouples with standard silver soldering methods.

1015-

Code	Sheath Diameter
D	.125
E	.187
F	.250



1015-D
Ordering Example

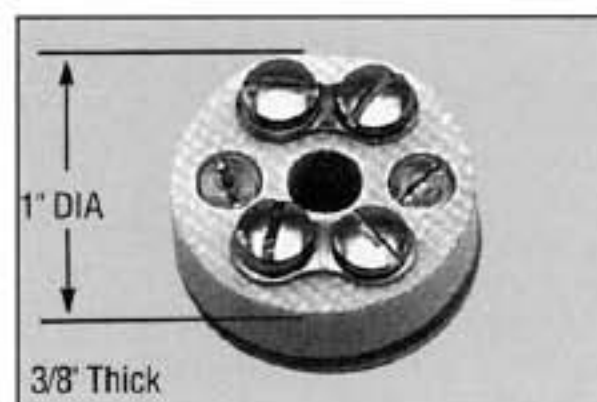
Fiberglass Terminal Head

1016 Series For Single Thermocouple Applications

This economical binding screw-type terminal is readily installed on Thermo-pak materials with standard silver solder. Four binding screws are provided, two for connection of thermocouple conductors and two for lead connections. This terminal has an upper temperature limit of 350°F.

1016-

Code	Sheath Diameter
D	.125
E	.187
F	.250

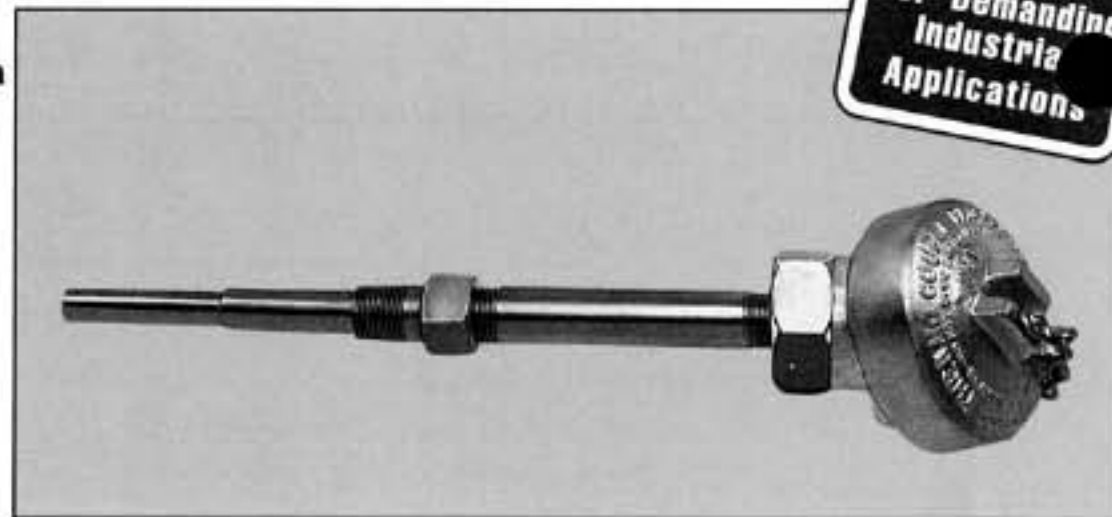


1016-D
Ordering Example

Standard Thermowell Assembly

16000 Series

- Thermowell Has Step-Down Design
- Complete Thermocouple/ Thermowell Assembly
- Supplied With A Threaded Thermowell (.260 Bore)
- Explosion Proof Head Is Standard



16000

Code	Assembly Style
S	Simplex
D	Duplex

Code	Head Material
A	Aluminum
F	Cast Iron

Code	Extension Configuration
2	Head and nipple
4	Head and nipple/union/nipple

Code	Extension Length
2	2"
4	4"
6	6"
For other lengths consult factory	

Code	Element
3	Simplex, with ceramic insulators
6	Simplex magnesium oxide insulated cable
7	Duplex, with ceramic insulators
8	Duplex magnesium oxide insulated cable

Type 3 and 7 (*nonspring loaded*) are standard. Spring loading only available on Type 6 and 8.

Code	Wire Calibration
J	Iron/Constantan
K	Chromel/Alumel
T	Copper/Constantan
E	Chromel/Constantan
R	Plat. 13% Rhod./Plat.
S	Plat. 10% Rhod./Plat.
B	Plat. 30% Rhod./Plat. 6% Rhod.

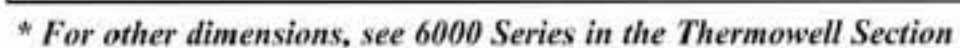
For duplex calibrations, please indicate double letters, example EE.

16000S-A-2-6-3-J-W2-3/4-S-10.5-0

Ordering Example

! Metric Orders Welcome

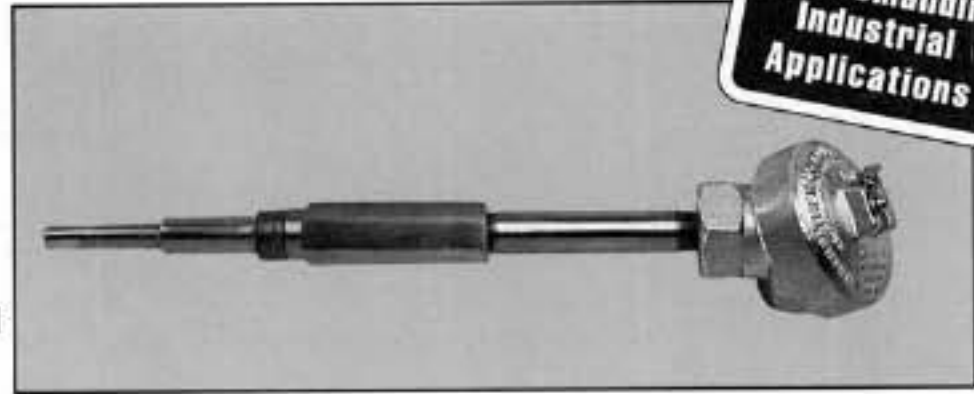
Place an **mm** in appropriate selection box: 100 mm



Lag Thermowell Assembly

16100 Series

- Complete Thermocouple/ Thermowell Assembly
- Supplied With A Threaded Thermowell (.260 Bore)
- Explosion Proof Head Is Standard
- Supplied With Standard Lag Length



16100

Code	Assembly Style
S	Simplex
D	Duplex

Code	Head Material
A	Aluminum
F	Cast Iron

Code	Extension Configuration
2	Head and nipple
4	Head and nipple/union/nipple

Code	Extension Length
2	2"
4	4"
6	6"
For other lengths consult factory.	

Code	Element
3	Simplex, with ceramic insulators
6	Simplex magnesium oxide insulated cable
7	Duplex, with ceramic insulators
8	Duplex magnesium oxide insulated cable

Type 3 and 7 (*nonspring loaded*) are standard. Spring loading only available on Type 6 and 8.

Code	Wire Calibration
J	Iron/Constantan
K	Chromel/Alumel
T	Copper/Constantan
E	Chromel/Constantan
R	Plat. 13% Rhod./Plat.
S	Plat. 10% Rhod./Plat.
B	Plat. 30% Rhod./Plat. 6% Rhod.

For duplex calibrations, please indicate double letters, example EE.

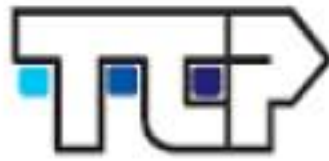
16100S-A-2-6-3-J-W2-3/4-S-10.5-0

Ordering Example

! Metric Orders Welcome

Place an **mm** in appropriate selection box: 100 mm





Thermo-Couple Products

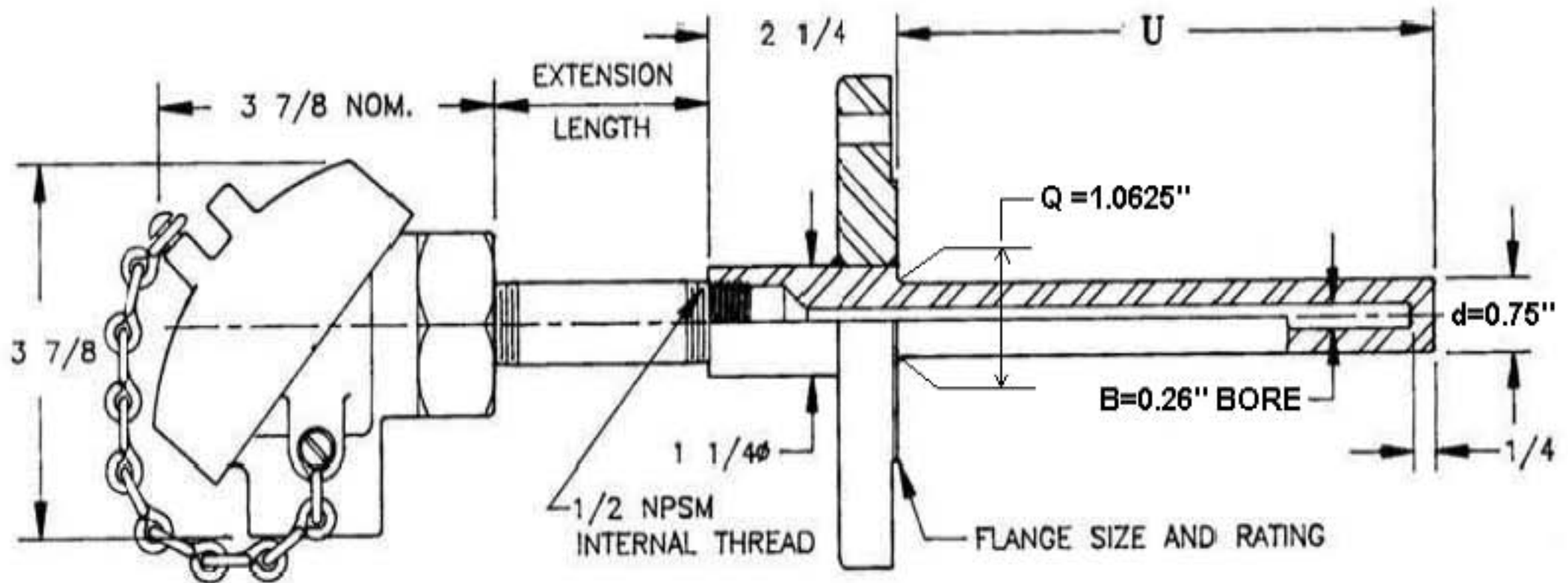
Number One In High Temperature Measurement



Thermo-Couple and Thermo-Well Assembly

Pressure Rating: ANSI 300#, 600#, 900#, 1500#, 2500#

Material: SS304, SS316, SS321, SS347, Monel, C.S.



Wall thickness: At flange root, the tube wall thickness is $(Q-B)/2=0.40125''(10.2\text{mm})$

At tip end, the tube wall thickness is: $(0.75-0.26)/2=0.245''(6.233\text{mm})$

The well shall drilled and machined with a metal bar, and the well shall be taper shapped
Tapered design provides Greater Rigidity Than Straight Design

Explosion Proof Head Is Standard

Flange Is Fully Welded to Thermowell

Thermo-well Calculation

1. Maximum Pressure Calculation for thermo-well

When $D_o/\delta_e < 10$: $P1 = \left[\frac{1.625}{D_o/\delta_e} - 0.626 \right] \cdot B \text{ (MPa)}$

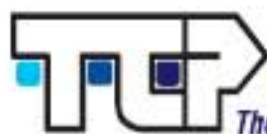
$$P2 = \frac{2\delta_0}{D_o/\delta_e} \left[1 - \frac{1}{D_o/\delta_e} \right] \text{ (MPa)}$$

Take the smaller value of P1 or P2 as the allowed pressure.

D_o : Outer diameter (mm)

δ_e : Tube wall thickness (mm)

B: Ability to stand outer press, for SS321, at 500°C, B=70-80Mpa



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Number One In High Temperature Measurement



σ_o : Allowed maximum stress for material, for SS321, at 500°C, $\sigma_o=108\text{Mpa}$
Corrosion shall be taken into consideration.

Assume: The thermo-well shall be working at 500°C, 25Mpa, calculate the needed wall thickness:

- (1) At flange end, the thickness should be 8.25mm or large.
- (2) At tip end, the thickness should be 3mm or large.

2. Fluid speed calculation

The fluid flow through the thermo-well, Kaman swirl shall be produced, when the frequency equal or large than the inherent vibration frequency, the thermo-well shall be broken, that shall be very dangerous, so we must know the fluid speed limitation for each standard thermo-well. If the process fluid speed near the limit, the factory shall take measures to protect it, assure the customer use the products in safe condition.

Equation: Vibration frequency caused by fluid speed:

$$f_v = St \times (V/d_o)$$

d_o : Outer diameter (m)

V : Fluid speed across the tube

St : STEHARO coefficient

Thermo-well Inherent Frequency:

$$f_n = \frac{a_n^2}{l^2} \sqrt{\frac{EI_n}{\rho l}} \quad \left(\frac{1}{s}\right)$$

f_n : Vibration frequency (1/S)

a_n : n Times vibration coefficient, $1 + \cos a$. $\cos a = 0$, then $a_1=1.875$, $a_2=4.694$, $a_3=7.854$

I_a : Rotation Force, $I_a = 0.0491(D^4 - d^4)$ (m^4)

D : Tube outer diameter (m), d : Tube inner diameter(m)

E : Spring Force (N/m^2) Take $E = 20.58 \times 10^{10} (N/m^2)$

ρ : Density of Unit Length (kg/m),

After calculated f_n , with $f_n = f_v = St \times (V/d_o)$, $V = f_n \times d_o / St$, we can calculate the speed limit of the thermo-well.

The calculation speed see speed list for this project.

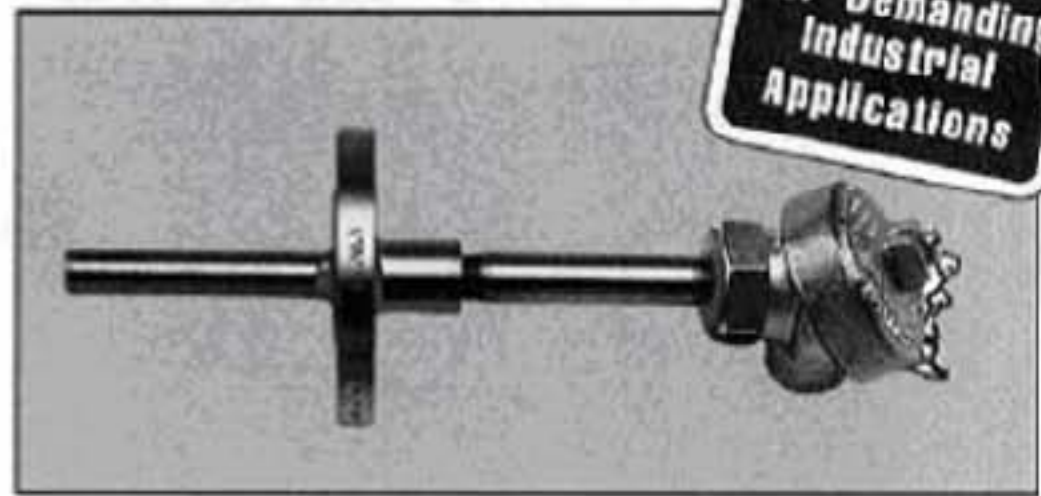


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Flanged Thermowell Assembly

16700 Series

- Complete Flanged Thermowell Assembly With .260 Bore
- Explosion Proof Head Is Standard
- Flange Is Fully Welded To Thermowell



16700

Code	Assembly Style
S	Simplex
D	Duplex

Code	Head Material
A	Aluminum
F	Cast Iron

Code	Extension Configuration
2	Head and nipple
4	Head and nipple/union/nipple

Code	Extension Length
2	2"
4	4"
6	6"

For other lengths consult factory

Code	Element
3	Simplex, with ceramic insulators
6	Simplex magnesium oxide insulated cable
7	Duplex, with ceramic insulators
8	Duplex magnesium oxide insulated cable

Type 3 and 7 (*nonspring loaded*) are standard. Spring loading only available on Type 6 and 8.

Code	Wire Calibration
J	Iron/Constantan
K	Chromel/Alumel
T	Copper/Constantan
E	Chromel/Constantan
R	Plat. 13% Rhod./Plat.
S	Plat. 10% Rhod./Plat.
B	Plat. 30% Rhod./Plat. 6% Rhod.

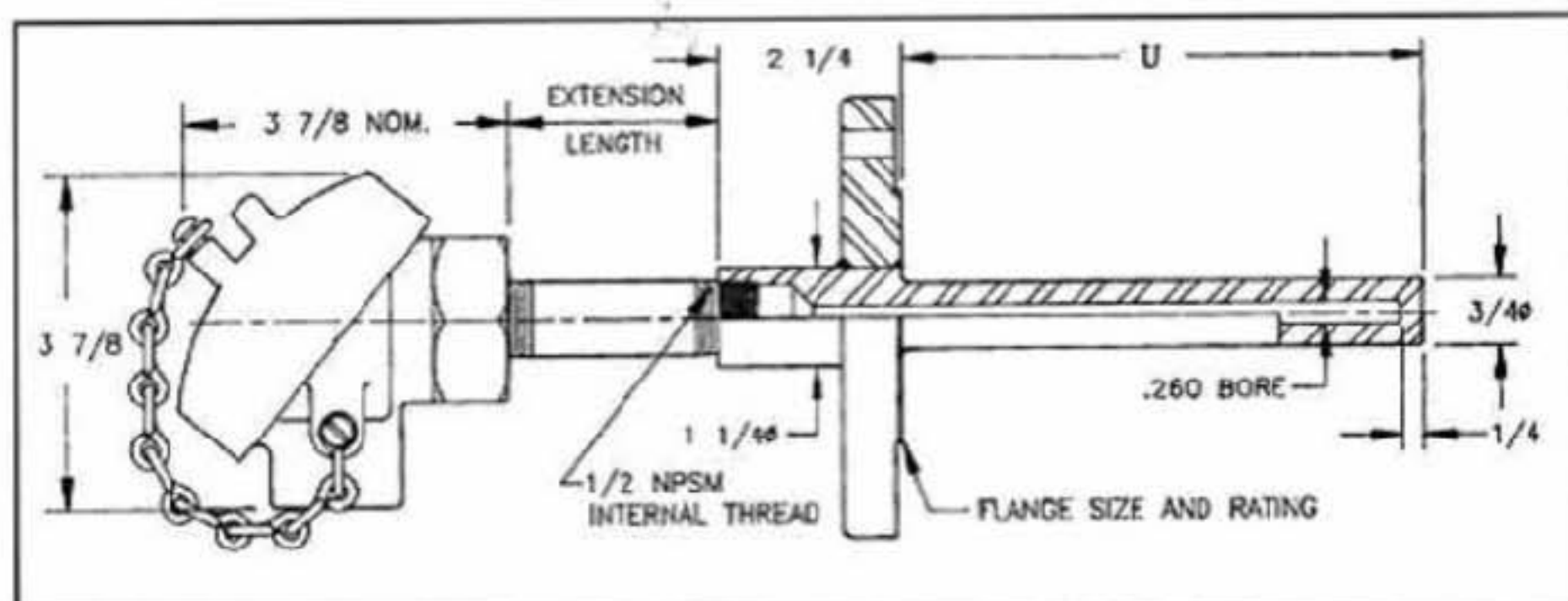
For duplex calibrations, please indicate double letters, example EE.

16700S-A-2-6-3-J-W2-1-300-RF-C-10.5-0

Ordering Example

! Metric Orders Welcome

Place an **mm** in appropriate selection box:



* For other dimensions, see 6700 Series in the Thermowell Section

Code	Other Pertinent Data
0	None
2	Spring Loaded
999	Special Request Consult Factory

Code	Thermowell Insertion Length "U"
2.5	2 1/2"
4.5	4 1/2"
7.5	7 1/2"
10.5	10 1/2"
13.5	13 1/2"
16.5	16 1/2"
22.5	22 1/2"

Code	Thermowell Material
C	304 Stainless Steel
H	316 Stainless Steel
M	Monel
S	Carbon Steel

Code	Flange Face
RF	Raised Face
RTJ	Ring Type Joint

Code	Flange Rating
300	300 lb
600	600 lb
900	900 lb
1500	1500 lb
2500	2500 lb

Code	Flange Size
1	1"
1.5	1 1/2"
2	2"

Code	Junction Style
W2	Grounded Junction
W4	Ungrounded Junction

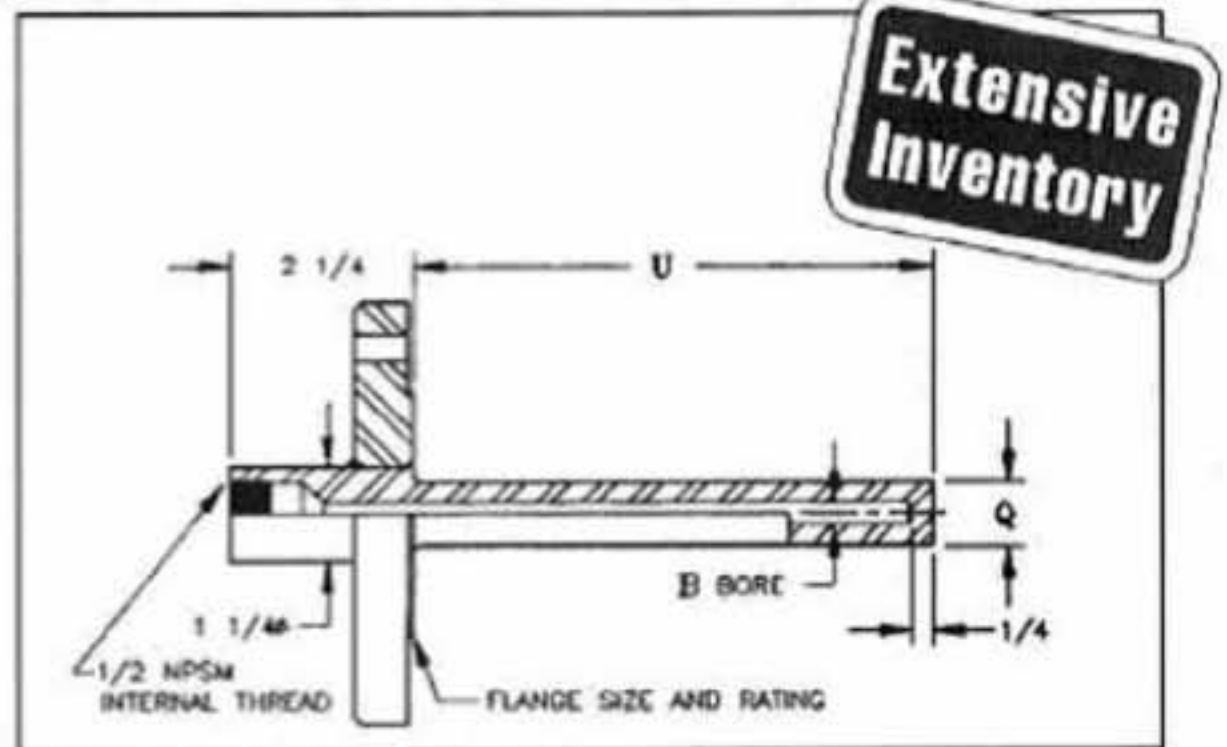
W2 is standard

Flange Thermowell

6700 Series

- Standard Bore Size: .260 or .385
- Flange Is Fully Welded To Thermowell
- Brass Plug and Chain Optional

Bore "B"	.260"	.385"
Diameter "Q"	3/4"	7/8"



6700

Code	Material
S	Carbon Steel (C1018)
C	304 Stainless Steel
H	316 Stainless Steel
D	446 Stainless Steel
M	Monel
A	Inconel 600
Consult factory for other materials	

Code	Bore Diameter "B"
.260	.260
.385	.385

Code	Thermowell Insertion Length "U"
2	2"
4	4"
7	7"
10	10"
13	13"
16	16"
22	22"
For other length consult factory	

Code	Flange Size
1	1"
1.5	1 1/2"
2	2"
3	3"

Code	Other Pertinent Data
0	None
999	Special request consult factory

Code	Plug and Chain
0	None
1	Brass
2	Stainless Steel

Code	Facing
FF	Flat Face
RF	Raised Face
RTJ	Ring Type Joint
SFRF	Smooth Face, Raised Face

Code	Rating
300	300 lb
600	600 lb
900	900 lb
1500	1500 lb
2500	2500 lb

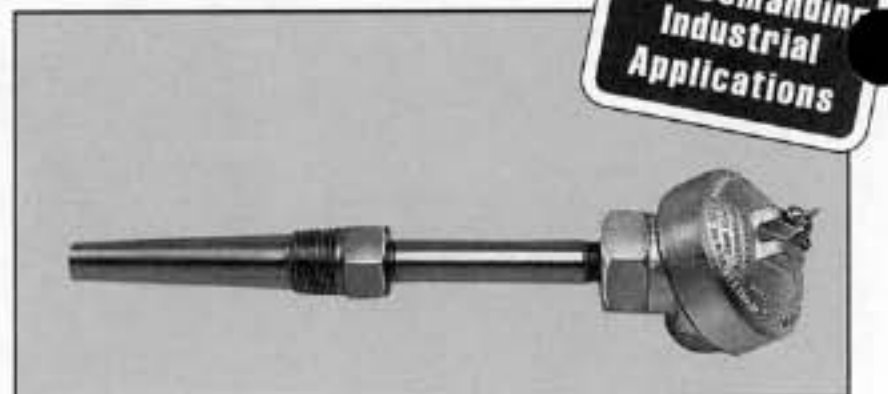
6700-C-.260-7-1.5-300-FF-0-0

Ordering Example

Heavy Duty Thermowell Assembly

16300 Series

- Tapered Design Provides Greater Rigidity Than Straight Shank Design
- Explosion Proof Head Is Standard
- Threaded Tapered Thermowell With .385 Bore



16300

Code	Assembly Style
S	Simplex
D	Duplex

Code	Head Material
A	Aluminum
F	Cast Iron

Code	Extension Configuration
2	Head and nipple
4	Head and nipple/union/nipple

Code	Extension Length
2	2"
4	4"
6	6"

For other lengths consult factory

Code	Element
3	Simplex, with ceramic insulators
6	Simplex magnesium oxide insulated cable
7	Duplex, with ceramic insulators
8	Duplex magnesium oxide insulated cable

Type 3 and 7 (nonspring loaded) are standard. Spring loading only available on Type 6 and 8.

Code	Wire Calibration
J	Iron/Constantan
K	Chromel/Alumel
T	Copper/Constantan
E	Chromel/Constantan
R	Plat. 13% Rhod./Plat.
S	Plat. 10% Rhod./Plat.
B	Plat. 30% Rhod./Plat. 6% Rhod.

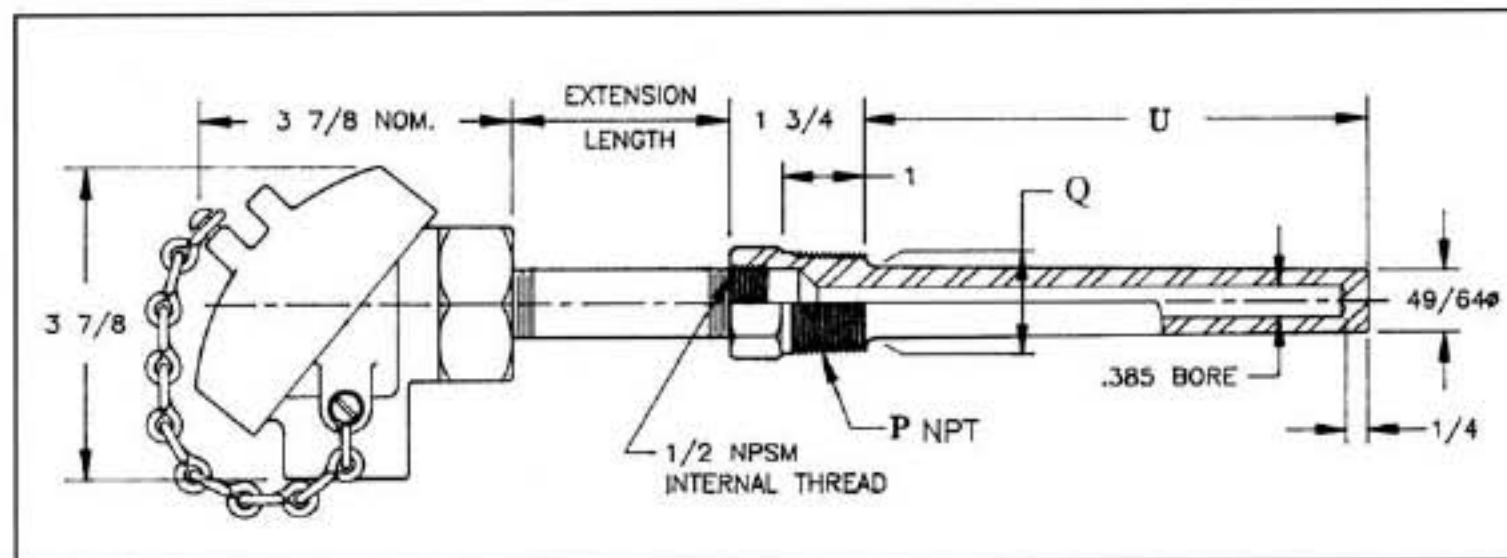
For duplex calibrations, please indicate double letters, example EE.

16300S-A-2-6-3-J-W2-3/4-S-10.5-0

Ordering Example

! Metric Orders Welcome

Place an **mm** in appropriate selection box: 100 mm



* For other dimensions, see 6300 Series in the Thermowell Section

Code	Other Pertinent Data
0	None
2	Spring Loaded
999	Special Request Consult Factory

Code	Thermowell Insertion Length "U"
2.5	2 1/2"
4.5	4 1/2"
7.5	7 1/2"
10.5	10 1/2"
13.5	13 1/2"
16.5	16 1/2"
22.5	22 1/2"
For other lengths consult factory	

Code	Thermowell Material
C	304 Stainless Steel
H	316 Stainless Steel
M	Monel
S	Carbon Steel
For other material consult factory	

Code	Process Connection "P"
3/4	3/4" NPT
1	1" NPT

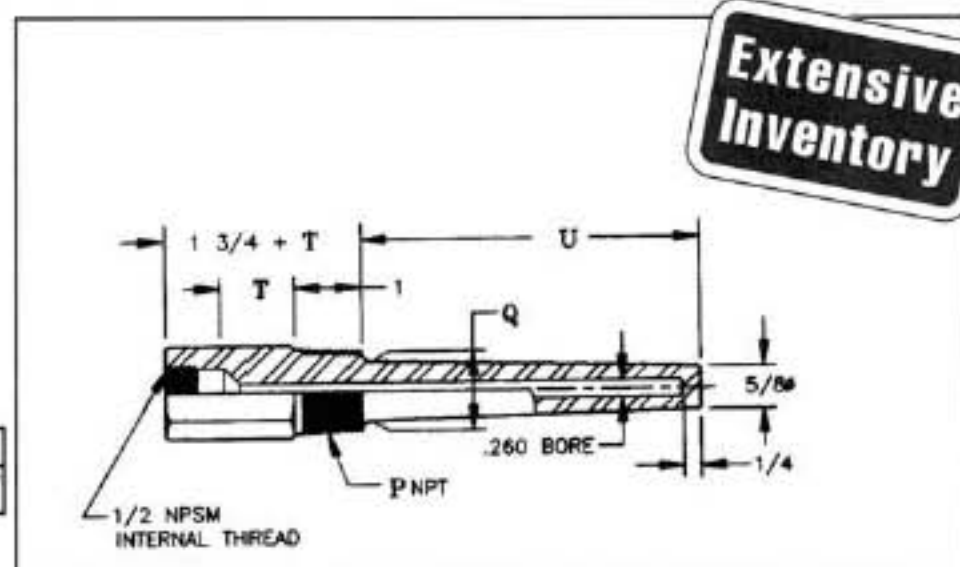
Code	Junction Style
W2	Grounded Junction
W4	Ungrounded Junction
W2 is standard	

Heavy Duty Well

6250 Series

- Standard Bore Size: .260
- Tapered Design To Provide Greater Rigidity
- Brass Plug and Chain Optional

Process Connection "P"	1/2"	3/4"	1"
Diameter "Q"	5/8"	7/8"	1-1/16"



6250

Code	Material
S	Carbon Steel (C1018)
C	304 Stainless Steel
H	316 Stainless Steel
D	446 Stainless Steel
M	Monel
A	Inconel 600
Consult factory for other materials	

Code	Process Connection "P"
1/2	1/2" NPT
3/4	3/4" NPT
1	1" NPT

Code	Other Pertinent Data
0	None
999	Special request consult factory

Code	Plug and Chain
0	None
1	Brass
2	Stainless Steel

Code	Thermowell Insertion Length "U"
2.5	2 1/2" T = 2"
4.5	4 1/2"
7.5	7 1/2"
10.5	10 1/2" T = 3"
13.5	13 1/2"
16.5	16 1/2"
22.5	22 1/2"
For other length consult factory	

6250-C-3/4-7.5-0-0
Ordering Example

Metric Orders Welcome

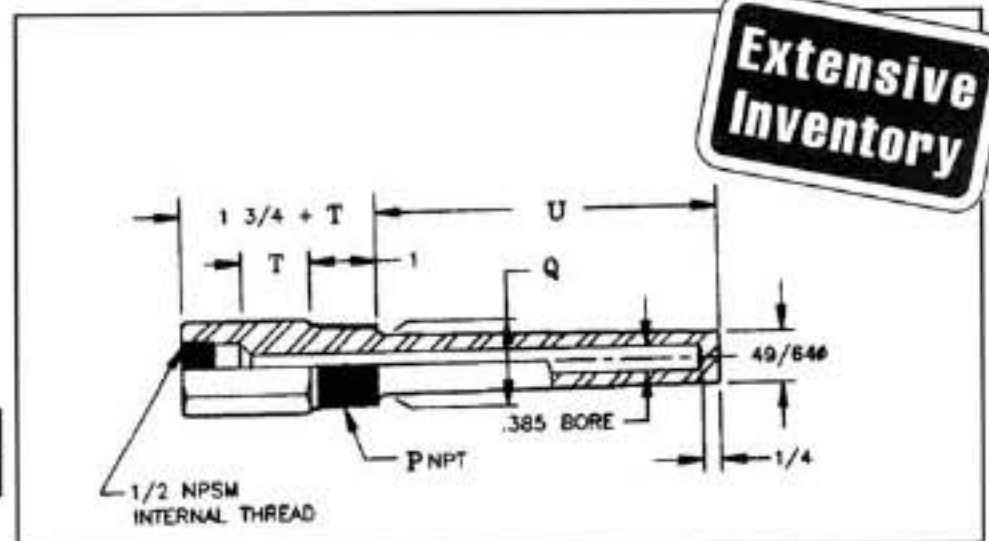
Place an **mm** in appropriate selection box:

Heavy Duty Well

6350 Series

- Standard Bore Size: .385
- Supplied With A Standard Lag Length
- Brass Plug and Chain Optional

Process Connection "P"	3/4"	1"
Diameter "Q"	7/8"	1-1/16"



6350

Code	Material
S	Carbon Steel (C1018)
C	304 Stainless Steel
H	316 Stainless Steel
D	446 Stainless Steel
M	Monel
A	Inconel 600
Consult factory for other materials	

Code	Process Connection "P"
1/2	1/2" NPT
3/4	3/4" NPT
1	1" NPT

Code	Other Pertinent Data
0	None
999	Special request consult factory

Code	Plug and Chain
0	None
1	Brass
2	Stainless Steel

Code	Thermowell Insertion Length "U"
2.5	2 1/2" T = 2"
4.5	4 1/2"
7.5	7 1/2"
10.5	10 1/2" T = 3"
13.5	13 1/2"
16.5	16 1/2"
22.5	22 1/2"
For other length consult factory	

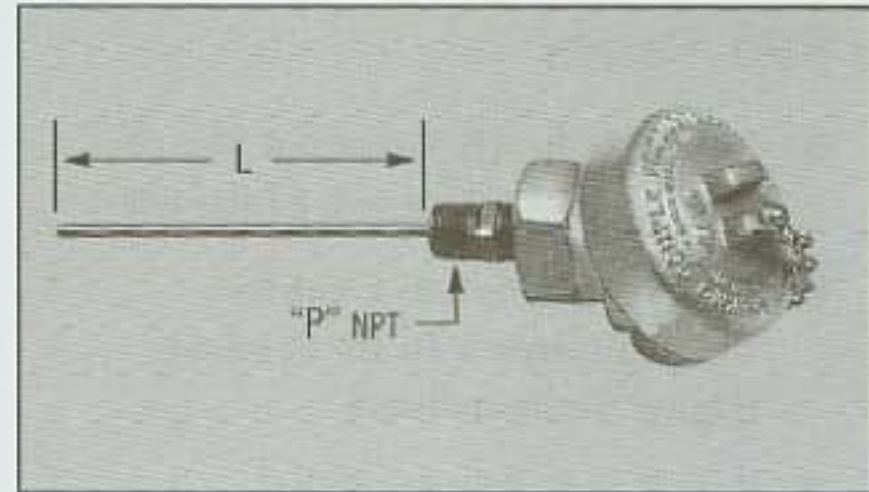
6350-C-3/4-7.5-0-0
Ordering Example



Standard Thermocouple

700 Series

- Industrial Design With Cast Screw Cover Heads
- "Factory Mutual" Approved Heads In Cast Iron And Aluminum
- High Strength Bendable Designs
- Mineral Insulation Enables Thermocouples To Be Used At Higher Temperatures



700

Code	Wire Calibration
J	Iron/Constantan
K	Chromel/Alumel
T	Copper/Constantan
E	Chromel/Constantan
R	Plat. 13% Rhod./Plat.
S	Plat. 10% Rhod./Plat.
B	Plat. 30% Rhod./Plat. 6% Rhod.
For duplex calibrations please indicate double letters, example EE.	
Code	Sheath Diameter
D	.125
E	.187
F	.250
Consult factory for other diameters	
Immersion Length "L"	
Specify in inches 01 to 99 (6 inch increments standard) for lengths over 99 inches consult factory	
Code	Junction Style
W1	Grounded Flat Tip
W2	Grounded Rounded Tip
W3	Ungrounded Flat Tip
W4	Ungrounded Rounded Tip
W2 is standard	

Code	Other Pertinent Data
0	None
999	Special Request Consult Factory
Code	Spring Loading
0	None
1	Spring Loaded Element
None is standard. Spring loading not available if mounting thread is 0	
Code	Mounting Thread "P"
0	None
1/4	1/4" NPT
3/8	3/8" NPT
1/2	1/2" NPT
1/2" NPT is standard	
Code	Termination Style
0	None
AL	Aluminum Head
CI	Cast Iron Head
P	Poly Head
Cast Iron is standard	
Code	Sheath Material
304	304 Stainless Steel
316	316 Stainless Steel
600	Inconel 600
304 is standard	
Consult factory for other options	

700-J-E-6-W2-304-AL-3-1/4-0
Ordering Example

Metric Orders Welcome

Place an **mm** in appropriate selection box:



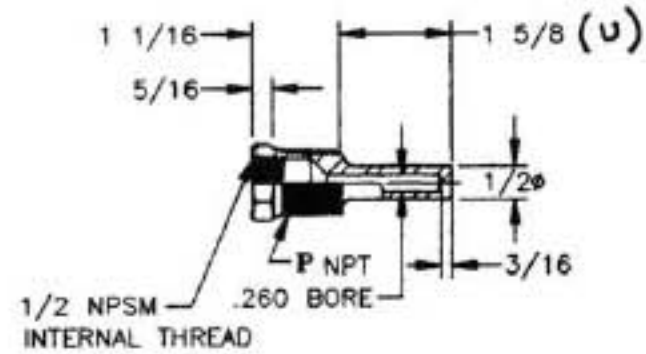
Limited Space Well

6500 Series

- Standard Bore Size: .260
- Brass Plug and Chain Optional

P 3/4" 1"

**Extensive
Inventory**



6500

1.625

Code	Material
S	Carbon Steel (C1018)
C	304 Stainless Steel
H	316 Stainless Steel
D	446 Stainless Steel
M	Monel
A	Inconel 600
Consult factory for other materials	

Code	Process Connection "P"
3/4	3/4" NPT
1	1" NPT
For special requirements contact factory	

Code	Other Pertinent Data
0	None
999	Special request consult factory

Code	Plug and Chain
0	None
1	Brass
2	Stainless Steel

Insertion Length "U"
Only available in 1 5/8" ("U")

6500-C-3/4-1.625-0-0

Ordering Example

TCP 技术简介

TCP Is Number One In High Technology Temperature Measurement

TCP 公司已经有 40 多年的历史，TCP 从成立之日起，一直致力于技术的研究和进步，和其他几个全世界闻名的测温元件制造商一起，发展和完善了热电偶/热电阻的理论和应用技术问题，成为世界上处于领导地位的少数几个测温元件制造商；在美国 TCP 公司与 OMEGA 公司是最著名的测温元件制造商，两家的产品占据了美国市场的 69%，国际市场的 33%，在世界各大石油公司的工厂中，都有 TCP 的产品。

TCP 公司产品齐全，有各种高压和中低压热电偶、热电阻，炉管温度热电偶，轴承温度测量元件，微小型温度测量元件等，许多产品是世界上第一流的。

TCP 产品主要特点：

1. 测量精度高，热偶：0.4%。热阻：0.2%
2. 响应时间快：热偶：<50mS。热阻：<10mS
3. 安全系数高。

TCP 高压热偶的安全措施如下：

1. 对每支热偶进行严格的检测和实验，保证其工作性能
2. 对每支热偶均进行 X-光探伤
3. 锥型设计，整体钻孔制造，保证耐压强度
4. 对每支热偶进行震动频率计算，根据客户要求的材料，工作温度，插入深度确定最大可用流速，建议用户更改长度或安装方式，如果长度和安装方式不能改变时，工厂采取加固措施

温度计套管的震动理论：

温度计套管插入管道，相当于一个单端固定的单摆，在流体的冲击下，就会产生振动（摆动），当振动频率达到套管的固有振动频率时，旧会产生套管折断，发生严重事故，而这个问题往往会被许多使用者所忽视，TCP 公司在提供产品的同时，向用户提供最大流速的计算，由用户确认无误才进行加工。

根据斯哈特曼理论，温度计套管的振动频率 f 与套管长度成反比，与流速成正比，

$$f=k \frac{V}{L} \quad (1)$$

套管的固有振动频率与套管壁厚、锥度成正比，与长度成反比，与金属材料的扬氏模数、可拉伸性能等有关，金属性能又与使用温度、压力密切相关，由此可得到套管的固有振动频率，在保证套管的固有振动频率大于套管受冲击力产生的震动频率的前提下，即可得到套管的极限振动频率，在考虑一定的余量后，由（1）式即可得到流体流速。

根据我们的计算，为保证套管受压能力，对于 2500 磅级不锈钢套管，端部最少厚度不应小于 3.8mm，为保证满足正常工作流速，根部厚度不应小于 8mm，整个套管呈锥型，在这个前提下计算出最大限制流速，如果实际工作流速超出该限制，采取的措施：（1）缩短套管，（2）改变安装角度（斜插，实际是缩短长度），如果长度不能缩短，只有请工厂特殊制造，既加强根部（增加根部厚度并加支撑），这样会增加费用，最好是缩短长度。

从我们的计算书可看出：同种材质的热偶套管，长度越大，极限流速越小；温度越高，极限流速越小。请用户核对管道流速，调整插入深度。