

Thermowells

Thermowells are used to provide an isolation between a temperature sensor and the environment, either liquid, gas or slurry. A thermowell allows the temperature sensor to be removed and replaced without compromising either the ambient region or the process.

Care must be taken in determining the material used for the thermowell as well as other factors. Thermo Sensors offers design assistance that includes pressure, temperature and or corrosion as well as vibration effects of the fluids. This vibration can cause well stem failure.

Thermo Sensors thermowell materials include:

- Carbon Steel
- 304 & 316 Stainless Steel
- Monel
- Brass

Please refer to our order guide to assist in determining your needs. We can also provide technical design assistance and application suggestions. Give us a call.

How to Select Thermowells

Introduction

Thermowells are used to shield thermocouple elements against mechanical damage and corrosion. Many variations are available in a variety of materials to meet individual job specifications.

The chemical and physical properties of all standard bar stock materials are rigidly controlled. All bar stock wells are drilled by the gun drilling process. Use of specially designed and constructed measuring equipment enables standard guaranteed bore concentricity to be within $\pm 10\%$ of wall thickness. Internal threads are within 1/2 turn of standard plug gauge. External threads are within 1/4 turn of standard ring gauge.

If required by purchase order, your thermowells undergo an internal hydrostatic test as a final precaution against pressure failure. Test pressures and duration are determined by the customer. Radiograph and other tests can be performed and results furnished upon request.

A variety of alloys suitable for every thermowell requirement is available. Thermowell material should be selected for ability to withstand the process environments, high thermal conductivity and low porosity to gases.

Choosing Bore Sizes for Maximum Flexibility

Where several types of temperature measuring instruments are used, the selection of a standard bore diameter can provide greater efficiency and flexibility of use. The same well can accommodate either thermocouple, resistance thermometer, bi-metal thermometer or test thermometer. The bore sizes of wells shown on this website accommodate the most commonly used temperature sensing elements. For example:



.260 Diameter Bore:

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- Bi-Metal Thermometers (1/4" stem)
- Thermocouples (#14 Awg)
- 1/4" & 3/8" O.D. Cerampak Thermocouples & RTD's
- Liquid-in-glass Test Thermometers (unarmored)
- Other elements having .252 max. O.D.

.385 Diameter Bore:

- Bi-metal Thermometers (3/8" stem)
- Thermocouples (#14 Gauge)
- 1/4" & 3/8" O.D. Cerampak Thermocouples & 3/8" RTD's (Use .260 Bore for 1/4" RTD's)
- Liquid-in-glass Test Thermometers (armored)
- Other elements having .377 max. O.D.

When to Use Tapered or Straight Thermowells

Tapered thermowells provide greater strength without sacrificing sensitivity. Because of its higher strength-to-weight ratio, the tapered thermowell provides greater resistance to high frequency vibrations than straight thermowells. This permits reliable operation at high fluid velocities. Thus, for higher fluid velocities, the tapered well should be chosen; for lower fluid velocities, the straight well. When choosing wells, refer to the [velocity rating charts](#) and other design information.

Choosing the Material

A most important factor in selecting thermowell material is to determine the corrosive conditions to which the well will be exposed. Recommended materials for various services are given in the [Thermowell Material Guide](#). The high mirror polish given to all wells enhances its corrosion resistance capability.

Occasionally, the material consideration is one of strength rather than corrosion. For example, a stainless steel well may be required for high pressure water service, where a brass well might have been satisfactory from a corrosion viewpoint. It will be helpful to consult the [pressure-temperature ratings](#) given for each well type.

Choosing the Proper Connection

In this website you will find standardized wells of threaded, flanged (ASA and Van Stone), and socket weld types with standard bore sizes. A provision for customer specifying design parameters or "weld-in" thermowells is also provided.

Threaded wells are made in readily weldable material. Standard flanged wells (other than Van Stone) have flanges welded front and back with "V" or "J" groove design. Full penetration double welded flanges are also available.

The double-welded construction eliminates possible crevice corrosion and stress cracking. Heat treated to NACE specs is available.

Socket weld of wells are especially simple to install. They fit ASA standard socket weld couplings or flanges to produce a clean, tight installation.

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Velocity Ratings of Thermowells

In some cases, well failures are due, not to the effect of pressure, temperature, or corrosion, but to the vibrational effects to which they are subjected. Fluid, flowing by the well, forms a turbulent wake (the Von Karman Trail) with a definite frequency based on well dimensions and fluid velocity. If the natural frequency of the well equals the wake frequency, the well stem will vibrate to destruction and break off in the piping. It is, therefore, important that the well have sufficient design to prevent a frequency equality condition.

In the following tables, a recommended maximum velocity rating can be found for several standard well lengths and materials. To simplify the information, ratings given are based on operating temperatures of 1000° F. for wells made of Carbon Steel (C-1018) and Stainless Steel (304 and 316). Values for brass wells are based on 350° F. Operation limits for Monel wells are based on 900° F service. Slightly higher velocity is possible at lower temperatures. Single values appearing in the velocity tables may be considered safe for water, steam, air or gas. In shorter insertion lengths, consideration is given to the velocity pressure effect of water flowing at higher velocities. The values in parenthesis, therefore, represent safe values for water flow while the unbracketted value may be used for steam, air, gas and similar density fluids.

Maximum Fluid Velocity Feet per Second								
Well Type	Material	Insertion Length -"U"						
		2	4	7	10	13	16	22
1V & 3V 1G & 3G and 1F	Carbon Steel	404 (129)	184 (71.2)	67.0 (42.7)	34.0	20.6	13.7	7.4
	304 & 316 SS	430 (179)	192 (99.3)	69.7 (59.6)	35.4	21.5	14.3	7.7
	Monel	350 (143)	168 (79.8)	61 (47.7)	31.0	18.8	12.5	6.7
2V & 4V 2G & 4G and 2F	Carbon Steel	410 (152)	248 (84.3)	91.3 (50.6)	45.7	27.6	18.5	10.0
	304 & 316 SS	444 (211)	285 (117)	95.2 (70.3)	47.6	28.8	19.3	10.4
	Monel	338 (168)	226 (93.3)	83.3 (56.0)	41.6	25.2	16.9	9.1

Maximum Fluid Velocity Feet per Second									
Well Type	Material	Insertion Length -"U"							
		2 1/2	4 1/2	7 1/2	10 1/2	13 1/2	16 1/2	19 1/2	22 1/2
1A and 1B	Brass	207 (59.3)	89.1 (39.8)	32.2 (23.9)	16.4	9.9	6.6	4.8	3.6
	Carbon Steel	290 (106)	123 (71.2)	44.9 (42.7)	22.8	13.8	9.3	6.7	4.9
	304 & 316 SS	300 (148)	128 (99.3)	46.4	23.6	14.3	9.6	6.9	5.1
	Monel	261 (118)	112 (79.8)	40.6	20.7	12.4	8.3	6.1	4.5
3A and 3B	Brass	207 (59.3)	102 (47.6)	37.0 (28)	18.8	11.4	7.6	5.5	4.1
	Carbon Steel	290	143	51.6	26.2	15.9	10.6	7.6	5.7

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	304 & 316 SS	(106) 300	(84.3) 148	(50.6) 53.5	27.2	16.5	11.0	7.9	5.9
	Monel	(148) 261 (118)	(117) 128 (93.3)	46.7	23.7	14.4	9.5	6.9	5.1

Maximum Fluid Velocity Feet per Second									
Well Type	Material	Insertion Length -"U"							
		2 1/2	4 1/2	7 1/2	10 1/2	13 1/2	16 1/2	22 1/2	
1S	Carbon Steel	290 (106)	123 (71.2)	44.9 (42.7)	22.8	13.8	9.3	4.9	
	304 & 316 SS	300 (148)	128 (99.3)	46.4	23.6	14.3	9.6	5.1	
3S	Carbon Steel	290 (106)	143 (84.3)	51.6 (50.6)	26.2	15.9	10.6	5.7	
	304 & 316 SS	300 (148)	148 (117)	53.5	27.2	16.5	11.0	5.9	
2S and 4S	Carbon Steel	426 (260)	192 (144)	69.5	35.4	20.5	14.3	7.7	
	304 & 316 SS	449 (360)	199	71.9	36.6	21.2	14.8	8.0	

Maximum Fluid Velocity Feet per Second									
Well Type	Material	Insertion Length -"U"							
		2 1/2	4 1/2	7 1/2	10 1/2	13 1/2	16 1/2	19 1/2	22 1/2
1C and 1D	Brass	305 (97.5)	93.8 (54.1)	33.9	17.1	10.5	7.0	5.0	3.7
	Carbon Steel	386 (175)	180 (97.2)	65.3 (58.3)	33.0	20.1	13.4	9.6	7.1
	304 & 316 SS	440 (243)	197 (135)	71.2	36.0	22.0	14.7	10.5	7.8
	Monel	354 (195)	155 (108)	56.1	28.4	17.3	11.6	7.5	5.6
3C and 3D	Brass	354 (161)	108 (89.5)	39.4	19.8	12.2	8.1	5.8	4.3
	Carbon Steel	448 (289)	209 (161)	75.7	38.4	23.3	15.5	11.1	8.2
	304 & 316 SS	490 (403)	228 (225)	82.5	41.8	25.5	17.1	12.2	9.1
	Monel	410 (322)	179 (178)	65.1	33.0	20.1	13.5	8.7	6.5

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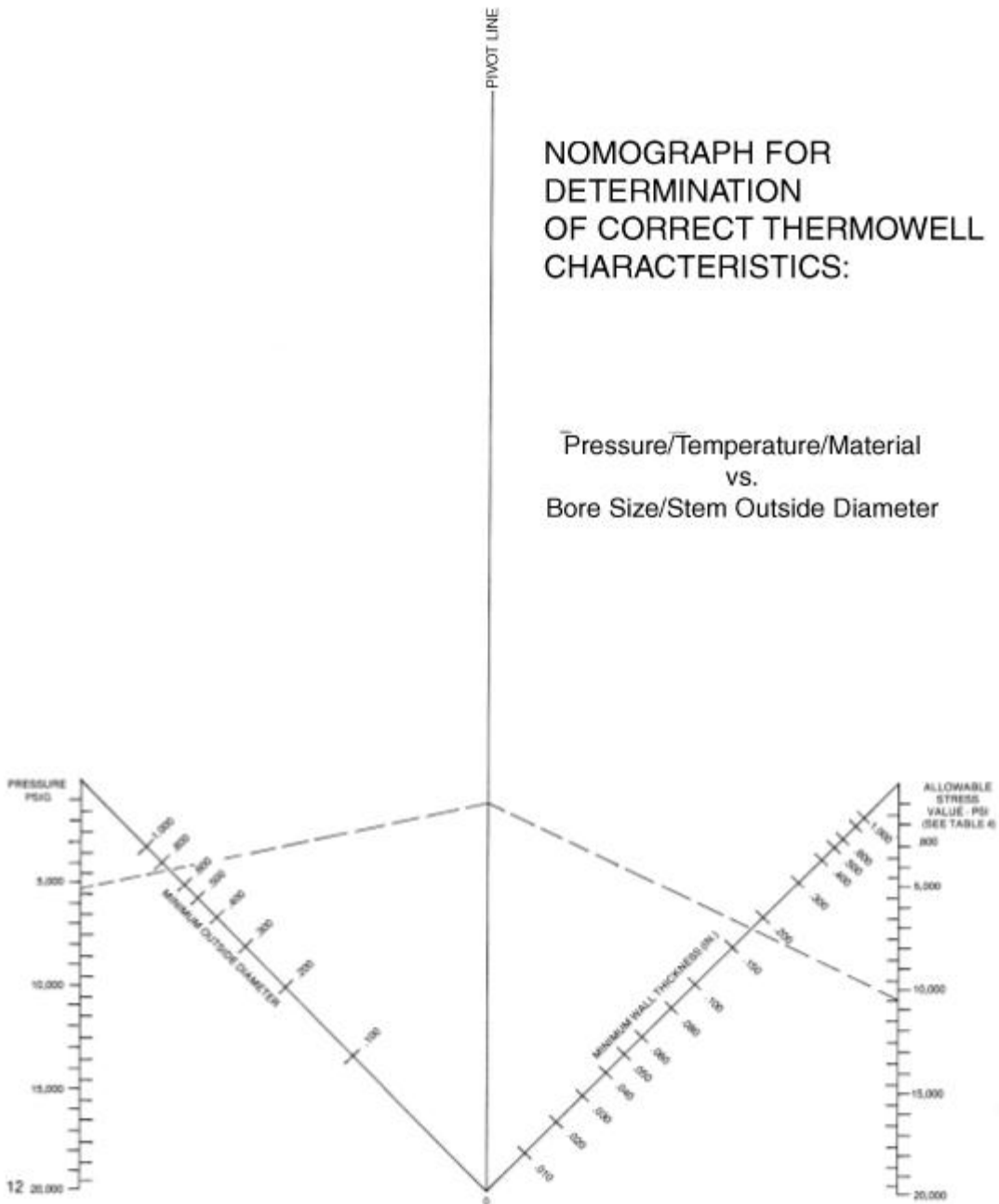
Maximum Fluid Velocity Feet per Second									
Well Type	Material	Insertion Length -"U"							
		2 1/2	4 1/2	7 1/2	10 1/2	13 1/2	16 1/2	19 1/2	22 1/2
2A & 4A and 2B & 4B	Brass	290 (145)	150 (80)	54.1 (48)	27.6	16.7	11.1	8.0	6.0
	Carbon Steel	326 (260)	192 (144)	69.5	35.4	20.5	14.3	10.3	7.7
	304 & 316 SS	349 (360)	199	71.9	36.6	21.2	14.8	10.7	8.0
	Monel	316 (320)	189 (178)	68.1	34.8	20.8	14.0	10.0	7.5

Maximum Fluid Velocity Feet per Second									
Well Type	Material	Insertion Length -"U"							
		2 1/2	4 1/2	7 1/2	10 1/2	13 1/2	16 1/2	19 1/2	22 1/2
4C and 4D	Brass	321 (150)	129 (83.5)	46.8	23.6	14.5	9.6	6.9	5.1
	Carbon Steel	410 (270)	249 (150)	90.3	45.6	27.8	18.5	13.2	9.8
	304 & 316 SS	483 (350)	272 (208)	97.3	49.7	30.4	20.3	14.5	10.7
	Monel	396 (300)	214 (167)	77.5	39.2	23.8	16.0	10.3	7.7

Maximum Fluid Velocity Feet per Second									
Well Type	Material	Insertion Length -"U"							
		2 1/2	4 1/2	7 1/2	10 1/2	13 1/2	16 1/2	19 1/2	22 1/2
2C and 2D	Brass	319 (148)	141 (82)	51.0	25.0	15.6	10.4	7.0	5.3
	Carbon Steel	358 (264)	234 (146)	84.5	43.0	26.0	17.4	12.0	9.0
	304 & 316 SS	390 (355)	248 (203)	89.0	45.0	27.5	18.0	13.2	9.9
	Monel	347 (315)	209 (165)	75.0	38.0	22.0	15.0	10.0	7.6

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Nomograph



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The Nomograph and Table 4 below may be applied in calculating wall thickness. The following example demonstrates the use of the nomograph in a typical problem situation.

Problem: To find maximum operating pressure of a thermowell, 304 stainless steel material, with a .385 inch bore and .750 minimum outside diameter whose maximum operating temperature will be 700°F.

Solution: Maximum allowable stress (Table 4) 10,500 PSI. Wall thickness (Min.) = .182.

A) Align 10,500 on right scale with .182 on wall thickness scale and mark intersection on pivot line.

B) Align pivot point intersection with correct outside diameter.

C) Read maximum pressure on left scale (5100 PSIG).

Table 4 - Allowable Stress Values (PSI)¹

Material	Temperature °F						
	0	300	500	700	900	1100	1300
Aluminum (1100)	2,350	1,850	-	-	-	-	-
Aluminum (6061-T6)	6,000	5,000	-	-	-	-	-
Nickel	10,000	10,000	9,500	-	-	-	-
Steel ²	11,250	11,000	10,250	9,000	7,750	6,500	-
304 S. Stl.	18,750	13,750	11,400	10,500	10,000	8,250	3,400
316 S. Stl.	18,750	16,400	15,500	15,100	11,650	8,500	3,500
310 S. Stl .	18,750	14,600	12,600	11,300	10,300	9,450	4,000
321 - 347 S. Stl.	18,750	15,300	13,500	12,200	11,300	9,100	2,200
410 S. Stl .	15,000	13,800	12,850	12,050	9,650	2,900	-
446 S. Stl.	17,500	16,100	15,000	-	-	-	-
A182-F11	16,150	16,150	16,150	16,150	13,100	4,000	-
A182-F22	17,500	17,500	17,500	17,500	14,000	4,200	-
Copper	6,000	5,000	-	-	-	-	-
Admiralty Brass	10,000	10,000	-	-	-	-	-
Monel 400	16,600	13,600	13,100	13,100	8,000	-	-
Inconel 600	20,000	18,800	18,500	18,500	16,000	3,000	-
Incoloy 8003	15,600	12,100	10,400	9,600	9,100	8,800	4,150
Hastelloy B ⁴	25,000	24,750	21,450	-	-	-	-
Hastelloy X ⁵	23,350	18,850	16,000	15,500	15,500	15,500	9,500

1. Values from ASME Boiler and Pressure Vessel Code Section VIII - Unfired Pressure Vessels, 1965.
2. ASME Spec. Min. Tensile = 45,000 PSI
3. ASME Code (See Note 1), Case 1325 (special ruling)
4. ASME Code (See Note 1), Case 1323 (special ruling)
5. ASME Code (See Note 1), Case 1321 (special ruling)

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Pressure - Temperature Ratings

Pressure-Temperature Rating* lbs. per sq. Inch

Well Type	Material	Temperature °F						
		70°	200°	400°	600°	800°	1000°	1200°
Series a (All)	Brass	5000	4200	1000	---	---	---	---
Series B (All)	Carbon Steel	5200	5000	4800	4600	3500	1500	---
Series S (All)	304SS	7000	6200	5600	5400	5200	4500	1650
2C, 4C	316SS	7000	7000	6400	6200	6100	5100	2500
2D, 4D	Monel	6500	6000	5400	5300	5200	1500	---

*Values based on allowable stress levels published in the 1956 edition of the a .S.M.E. Boiler Code, Section VIII.

Pressure-Temperature Rating* lbs. per sq. Inch

Well Type	Material	Temperature °F						
		70°	200°	400°	600°	800°	1000°	1200°
1C, 3C, 1D, 3D	Brass	5300	4750	1100	---	---	---	---
	Carbon Steel	5950	5750	5450	5250	4000	1750	---
	304SS	7800	7050	6400	6150	6000	5190	1875
	316SS	7800	7800	7250	7100	6950	5800	2720
	Monel	7450	6850	6150	6100	5940	1750	---

*Values based on allowable stress levels published in the 1956 edition of the a .S.M.E. Boiler Code, Section VIII.

Pressure-Temperature Rating* lbs. per sq. Inch

Well Type	Material	Temperature °F						
		70°	200°	400°	600°	800°	1000°	1200°
Series F (All)	Carbon Steel	-----	Up	-----	To	2500#		
Series G	304SS	-----	Up	-----	To	-----	2500#	
(All)	316SS	-----	Up	-----	To	-----	-----	2500#
Series V (All)	Monel	-----	Up	-----	To	2500#		

*Values based on allowable stress levels published in the 1956 edition of the a .S.M.E. Boiler Code, Section VIII and recommendations of ASA B 16, 5-1957.

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Design Procedure***

The purpose of this design procedure is to enable the user to determine if a well selected for thermometry considerations is strong enough to withstand specific application conditions of temperature, pressure, velocity, and vibration. Well failures are caused by forces imposed by static pressure, steady state flow, and vibration. Separate evaluations of each of the above effects should be made in order to determine the limiting condition. This design procedure does not allow for effects due to corrosion or erosion.

The natural frequency of a well-designed in accordance with Fig. 1.1 and of the dimensions given in Table 1.1 is given by the following equation:

$$f_n = \frac{K_f}{L^2} \sqrt{\frac{E}{g}} \dots \dots [1]$$

where

- f_n = natural frequency of the well at use temperature, cycles per sec
- L = length of well as given in Fig. 1.1, in.
- E = modulus of elasticity of well material at use temperature, psi
- g = specific weight of well material at use temperature, lb per cu in.
- K_f = a constant obtained from Table 1.2

The wake or Strouhal frequency is given by:

$$f_w = \frac{V}{B} 2.64 \dots \dots [2]$$

- where f_w = wake frequency, cycles per sec
- V = fluid velocity, fps
- B = diameter at tip (Fig. 1.1), in.

The ratio of wake to natural frequency (f_w/f_n) shall not exceed 0.8, and when this condition is met, the Magnification Factor, relationship of dynamic to static amplitude is given by:

$$F_M = \frac{(f_w/f_n)^2}{1 - (f_w/f_n)^2} = \frac{r^2}{1 - r^2} \dots \dots [3]$$

For $r \leq 0.8$

where

- F_M = magnification factor, dimensionless
- r = frequency ratio, (f_w/f_n), dimensionless

Stress Analysis

The maximum pressure that a thermometer well can withstand for a given material at a given temperature shall be computed from the following:

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$$P = K_1 S \dots\dots\dots [4]$$

where

- P = maximum allowable static gage pressure, psi
- S = allowable stress for material at operating temperature as given in the ASME Boiler and Pressure Vessel or Piping Codes, psi
- K₁ = a stress constant obtained from Table 1.3.

The maximum length that a thermometer well can be made for a given service is dependent upon both vibratory and steady state stress. The necessity for keeping the frequency ratio at 0.8 or less imposes one limitation on maximum length. The other limitation is one of steady state stress considerations, as given by the following equation:

$$L_{max} = \frac{K_2}{V} \sqrt{\frac{v(S - K_3 P_0)}{1 + FM}} \dots\dots [5]$$

where

- L_{max} = maximum value of L (as shown in Fig. 1.1) for a given service, in.
- V = fluid velocity, fps
- v = specific volume of the fluid, cu ft per lb.
- S = allowable stress for material at operating temperature as given in the ASME Boiler and Pressure vessel or Piping Codes, psi
- P₀ = static operating gage pressure, psi
- FM = magnification factor as computed from Eq [3]
- K₂, K₃ = stress constants obtained from Table 1.3

Table 1.1 well dimensions, in Inches

Dimension	Nominal Size of Sensing Element
	(1/4)
A (minimum)	13/16
B (minimum)	5/8
d (minimum)	0.254
d (maximum)	0.262

**Fig. 1.1 power test code
 Thermometer wells**

Well Length L, in.	K _f	Stress Constant	
2-1/2	2.06	K ₁	0.412
4-1/2	2.07	K ₂	37.5
7-1/2	2.08	K ₃	0.116
10-1/2	2.09		

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16	2.09		
24	2.09		
Table 1.2 values of K_f		Table 1.3 values of stress constants	

*** Power Test Code Thermometer Wells, J. W. Murdock, Journal of Engineering for Power, Trans. ASME, vol. 81, 1959

Thermowell Material Guide

Thermowell materials for various average applications are listed in the following table. The list has been carefully prepared and takes into consideration such factors as contamination, electrolysis, catalytic reaction and other variables. Standard materials are recommended wherever possible. Service may vary, however, in industrial use as a result of temperature, pressure, concentration and impurities in the corrosive medium.

While the recommendations cannot guarantee service, they will serve as an effective guide. **Thermo Sensors Corporation** can provide consultation for special applications upon request.

Industry	Application	Conditions	Material
Cement and Lime	Kiln hot end (clinker) cool end (flue) Clinker cooler Exit Flue	to 2600 °F 600-2000 °F to 1200 °F	C30 Ceramic 28% Chrome Iron - Inconel 601 Cerampak - 28% Chrome Iron - Inconel 601 Inconel 601, 28% Chrome Iron - Silicon Carbide, Silicon Nitride
Ceramic	Dryers Kilns-Brick Vitreous enameling Grinding wheels Abrasive grits Porcelain pottery	1800-2200 °F 1600-2000 °F to 500 °F to 2300 °F 2000-2400 °F	Carbon Steel - Silicon Carbide - Silicon Nitride - Wrought Iron C30 Ceramic - Inconel 600 - Silicon Carbide - Silicon Nitride Inconel 600 - Firebrick - 28 % Chrome Iron - Silicon Carbide - Silicon Nitride Wrought Iron C30 Ceramic C30 Ceramic
Chemical	Acetate Solvents Acetic Acid Acetic Anhydride Acetone Acetone Acetylene Alcohol Ethyl Alcohol Methyl Aluminum	Crude or Pure 10%-70 °F 50%-70 °F 50%-212 °F 99%-70 °F 99%-212 °F 212 °F 70 °F 212 °F 70 °F 212 °F Molten	Monel - Nickel 304 Stainless Steel 304 Stainless Steel 316 Stainless Steel - Monel Monel Monel Monel - Nickel 304 Stainless Steel 304 Stainless Steel - Monel - Nickel 304 Stainless Steel 304 Stainless Steel 304 Stainless Steel 304 Stainless Steel Cast Iron

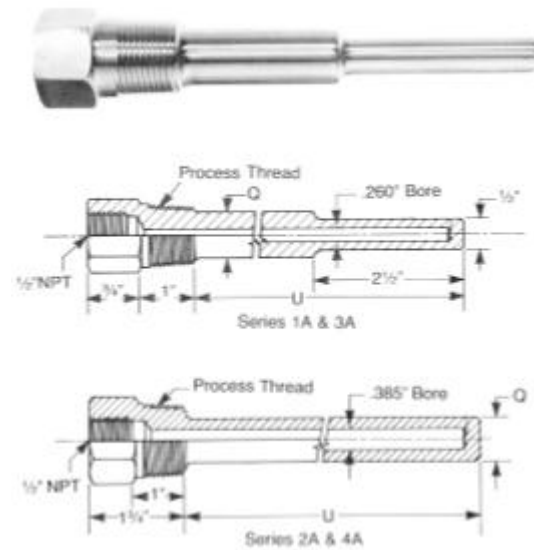
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Aluminum Acetate	Saturated	304 Stainless Steel
Aluminum Chloride		Hastelloy B
Aluminum Sulphate	10%-70 °F	304 Stainless Steel
	Saturated 70 °F	304 Stainless Steel
	10%-212 °F	316 Stainless Steel
	Saturated 212 °F	316 Stainless Steel
Ammonia	All concentrations 70 °F	304 Stainless Steel - 316 Stainless Steel
Ammonia Hydroxide		2024-T4 Aluminum - 304 Stainless Steel - 316 Stainless Steel
Ammonia Liquors		2024-T4 Aluminum - 304 Stainless Steel - 316 Stainless Steel
Ammonia Phosphate (Dibasic)		Monel
(Monobasic)		Phosphor Bronze
(Tribasic)		Monel
Ammonium Chloride	All Concentrations 212 °F	316 Stainless Steel
Ammonium Nitrate	All Concentrations 70 °F	304 Stainless Steel
		304 Stainless Steel
Ammonium Sulphate	All Concentrations 212 °F	304 Stainless Steel
		316 Stainless Steel
	5%-70 °F	316 Stainless Steel
Amylacetate	10%-212 °F	Monel - 304 Stainless Steel
Aniline	Saturated 212 °F	304 Stainless Steel - Monel
Asphalt		C1018 Steel - 304 Stainless Steel - Monel - Nickel
Barium Carbonate	All Concentrations 70 °F	304 Stainless Steel
Barium Chloride		Monel
	70 °F	Monel - Hastelloy C
Barium Hydroxide	5%-70 °F	316 Stainless Steel - Hastelloy C
Benzaldehyde	Saturated 70 °F	C1018 Steel
Benzene	Aqueous - Hot	C1018 Steel
Benzine		304 Stainless Steel
Benzol		C1018 Steel - 2024-T4 Aluminum - Monel - Inconel 600
Boracic Acid	70 °F	304 Stainless Steel
Brines		304 Stainless Steel
Bromine	Hot	Monel
	5% Hot or Cold	Tantalum Sleeved
Butadiene		Monel
Butane	70 °F	Brass - 304 Stainless Steel
Buthlacetate	Dry 125 °F	304 Stainless Steel
Butyl Alcohol		Monel
Butylenes	70°F	Copper - 304 Stainless Steel
		C1018 Steel - Phosphor Bronze

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Threaded Thermowells - Straight/Stepped

Series A: Threaded Straight Stem Thermowells



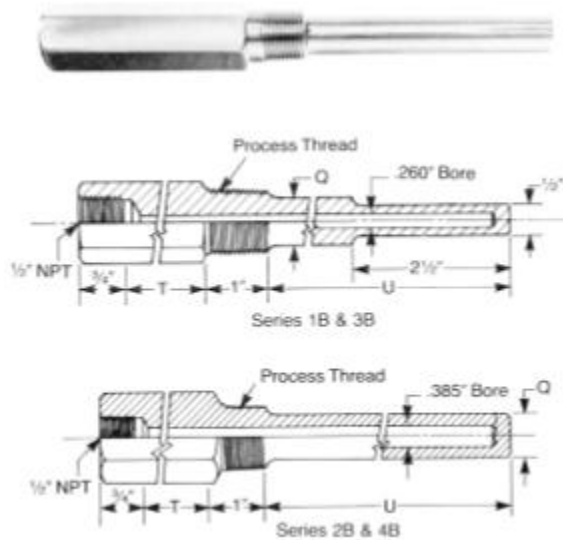
Process Thread	Bore	Q	Ordering Code		
			Type	Material	"U"
1/2" NPT	.260	5/8"	1/2A	Select Material Code from Here	Specify in Inches ----- Standard Lengths: 2 1/2", 4 1/2", 7 1/2", 10 1/2", 13 1/2", 16 1/2", 22 1/2"
3/4" NPT	.260	3/4"	1A		
	.385	49/64"	2A		
1" NPT	.260	7/8"	3A		
	.385	49/64"	4A		

How to Order:

Example: 2A36-10 1/2
 Process Thread = 3/4" NPT
 Bore = .385"
 Material = 316 Stainless Steel
 "U" = 10 1/2"

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Series B: Threaded Straight Stem Lagging Thermowells



Process Thread	Bore	Q	Ordering Code		
			Type	Material	"T" "U"
1/2" NPT	.260	5/8"	1/2 B	Select Material Code from Here	Standard "T" & "U" Dimensions: ----- Specify in Inches "T" "U" 2" 2 1/2" 3" 4 1/2" 3" 7 1/2" 3" 10 1/2" 3" 13 1/2" 3" 19 1/2"
3/4" NPT	.260	3/4"	1B		
	.385	49/64"	2B		
1" NPT	.260	7/8"	3B		
	.385	49/64"	4B		

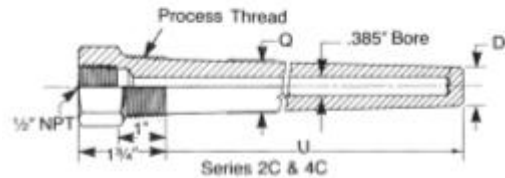
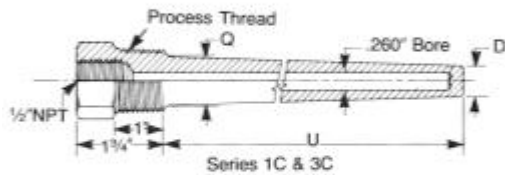
How to Order:

Example: 2B34-T3-4 1/2
 Process Thread = 3/4" NPT
 Bore = .385"
 Material = 304 Stainless Steel
 "T" = 3"
 "U" = 4 1/2"

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Threaded Thermowells - Tapered

Series C: Threaded Tapered Stem Thermowells



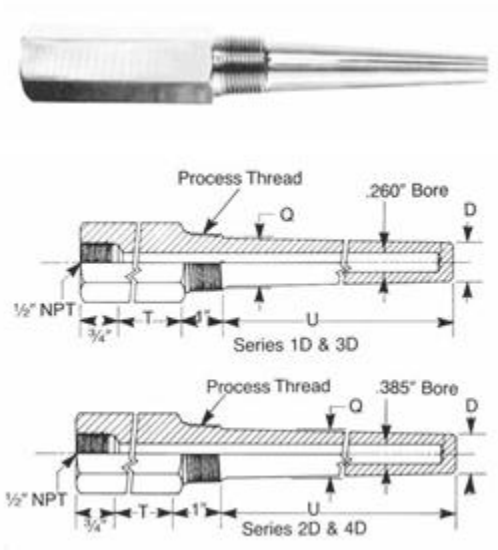
Process Thread	Bore	Q	D	Ordering Code		
				Type	Material	"U"
1/2" NPT	.260	11/16"	5/8"	1/2 C	Select Material Code from Here	Specify in Inches ----- Standard Lengths: 2 1/2", 4 1/2", 7 1/2", 10 1/2", 13 1/2", 16 1/2", 22 1/2"
	-	-	-	-		
3/4" NPT	.260	7/8"	5/8"	1C		
	.385	7/8"	49/64"	2C		
1" NPT	.260	1 1/16"	5/8"	3C		
	.385	1 1/16"	49/64"	4C		

How to Order:

Example: 3C60-7 1/2
 Process Thread = 1" NPT
 Bore = .260"
 "Q" = 1 1/16"
 "D" = 5/8"
 Material = Inconel 600
 "U" = 7 1/2"

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Series D: Threaded Tapered Stem Lagging Thermowells



Process Thread	Bore	Q	D	Ordering Code		
				Type	Material	"T" "U"
1/2" NPT	.260	11/16"	5/8"	1/2 D	Select Material Code from Here	Standard "T" & "U" Dimensions: ----- Specify in Inches "T" "U" 2" 2 1/2" 3" 4 1/2" 3" 7 1/2" 3" 10 1/2" 3" 13 1/2" 3" 19 1/2"
	-	-	-	-		
3/4" NPT	.260	7/8"	5/8"	1D		
	.385	7/8"	49/64"	2D		
1" NPT	.260	1 1/16"	5/8"	3D		
	.385	1 1/16"	49/64"	4D		

How to Order:

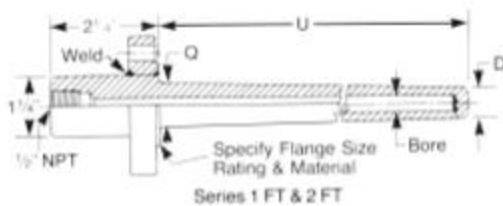
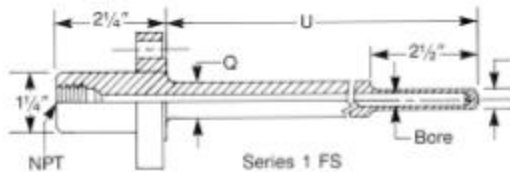
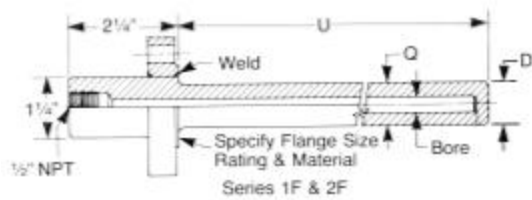
Example: 4D40-T2-2 1/2
 Process Thread = 1" NPT
 Bore = .385"
 "Q" = 1 1/16"
 "D" = 49/64"
 Material = 410 Stainless Steel
 "T" = 2"
 "U" = 2 1/2"

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Flanged Thermowells and Sleeves for Series 1F and 2F

Series F: Flanged Thermowells

- Type F - Straight Stem
- Type FT - Tapered Stem
- Type FS - Stepped Stem



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Bore	Q	D	Ordering Code			
			Style	Material	"U"	Flange
.260"	3/4"	3/4"	1F	Select Material Code from Here	Specify in Inches ----- Standard Lengths: 2", 4", 7", 10", 13", 16", 22"	**Series 1 ft & 2 ft Wells With 1" Flange Will Have Taper as Noted. ----- Specify Flange Size, Rating, Facing, Material Only if Different Material than Stem.
	3/4"	1/2"	1FS			
.260"	1 1/16"	5/8"	1FT			
.385"	7/8"	7/8"	2F			
.385"	1 1/16"	49/64	2FT			

How to Order:

Example: 1F36-10-1 1/2" x 300 RF

Bore = .260"

"Q" = 3/4"

Material = 316 Stainless Steel Well

"U" = 10"

1 1/2" x 300#RF T316 Flange

Lagging: The 2.25" Head Dimension shown is standard. If additional length (LAG) is needed within the 2.25" dimension, specify by placing a "-T" followed by additional length required (in inches) between the material code and "U" dimension code.

Example: 2FT36-T3-10-1x150 RF

Note: The "T" dimension + 2 1/4" will be the length from the bottom of the flange to the open end of the well.

Sleeves for Series 1F and 2F Thermowells



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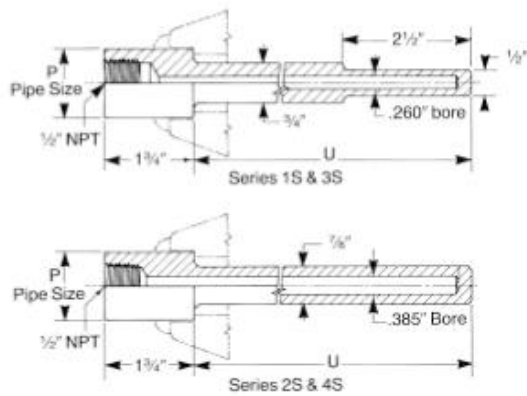
Sleeve Material	Ordering Code
Tantalum	TS
Zirconium	ZS
Specify	(Other)

How To Order:

Place Ordering Code as a Suffix Following the Flanged Well Part Number.

Example: 1F36-10-1 1/2"x 300 RF - TS Well as above with Tantalum Sleeve.

Socket Weld Thermowells



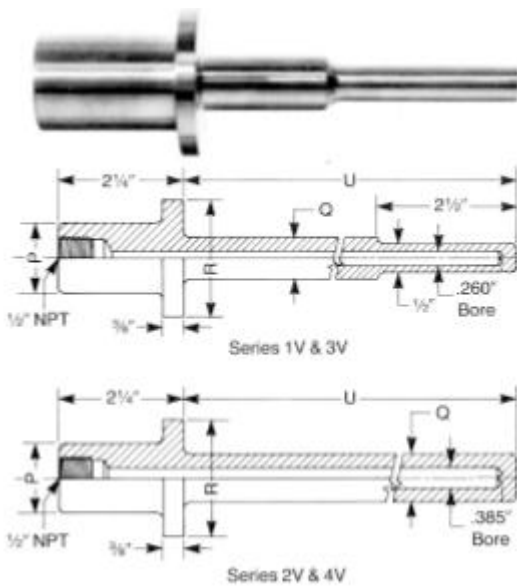
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Pipe Size "P"	Bore	Q	Ordering Code		
			Type	Material	"U"
3/4" Nominal (1.050" Dia.)	.260	3/4"	1S	Select Material Code from Here	Specify in Inches ----- Standard Lengths: 2 1/2", 4 1/2", 7 1/2", 10 1/2", 13 1/2", 16 1/2", 22 1/2"
	.385	7/8"	2S		
1" Nominal (1.315" Dia.)	.260	3/4"	3S		
	.385	7/8"	4S		

How to Order:

Example: 1S96-10 1/2
 "P" Dim. = 3/4" Nom. Pipe
 Bore = .260"
 Material = Monel
 "U" = 10 1/2"

Van Stone Thermowells



Backing flanges for van stone wells are available.
 Specify as separate item giving flange size, rating and material.

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Pipe Size "P"	Bore	Q	R	Ordering Code		
				Type	Material	"U"
1" Nominal (1.315" Dia.)	.260	3/4"	2"	1V	Select Material Code from Here	Specify in Inches ----- Standard Lengths: 2", 4", 7", 10", 13", 16", 22"
	.385	7/8"	2"	2V		
1 1/2" Nominal (1.900" Dia.)	.260	3/4"	2 7/8"	3V		
	.385	7/8"	2 7/8"	4V		

How to Order:

Example: 1V20-13
 "P" Dim. = 1" Nom. Pipe
 Bore = .260"
 "Q" = 3/4"
 "R" = 2"
 Material - Carpenter 20
 "U" = 13"

Limited Space / Weld-In Thermowells

Limited Space Thermowells

Limited space thermometer wells for 1/4" diameter stems with 2 1/2" stem lengths.

Application

Bimetal thermometers, thermocouples and RTD's with 1/4" diameter stems and 2 1/2" length.

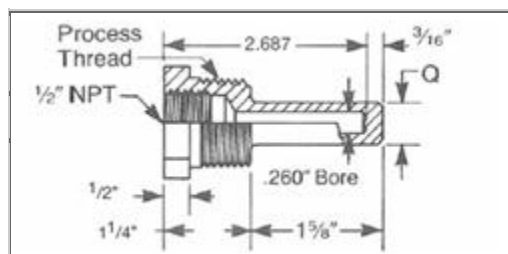
Thread Connections

Standard wells have either a 3/4" or 1" NPT process connection and a 1/2" NPT internal thread. Other thread sizes are available.

Material

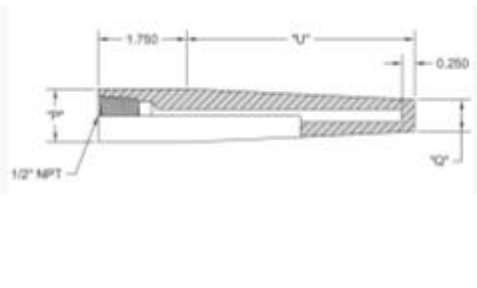
Thermometer wells are available in a wide selection of materials. [Click here](#) for material codes.

Series 1H & 2H - Limited Space

	Process Thread	Q	Stem Length	Insertion Length	Ordering Code
		3/4" NPT	1/2"	2 11/16"	1 5/8"
	1" NPT	1/2"	2 11/16"	1 5/8"	3H (Material)

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Weld-In Thermowells

	Pipe Size "P"	Bore	Actual Diameter "P"	Q	Ordering Code		"U"
					Type	Material	
3/4" Nominal		.260	1.05	.625"	1W	Select Material Code from Page 19	Specify in Inches
					2W		
1" Nominal		.260	1.315	.625"	3W		
					4W		

How to Order:

- Determine process thread required and specify the corresponding part number listed in the "ordering code" column.
- Replace "(Mat'l.)" with desired material code. Material codes are [here](#).

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Plug and Chain Options



A Plug and Chain is available as an option for all thermowells. It is used to keep the bore clean when the thermowell is not in use. Used to keep "test wells" bore clean when not in use.

Material	Order Code
Brass	-B
Stainless Steel	-S

How to Order:

Determine the part number on the basic thermowell selected and add the desired order code shown in the table as a suffix.

Example: 3A36 - 10.5 - B

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Thermowell Material Ordering Codes

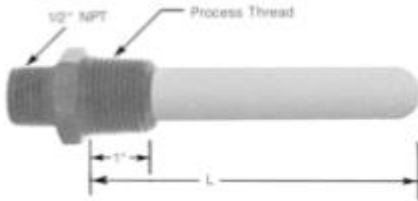
Order Code	Material
34	304 Stainless Steel
34L	304L Stainless Steel
39	309 Stainless Steel
30	310 Stainless Steel
36	316 Stainless Steel
36L	316L Stainless Steel
31	321 Stainless Steel
37	347 Stainless Steel
40	410 Stainless Steel
46	446 Stainless Steel
60	Inconel 600
61	Inconel 601
80	Incoloy 800
81	Incoloy 801
24	Aluminum (2024-T4)
23	Brass
18	Carbon Steel (C1018)
20	Carpenter 20
11	Chrome-Moly A182-F11
22	Chrome-Moly A182-F22
86	Cast Iron - Ceramic Coated
87	Cast Iron
98	Copper
92	Hastelloy B
94	Hastelloy C
96	Monel
93	Nickel
21	Phosphor Bronze
99	Tantalum
25	Teflon
26	Titanium
Specify by name	Materials not listed

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Ceramic Protecting Tubes - Primary/Secondary

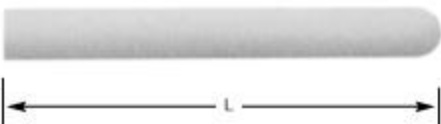
Ceramic Protecting Tubes - Primary

With Double Threaded Bushing



Tube Size* I.D. x O.D.	Process* Thread	Part Number	
		C30 Ceramic	C98 Ceramic
1/4" x 3/8"	3/4" NPT C.S.	C30 140F-(L)	C98 140F-(L)
3/8" x 1/2"	3/4" NPT C.S.	C30 380F-(L)	C98 380F-(L)
7/16" x 11/16"	3/4" NPT C.S.	C30 716F-(L)	C98 716F-(L)
9/16" x 3/4"	3/4" NPT C.S.	C30 916F-(L)	C98 916F-(L)
5/8" x 7/8"	1" NPT C.S.	C30 580F-(L)	C98 580F-(L)
3/4" x 1"	1 1/4" NPT C.S.	C30 340F-(L)	C98 340F-(L)

Without Fitting



Tube Size* I.D. x O.D.	Part Number	
	C30 Ceramic	C98 Ceramic
1/4" x 3/8"	C30 140-(L)	C98 140-(L)
3/8" x 1/2"	C30 380-(L)	C98 380-(L)
7/16" x 11/16"	C30 716-(L)	C98 716-(L)
9/16" x 3/4"	C30 916-(L)	C98 916-(L)
5/8" x 7/8"	C30 580-(L)	C98 580-(L)
3/4" x 1"	C30 340-(L)	C98 340-(L)

A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972



Tube Size* I.D. x O.D.	NPT**	Style 1		Style 2		Style 3	
		C30 Ceramic	C98 Ceramic	C30 Ceramic	C98 Ceramic	C30 Ceramic	C98 Ceramic
1/4" x 3/8"	3/4"	C30T140-(L)	C98T140-(L)	C30N140-(L)-(X)	C98N140-(L)-(X)	C30D140-(L)-(X)	C98D140-(L)-(X)
C98D140-(L)-(X)	3/4"	C30T380-(L)	C98T380-(L)	C30N380-(L)-(X)	C98N380-(L)-(X)	C30D380-(L)-(X)	C98D380-(L)-(X)
7/16" x 11/16"	3/4"	C30T716-(L)	C98T716-(L)	C30N716-(L)-(X)	C98N716-(L)-(X)	C30D716-(L)-(X)	C98D716-(L)-(X)
9/16" x 3/4"	3/4"	C30T916-(L)	C98T916-(L)	C30N916-(L)-(X)	C98N916-(L)-(X)	C30D916-(L)-(X)	C98D916-(L)-(X)
5/8" x 7/8"	1"	C30T580-(L)	C98T580-(L)	C30N580-(L)-(X)	C98N580-(L)-(X)	C30D580-(L)-(X)	C98D580-(L)-(X)
3/4" x 1"	1 1/4"	C30T340-(L)	C98T340-(L)	C30N340-(L)-(X)	C98N340-(L)-(X)	C30D340-(L)-(X)	C98D340-(L)-(X)

* Other tube sizes and fittings are available on special order.
 ** Other thread sizes may be specified using the optional fitting table below.

Optional Fittings			
Process Thread	Material	Maximum Tube O.D.	Option Code
1/2" NPT	Carbon Steel	1/2" O.D.	4C
1/2" NPT	Stainless Steel	1/2" O.D.	4S
3/4" NPT	Stainless Steel	3/4" O.D.	6S
1" NPT	Carbon Steel	1" O.D.	8C
1" NPT	Stainless Steel	1" O.D.	8S
1 1/4" NPT	Carbon Steel	1 1/8" O.D.	10C
1 1/4" NPT	Stainless Steel	1 1/8" O.D.	10S
1 1/2" NPT	Carbon Steel	1 1/2" O.D.	12C
1 1/2" NPT	Stainless Steel	1 1/2" O.D.	12S

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Ceramic Protecting Tubes - Secondary



Material	I.D. x O.D.	Style	Part Number
Silicon Carbide	1" x 1 3/4"	Collar	SCT 100 WC-(L)
		No Collar	SCT 100 NC-(L)
Hardware to Connect "SCT100WC" to Head			

How to Order:

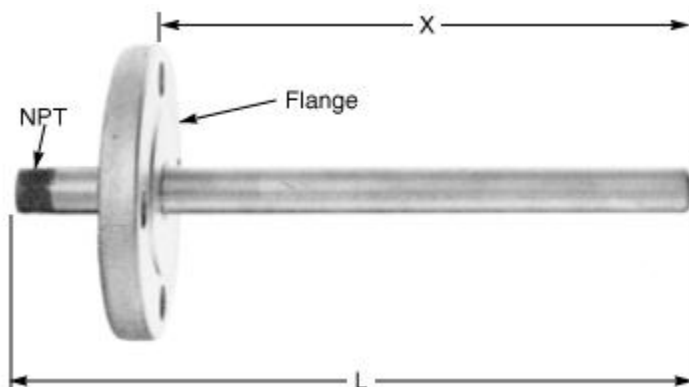
Select the tube size from the table and specify the part number shown for the desired material (C30 or C98), replacing the (L) and (X) with the required length in inches. If a fitting other than the standard thread is required, specify by adding the "option code" from the optional fitting table as a suffix to the part number.

Examples:

C98 716F-18-8S
 C30 916F-18-8C

Metal Protecting Tube with Flange / Cast Iron Protecting Tube

Metal Protecting Tube with Flange



A Leading Manufacturer of Quality Thermocouple and RTD Assemblies Since 1972

NPT	O.D. x I.D. (Nom.)**	Ordering Code				
		Series	Material	"L"	Flange	"X"
1/8"	.405" x .269"	F18	Select Material Code from Material Table	Specify in Inches	Specify Size, Rating, Facing, Material	Specify in Inches
1/4"	.540" x .364"	F14				
1/2"	.840" x .622"	F12				
3/4"	1.050" x .824"	F34				
1"	1.315" x 1.049"	F10				

How To Order:

1. Select series number.
2. Select material code from [Material Table](#) and add to series designation.
3. Specify desired "L" dimension in inches.
4. Specify desired flange by size, rating, facing and material.
5. Specify desired "X" dimension in inches.

Example:

F1036 - 48 - 1 1/2-150#RF-316s.s. - 42

Series/Mat'l "L" Flange "X"

Cast Iron Protecting Tube



Cast iron tubes are available both coated and uncoated. Coated tubes have a thin ceramic coating which resists wetting of the tube by molten metals with the advantage of longer life in molten aluminum, zinc and lead.

It is recommended that uncoated tubes be dipped frequently in ladle wash or similar material to prolong life.

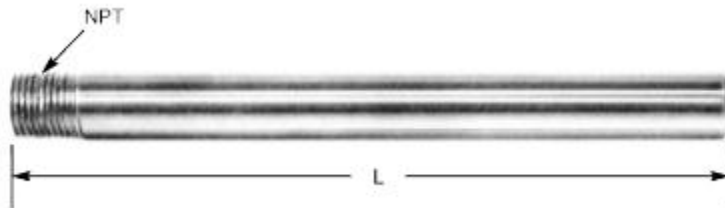
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How to Order:

Ordering Information	
Coated	8634-(L)
Uncoated	8734-(L)
Specify "L" in inches. Standard Lengths: 12", 18", 24", 30", 36", 42", 48"	

Metal Protecting Tubes/Tubes With Bushings

Metal Protecting Tube



NPT	O.D. x I.D. (Nom.)**	Ordering Code		
		Series	Material	"L"
1/8"	.405" x .269"	18	Select Material Code from Material Table	Specify in Inches
1/4"	.540" x .364"	14		
1/2"	.840" x .622"	12		
3/4"	1.050" x .824"	34		
1"	1.315" x 1.049"	10		

How to order:

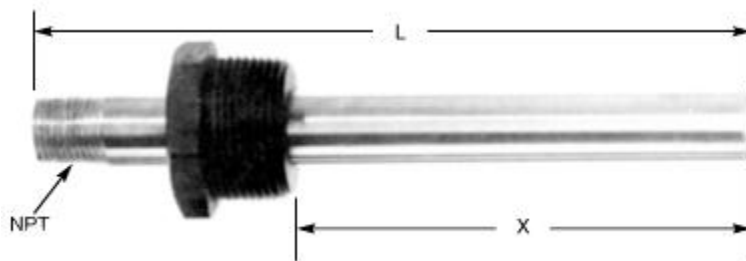
1. Select series number.
2. Select material code from [Material Table](#) and add to series.
3. Specify desired "L" dimension in inches.

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Example:

1260 - 18
 Series/Mat'l "L"

Metal Protecting Tube with Bushings



NPT	O.D. x I.D. (Nom.)**	Ordering Code				
		Series	Material	"L"	"P"	"X"
1/8"	.405" x .269"	B18	Select Material Code from Material Table	Specify in Inches	Specify D for 1/2" NPT F for 3/4" NPT H for 1" NPT K for 1 1/4" NPT M for 1 1/2" NPT	Specify in Inches
1/4"	.540" x .364"	B14				
1/2"	.840" x .622"	B12				
3/4"	1.050" x .824"	B34				
1"	1.315" x 1.049"	B10				

How to order:

1. Select series number.
2. Select material code from [Material Table](#) and add to series designation.
3. Specify desired "L" dimension in inches.
4. Select desired "P" NPT size and insert the proper letter code.
5. Specify desired "X" dimension in inches.

Example:

B1834 - 24 - K - 18
 Series/Mat'l "L" 1 1/4" NPT "X"

* Welded bushings are carbon steel unless otherwise specified.
 To specify a 304 s.s. bushing - insert "SS" between the bushing designation and the "X" dimension.
 Example: -HSS8 for a 1" NPT 304 ss bushing with X=8"

** These dimensions are for standard tubes made with schedule 40 pipes. To specify schedule 80 or 160 - insert "(80)" or "(160)" between the "Type" and "Material" selections in the ordering code table.
Example: 12(80)36-12, B112(80)34-18-H12 or F34(80)34-18-1x300RF-304-12 for schedule 80.

Ceramic Protecting Tube Characteristics

Thermo Sensors Corporation ceramic tubes are high quality, fine grained, * non-porous tubes. They are impervious to gases at temperatures near their melting point. Materials available range from mullite (C3 Ceramic) to high purity alumina (C98 Ceramic). Material selection depends upon operating conditions and performance requirements such as temperature, atmosphere, sensitivity to contamination and others.

C30 Ceramic (Mullite)

Maximum operating temperature of 2900° F (1600° C). Impervious to air to 3000° F, to dry hydrogen and carbon monoxide to 2550° F. Low rate of thermal expansion ($2.8 \times 10^{-6}/^{\circ}F$) enhances thermal shock resistance. Resistance to acid slag is good. Basic slag is fair. Recommended for J, K, N, and E type thermocouples.

C98 Ceramic (99.8% alumina)

Maximum operating temperature 3450° F (1900° C) in both oxidizing and reducing atmospheres. Inert to hydrogen, carbon, platinum, rhodium and refractory metals under most conditions. High thermal conductivity for fast temperature response. Being more dense than C30, affords longer life in acids, alkalis, molten metals, molten salts and slags. Impervious to most industrial furnace gases even at high temperatures. Recommended for R, S and B type thermocouples.

MCT Metal - Ceramic (LT-1)

Maximum operating temperature of 2800° F (1538° C). This tube is a combination of aluminum oxide and chromium. Stable in oxidizing atmospheres to 2200° F. Thermal and mechanical shock characteristics are better than pure ceramic tubes, but an extreme temperature span requires a slow insertion time to allow tube to preheat. Sulphur dioxide, sulphur trioxide and concentrated sulphuric acids have little effect on MCT tubes. Since copper, zinc, lead, brass and ferrous alloys do not "wet" MCT tubes their life is longer in such melts, abrasive resistance even at 2200° F. Do not use in acid or carbide slags or molten aluminum.

SCT (Silicon Carbide)

Maximum operating temperature of 3000° F (1649° C). Suggested as primary tube in molten aluminum. Porous* and affords protection from flame cutting. a secondary tube to provide thermal and mechanical shock resistance in assemblies using C30 and C98 as a primary.