# Texas Thermowell

## Thermowells, Protection Tubes, Sample Probes

Catalog 4240 June 2008

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# Introduction

Thermowells are recommended for temperature instruments in process systems where pressure, velocity, or viscous, abrasive, and corrosive materials are present individually or in combination. A properly selected thermowell will protect the temperature instrument from damage resulting from these process variables. Additionally, a thermowell enables removal of the temperature instrument for replacement, repair, or testing without affecting the process system.

Parker Texas Thermowell specializes in the design and manufacture of all types of thermowells. The 2100 Series thermowell designs shown in this guide are styles that are popular throughout industry. Special designs, as well as modifications of our standard offerings, are also available.

Parker Texas Thermowell is dedicated to unsurpassed quality, on-time delivery, and competitive pricing. This commitment has been recognized by the International Standards Organization (ISO) – our ISO 9001:2000 certification is additional assurance to our customers that their buying decisions can be made every day with a higher level of supplier confidence, and affirms our ongoing commitment to our quality policy –

> "Parker Texas Thermowell will deliver products, services and information that meet or exceed customer requirements and expectations every time."

This product guide is intended to provide technical data to deal with most applications. For severe applications not adequately covered here, please contact the factory for assistance.

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**⚠ WARNING**

FAILURE, IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

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# 2100 Series – Thermowells

## Specifications

### Materials

Parker Texas Thermowell thermowells are available in virtually any material to fit your application. Contact the factory regarding availability of materials not listed in the “Ordering Information” guide on pages 4 and 5.

### Strength

The strength of a thermowell depends on several parameters that relate thermowell construction to the installation environment. For most industrial applications, standard Parker Texas Thermowell thermowells provide the necessary strength if the material, style, and length are correctly specified for the application parameters: fluid type, temperature, pressure, and fluid velocity. It is important to note that most thermowell failures are caused by vibration that is induced by fluid flow.

In addition to providing this selection guide, Parker Texas Thermowell offers assistance in correctly selecting thermowells, given the application parameters. This service is available for a nominal charge. Contact the factory for more information.

### Construction

All 2100 Series thermowell bodies are machined from solid bar stock. Flange mounts are welded to the thermowell body. The serial number and material are etched on each thermowell. Additional tagging for specific customer requirements is available.

## Manufacturing Standards

### Bar Stock

Mill Standard +0.000" to -1/32"

### Shank O.D.

±0.010"

### “U” Dimension

±0.050"

### Overall Length

±0.050"

### Tip Thickness

1/4" ±0.050" (unless otherwise specified)

### Shank Surface Finish

Polished to 16 RMS

### Bore

±0.003"



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## Thermowell Terminology

**Process Connection:** External means to connect thermowell to process system. Wells can be threaded, bolted (to matching flange), clamped, or welded in place.

**Instrument Connection**: Internal threads to connect temperature instrument to thermowell.

**"U" Dimension**: Length of thermowell immersed into process system. Measured from the base of the process connection to the end tip of the well.

**"T" Dimension**: Also called "lag length" or "lagging extension." Extends length between the instrument and process connections to accommodate vessel or piping insulation.

**"A" Dimension**: Instrument insertion length into thermowell. Equal to bore length.

**"D" Dimension**: Also called "tip diameter." Diameter of thermowell shank at the end tip of the thermowell. This dimension may vary with process connection and/or shank design.

**"Q" Dimension**: Also called "root diameter." Diameter of thermowell shank below the process connection. This dimension may vary with process connection and/or shank design.

**Bore Diameter**: Dimension of internal bore to match the diameter of the instrument inserted into the thermowell.

**Stepped Shank**: Also called "reduced tip." The shank O.D. is reduced over the last 2-1/2" of the "U" dimension from the standard root diameter to 1/2" O.D. The stepped shank is available with a 0.260" bore diameter only.

**Straight Shank**: Shank O.D. is the same from the root diameter ("Q" dimension) to the tip diameter ("D" dimension). The straight shank is generally used with a 0.385" or larger bore diameter, but is also available with a 0.260" bore.

**Tapered Shank**: Shank O.D. is gradually reduced from the root diameter ("Q" dimension) to the tip diameter ("D" dimension). The tapered shank is recommended for heavy duty applications characterized by high vibration, pressure, temperature, and/or velocity.

## Selection Considerations

### Immersion Length ("U" Dimension)

For best temperature measurement accuracy, the "U" dimension should be long enough to permit the entire temperature-sensitive part of the measuring instrument to project into the medium being measured.

Liquid temperature measurement: A properly designed thermowell will extend into the fluid an amount equal to the length of the temperature-sensitive zone plus one inch or greater.

Gas temperature measurement: A properly designed thermowell will extend into the fluid an amount equal to the length of the temperature-sensitive zone plus three inches or greater.

The temperature-sensitive zone for thermocouples and thermistors is short (right at the tip of the device), enabling measurement accuracy with limited immersion into the process fluid.

Bi-metal thermometers, resistance temperature detectors (RTDs), and liquid-in-glass thermometers have bulbs with temperature-sensitive zones between one and two inches long.

Filled-system thermometer bulbs may have temperature-sensitive zones from one to several inches in length.

### Bore Diameter

While Parker Texas Thermowell offers thermowells with bore diameters up to 0.718", the most common are as follows:

**0.260" bore:**
Bi-metal Thermometers (1/4" stem)
Thermocouples (1/4" sheath)
RTDs (1/4" sheath)
Liquid-in-glass Test Thermometers (unarmored)
Other elements having 0.252" maximum diameter

**0.385" bore:**
Bi-metal Thermometers (3/8" stem)
Thermocouples (8 and 14 gage)
Liquid-in-glass Test Thermometers (armored)
Other elements having 0.377" maximum diameter


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## Shank Style

Tapered shank wells provide greater stiffness for the same sensitivity. The higher strength to weight ratio gives these wells higher natural frequency than for equivalent straight shank wells, thus permitting operation at higher fluid velocities.

## Velocity Ratings

In most cases, thermowell failures are not due to the effects of pressure and temperature. The calculations necessary to provide adequate strength under given conditions are familiar enough to permit proper choice of wall thickness and material.

Less familiar are the vibrational effects to which thermowells are subjected. Fluid flowing past the well forms a turbulent wake (the Von Karman Trail), which has a definite frequency based on the diameter of the well and the velocity of the fluid. The thermowell must have sufficient stiffness so that the wake frequency will never equal the natural frequency of the thermowell itself. If the natural frequency of the well were to coincide with the wake frequency, the well would vibrate to destruction and break off.

Table 1 provides recommended maximum velocity ratings for common well length and material combinations. To reduce the complexity of presenting this information, the ratings given are based on operating temperatures of 1000°F for carbon steel, 304 SST, and 316 SST wells. Ratings for brass wells are based on 350°F service. Ratings for Monel wells are based on 900°F service. Slightly higher velocity is possible at lower temperatures.

The velocity ratings provided are extremely conservative and intended primarily as a guide. Wells are safe from vibrational destruction if the resonant frequency is well below the wake frequency, or if the fluid velocity is constantly fluctuating through the critical velocity point. Nevertheless, if the installation is not hampered by a sufficiently stiff well, it is recommended that the values given not be exceeded.

### Table 1. Maximum Fluid Velocity Ratings (ft/sec)

| Shank Style | Root Dia. "Q" Dim. | Material | Process Fluid | Immersion Length – "U" Dimension | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2-1/2" | 4-1/2" | 7-1/2" | 10-1/2" | 13-1/2" | 16-1/2" | 19-1/2" | 22-1/2" |
| Stepped | 3/4" | Brass | Liquid | 59.3 | 39.8 | 23.9 | 16.4 | 9.9 | 6.6 | 4.8 | 3.6 |
| | | | Gas | 207 | 89.1 | 32.3 | | | | | |
| | | Carbon Steel | Liquid | 106 | 71.2 | 42.7 | 22.8 | 13.8 | 9.3 | 6.7 | 4.9 |
| | | | Gas | 290 | 123 | 44.9 | | | | | |
| | | 304, 316 SST | Liquid | 148 | 99.3 | 46.4 | 23.6 | 14.3 | 9.6 | 6.9 | 5.1 |
| | | | Gas | 300 | 128 | | | | | | |
| | | Monel | Liquid | 118 | 79.8 | 40.6 | 20.7 | 12.4 | 8.3 | 6.1 | 4.5 |
| | | | Gas | 261 | 112 | | | | | | |
| | 7/8" | Brass | Liquid | 59.3 | 47.6 | 37.0 | 18.8 | 11.4 | 7.6 | 5.5 | 4.1 |
| | | | Gas | 207 | 102 | 28.0 | | | | | |
| | | Carbon Steel | Liquid | 106 | 84.3 | 51.6 | 26.2 | 15.9 | 10.6 | 7.6 | 5.7 |
| | | | Gas | 290 | 143 | 50.6 | | | | | |
| | | 304, 316 SST | Liquid | 148 | 117 | 53.5 | 27.2 | 16.5 | 11.0 | 7.9 | 5.9 |
| | | | Gas | 300 | 148 | | | | | | |
| | | Monel | Liquid | 118 | 93.3 | 46.7 | 23.7 | 14.4 | 9.5 | 6.9 | 5.1 |
| | | | Gas | 261 | 128 | | | | | | |
| Straight | Any | Brass | Liquid | 145 | 80 | 48.0 | 27.6 | 16.7 | 11.1 | 8.0 | 6.0 |
| | | | Gas | 290 | 150 | 54.1 | | | | | |
| | | Carbon Steel | Liquid | 260 | 144 | 69.5 | 35.4 | 20.5 | 14.3 | 10.3 | 7.7 |
| | | | Gas | 326 | 192 | | | | | | |
| | | 304, 316 SST | Liquid | 360 | 199 | 71.9 | 36.6 | 21.2 | 14.8 | 10.7 | 8.0 |
| | | | Gas | 349 | | | | | | | |
| | | Monel | Liquid | 316 | 178 | 68.1 | 34.8 | 20.8 | 14.0 | 10.0 | 7.5 |
| | | | Gas | 320 | 189 | | | | | | |
| Tapered | Any | Carbon Steel | Liquid | 270 | 150 | 90.3 | 45.6 | 27.8 | 18.5 | 13.2 | 9.8 |
| | | | Gas | 410 | 249 | | | | | | |
| | | 304, 316 SST | Liquid | 350 | 208 | 97.3 | 49.7 | 30.4 | 20.3 | 14.5 | 10.7 |
| | | | Gas | 483 | 272 | | | | | | |
| | | Monel | Liquid | 300 | 167 | 77.5 | 39.2 | 23.8 | 16.0 | 10.3 | 7.7 |
| | | | Gas | 396 | 214 | | | | | | |



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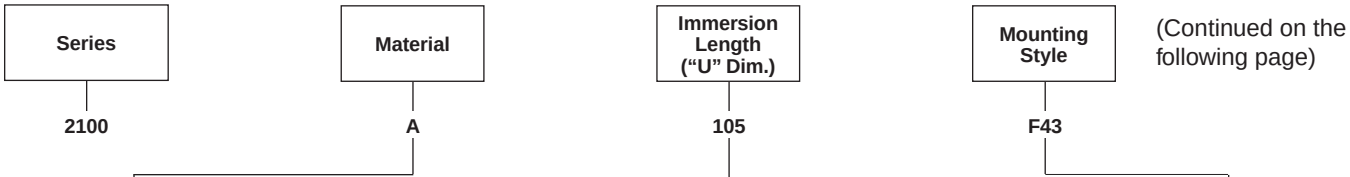
# 2100 Series – Thermowells

## Ordering Information

**Example Model Number:** 2100A105F43A030ARE-04-07-11




(Continued on the following page)

| Material | Code |
|---|---|
| 304 SST | A |
| 310 SST | C |
| 316 SST | D |
| 321 SST | F |
| Alloy 20 | G |
| Carbon Steel | H |
| Hastelloy C | J |
| Hastelloy B | K |
| Inconel 600 | M |
| Monel | P |
| Nickel 200 | T |
| Titanium | W |
| Brass | Y |
| Other (please specify) | X |

| Length ("U") (in inches) | Code |
|---|---|
| 1.625 | 016 |
| 2.0 | 020 |
| 2.5 | 025 |
| 3.0 | 030 |
| 3.5 | 035 |
| 4.0 | 040 |
| 4.5 | 045 |
| 5.0 | 050 |
| 5.5 | 055 |
| 6.0 | 060 |
| 6.5 | 065 |
| 7.0 | 070 |
| 7.5 | 075 |
| 8.0 | 080 |
| 8.5 | 085 |
| 9.0 | 090 |
| 9.5 | 095 |
| 10.0 | 100 |

| Length ("U") (in inches) | Code |
|---|---|
| 10.5 | 105 |
| 11.0 | 110 |
| 11.5 | 115 |
| 12.0 | 120 |
| 12.5 | 125 |
| 13.0 | 130 |
| 13.5 | 135 |
| 14.0 | 140 |
| 14.5 | 145 |
| 15.0 | 150 |
| 15.5 | 155 |
| 16.0 | 160 |
| 16.5 | 165 |
| 17.0 | 170 |
| 17.5 | 175 |
| 18.0 | 180 |
| 18.5 | 185 |

| Length ("U") (in inches) | Code |
|---|---|
| 19.0 | 190 |
| 19.5 | 195 |
| 20.0 | 200 |
| 20.5 | 205 |
| 21.0 | 210 |
| 21.5 | 215 |
| 22.0 | 220 |
| 22.5 | 225 |
| 23.0 | 230 |
| 24.0 | 240 |
| 25.0 | 250 |
| 26.0 | 260 |
| 27.0 | 270 |
| 28.0 | 280 |
| 29.0 | 290 |
| 30.0 | 300 |
| 31.0 | 310 |

| Length ("U") (in inches) | Code |
|---|---|
| 32.0 | 320 |
| 33.0 | 330 |
| 34.0 | 340 |
| 35.0 | 350 |
| 36.0 | 360 |
| 37.0 | 370 |
| 38.0 | 380 |
| 39.0 | 390 |
| 40.0 | 400 |
| 41.0 | 410 |
| 42.0 | 420 |
| 43.0 | 430 |
| 44.0 | 440 |
| 45.0 | 450 |
| 46.0 | 460 |
| 47.0 | 470 |
| 48.0 | 480 |

| Mounting Style | Shank Style | Process Connection | Code |
|---|---|---|---|
| Threaded | Stepped | 1/2" NPT | T21 |
| | | 3/4" NPT | T22 |
| | | 1" NPT | T23 |
| | | 1-1/2" NPT | T24 |
| | Straight | 1/2" NPT | T31 |
| | | 3/4" NPT | T32 |
| | | 1" NPT | T33 |
| | | 1-1/2" NPT | T34 |
| | Tapered | 1/2" NPT | T41 |
| | | 3/4" NPT | T42 |
| | | 1" NPT | T43 |
| | | 1-1/2" NPT | T44 |
| Flanged | Stepped | 1", Class 150 | F21 |
| | | 1-1/2", Class 150 | F22 |
| | | 2", Class 150 | F23 |
| | | 1", Class 300 | F24 |
| | | 1-1/2", Class 300 | F25 |
| | | 2", Class 300 | F26 |
| | | 1", Class 600 | F27 |
| | | 1-1/2", Class 600 | F28 |
| | | 2", Class 600 | F29 |
| | Straight | 1", Class 150 | F31 |
| | | 1-1/2", Class 150 | F32 |
| | | 2", Class 150 | F33 |
| | | 1", Class 300 | F34 |
| | | 1-1/2", Class 300 | F35 |
| | | 2", Class 300 | F36 |
| | | 1", Class 600 | F37 |
| | | 1-1/2", Class 600 | F38 |
| | | 2", Class 600 | F39 |

| Mounting Style | Shank Style | Process Connection | Code |
|---|---|---|---|
| Flanged | Tapered | 1", Class 150 | F41 |
| | | 1-1/2", Class 150 | F42 |
| | | 2", Class 150 | F43 |
| | | 1", Class 300 | F44 |
| | | 1-1/2", Class 300 | F45 |
| | | 2", Class 300 | F46 |
| | | 1", Class 600 | F47 |
| | | 1-1/2", Class 600 | F48 |
| | | 2", Class 600 | F49 |
| | | 1", Class 900/1500 | F51 |
| | | 1-1/2", Class 900/1500 | F52 |
| | | 2", Class 900/1500 | F53 |
| | | 1", Class 2500 | F54 |
| | | 1-1/2", Class 2500 | F55 |
| | | 2", Class 2500 | F56 |
| Van Stone | Stepped | 1" | V21 |
| | | 1-1/2" | V22 |
| | | 2" | V23 |
| | Straight | 1" | V31 |
| | | 1-1/2" | V32 |
| | | 2" | V33 |
| | Tapered | 1" | V41 |
| | | 1-1/2" | V42 |
| | | 2" | V43 |

| Mounting Style | Shank Style | Process Connection | Code |
|---|---|---|---|
| Socket Weld | Stepped | 3/4" pipe | K21 |
| | | 1" pipe | K22 |
| | Straight | 3/4" pipe | K31 |
| | | 1" pipe | K32 |
| | Tapered | 3/4" pipe | K41 |
| | | 1" pipe | K42 |
| | | 1-1/2" pipe | K43 |
| Weld-In | Tapered | 3/4" pipe (1.05" O.D.) | W41 |
| | | 1" pipe (1.32" O.D.) | W42 |
| | | 1-1/2" pipe (1.9" O.D.) | W43 |
| Sanitary | Stepped | 1-1/2" Tri-Clamp | S21 |
| | | 2" Tri-Clamp | S22 |
| | | 2-1/2" Tri-Clamp | S23 |
| | | 3" Tri-Clamp | S24 |
| | Straight | 1-1/2" Tri-Clamp | S31 |
| | | 2" Tri-Clamp | S32 |
| | | 2-1/2" Tri-Clamp | S33 |
| | | 3" Tri-Clamp | S34 |
| | Tapered | 1-1/2" Tri-Clamp | S41 |
| | | 2" Tri-Clamp | S42 |
| | | 2-1/2" Tri-Clamp | S43 |
| | | 3" Tri-Clamp | S44 |
| Other | (please specify) | (please specify) | XXX |



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(Continued from the previous page)

| Bore Diameter | Lag Length ("T" Dim.) | Instrument Connection | Root Diameter ("Q" Dim.) | Tip Diameter ("D" Dim.) | Options |
|---|---|---|---|---|---|
| A | 030 | A | R | E | -04<br>-07<br>-11 |

| Bore Diameter | Code |
|---|---|
| 0.260" | A |
| 0.385" | B |
| 0.437" | C |
| 0.515" | D |
| 0.656" | E |
| 0.718" | F |
| Other (please specify) | X |

| Length ("T") (in inches) | Code |
|---|---|
| 0.0 | 000 |
| 0.5 | 005 |
| 1.0 | 010 |
| 1.5 | 015 |
| 2.0 | 020 |
| 2.5 | 025 |
| 3.0 | 030 |
| 3.5 | 035 |
| 4.0 | 040 |
| 4.5 | 045 |
| 5.0 | 050 |
| 5.5 | 055 |
| 6.0 | 060 |
| 6.5 | 065 |
| 7.0 | 070 |
| 7.5 | 075 |
| 8.0 | 080 |
| 8.5 | 085 |
| 9.0 | 090 |
| 9.5 | 095 |
| Other (please specify) | XXX |

| Instrument Connection Thread | Code |
|---|---|
| 1/2" NPT | A |
| 1/2" NPSM | B |
| 1/4" NPT | C |
| 3/4" NPT | D |
| 3/4" NPSM | E |
| 1" NPT | F |
| 1" NPSM | G |
| Other (please specify) | X |

| Diameter ("Q") (in inches) | Code |
|---|---|
| 0.375 | A |
| 0.400 | B |
| 0.500 | C |
| 0.562 | D |
| 0.625 | E |
| 0.680 | F |
| 0.735 | G |
| 0.750 | H |
| 0.766 | J |
| 0.781 | K |
| 0.860 | L |
| 0.875 | M |
| 0.900 | N |
| 1.000 | P |
| 1.050 | Q |
| 1.063 | R |
| 1.125 | S |
| 1.250 | T |
| 1.315 | U |
| 1.375 | V |
| 1.500 | W |
| 1.625 | Y |
| 1.900 | Z |
| Other | X |

| Diameter ("D") (in inches) | Code |
|---|---|
| 0.375 | A |
| 0.400 | B |
| 0.500 | C |
| 0.562 | D |
| 0.625 | E |
| 0.680 | F |
| 0.735 | G |
| 0.750 | H |
| 0.766 | J |
| 0.781 | K |
| 0.860 | L |
| 0.875 | M |
| 0.900 | N |
| 1.000 | P |
| 1.050 | Q |
| 1.063 | R |
| 1.125 | S |
| 1.250 | T |
| 1.315 | U |
| 1.375 | V |
| 1.500 | W |
| 1.625 | Y |
| 1.900 | Z |
| Other | X |

| Option | Code |
|---|---|
| Thermowell material certificate | -01 |
| Thermowell Wake Frequency Calculation (Configuration Data Sheet Required) | -02 |
| Thermowell special internal pressure testing | -03 |
| Thermowell special external pressure testing | -04(1) |
| Thermowell dye penetration testing | -05 |
| Special cleaning for oxygen service | -06 |
| NACE MR-01-75 approval | -07 |
| Electropolishing | -08 |
| Stellite overlay | -09 |
| Chrome plating | -10 |
| Full penetration weld | -11* |

| Option | Code |
|---|---|
| Concentric serrations of thermowell flange face | -12* |
| Flat face flange | -13* |
| Ring Joint flange | -14* |
| Thermowell special surface finish (12Ra Max) | -15 |
| Special stamping | -17 |
| Plug and chain – stainless steel | -18 |
| Plug and chain – brass | -19 |
| Teflon coating | -20 |
| Weldment X-Ray | -21 |
| Tantalum sheath | -22* |
| Titantium sheath | -23* |
| Positive Material Identification (PMI) test | -24 |

* Available on flanged thermowells only. Only one flange face option allowed.



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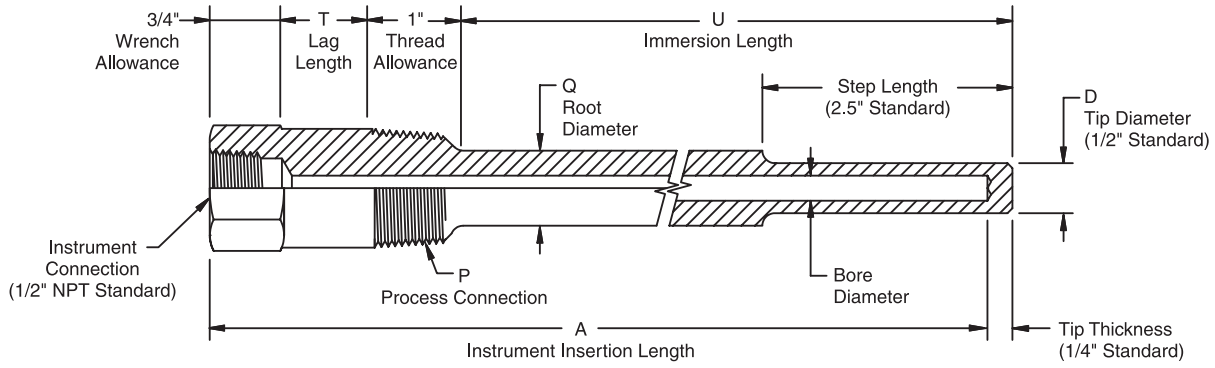
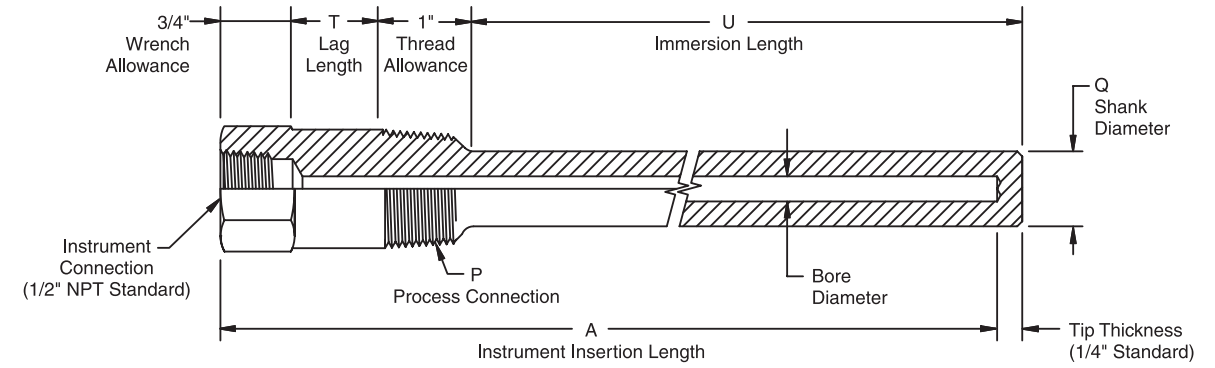
## Figure 1. Threaded Thermowells

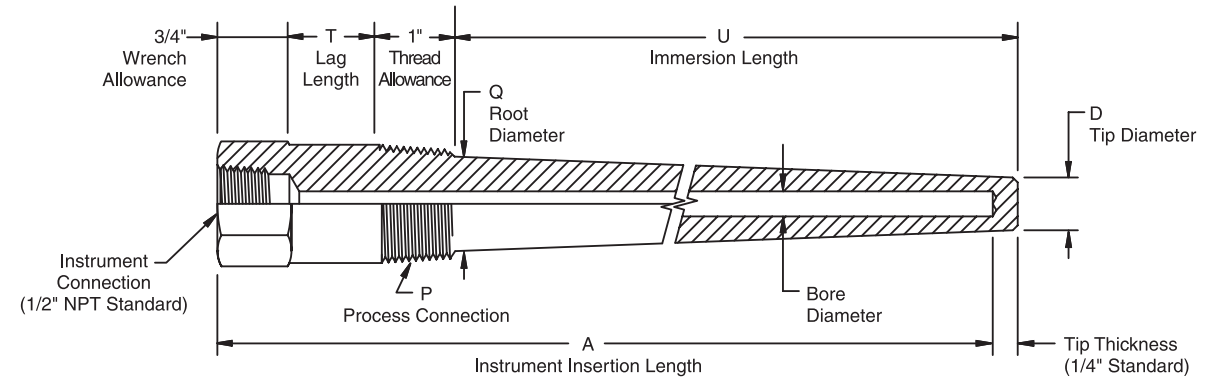
### Stepped



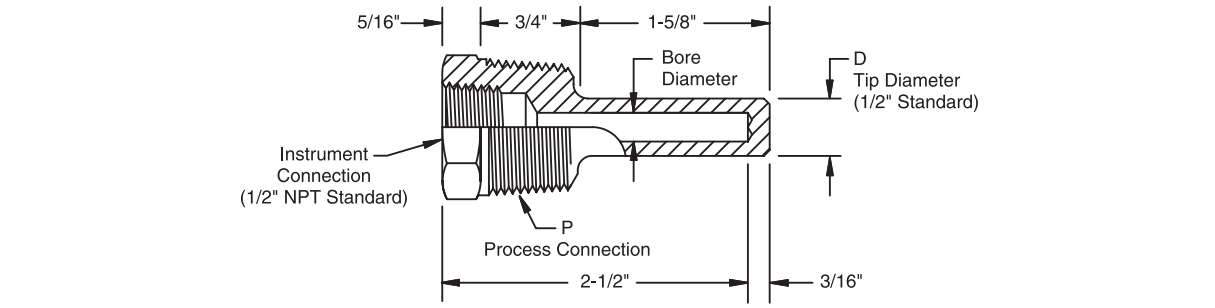

### Straight




### Tapered




### Limited Space Thermowell



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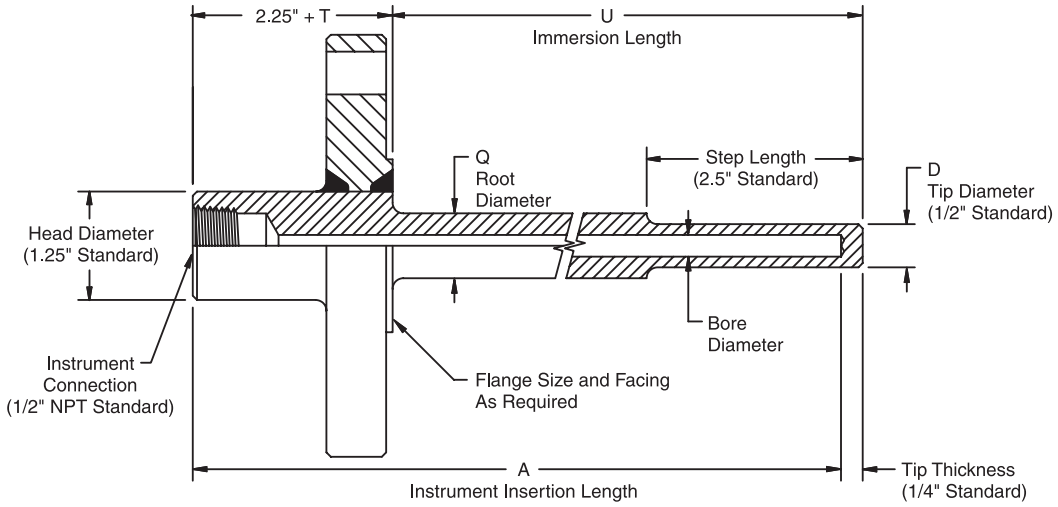
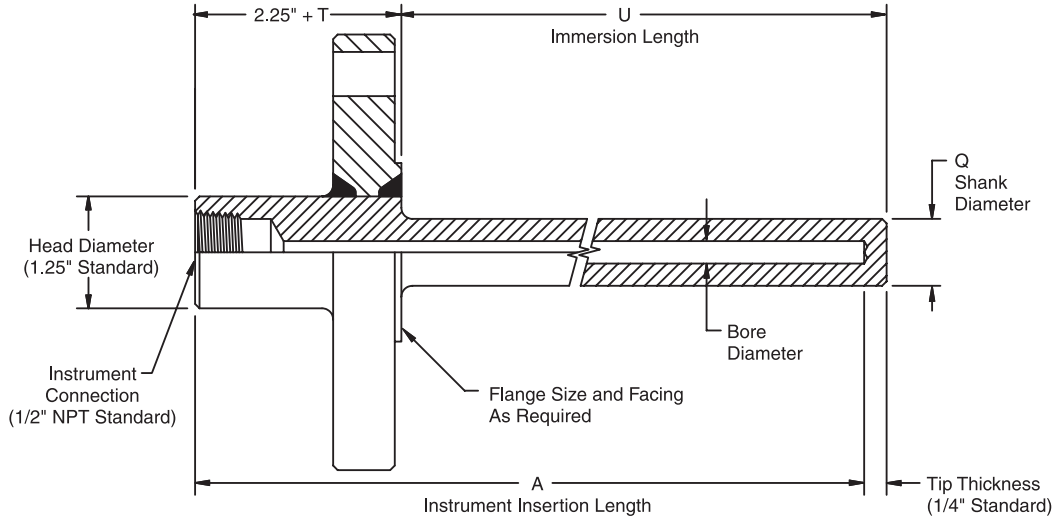
## Figure 2. Flanged Thermowells

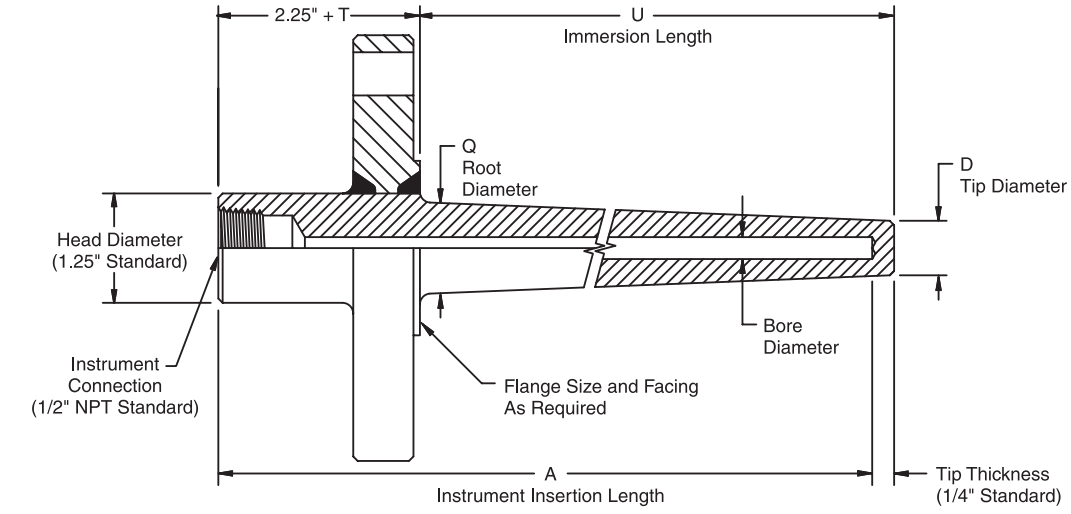
### Stepped




### Straight




### Tapered



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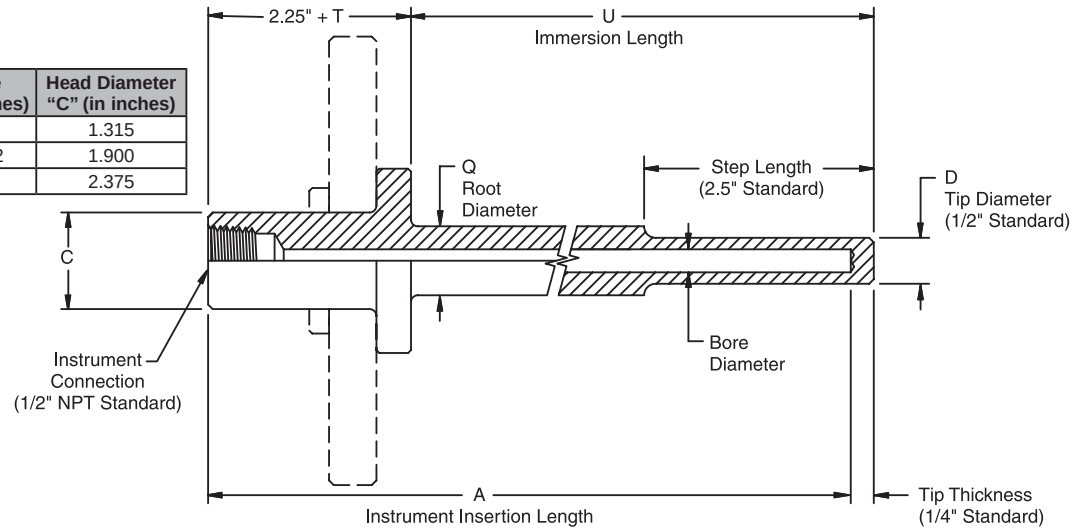
## Figure 3. Van Stone Thermowells

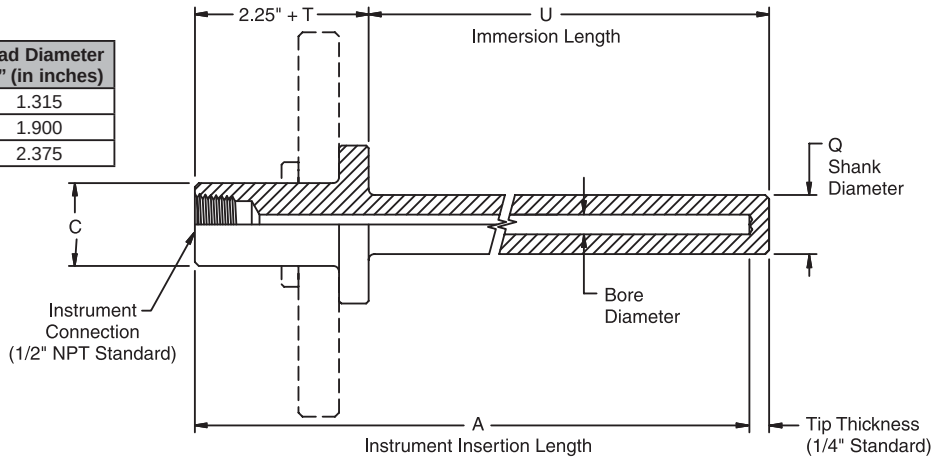
### Stepped

| Size (in inches) | Head Diameter "C" (in inches) |
|---|---|
| 1 | 1.315 |
| 1-1/2 | 1.900 |
| 2 | 2.375 |



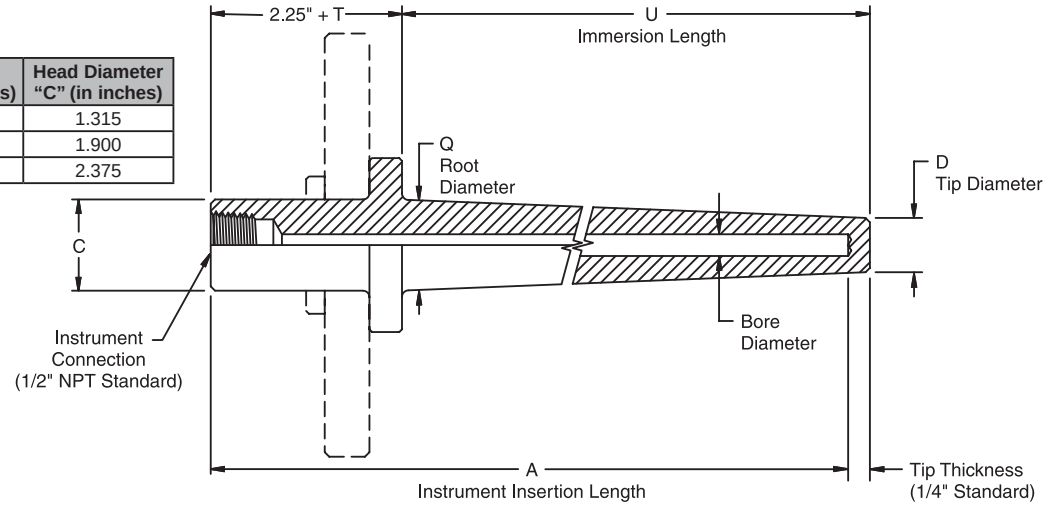

### Straight

| Size (in inches) | Head Diameter "C" (in inches) |
|---|---|
| 1 | 1.315 |
| 1-1/2 | 1.900 |
| 2 | 2.375 |




### Tapered

| Size (in inches) | Head Diameter "C" (in inches) |
|---|---|
| 1 | 1.315 |
| 1-1/2 | 1.900 |
| 2 | 2.375 |



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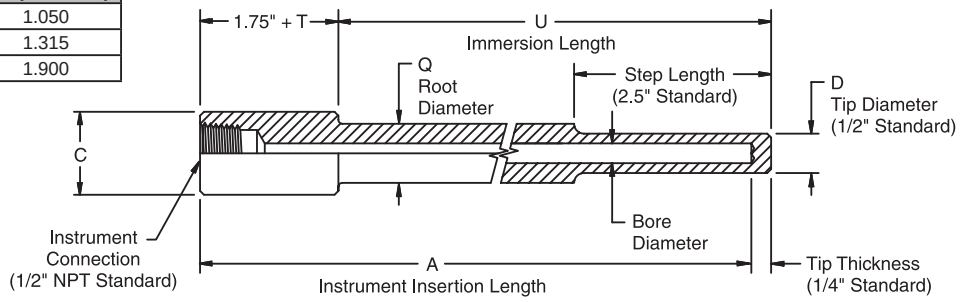
## Figure 4. Socket Weld Thermowells

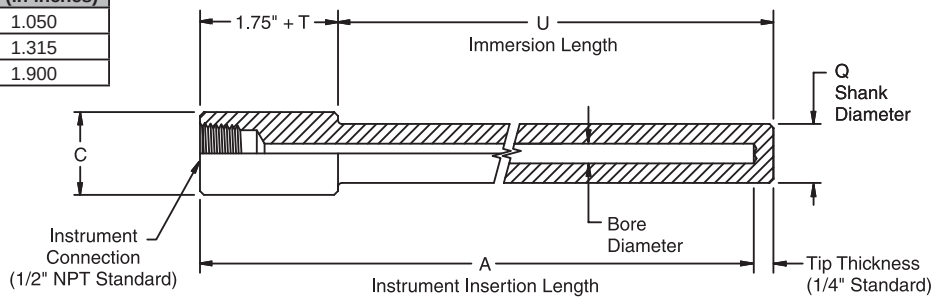
### Stepped

| Size (in inches) | Head Diameter "C" (in inches) |
|---|---|
| 3/4 | 1.050 |
| 1 | 1.315 |
| 1-1/2 | 1.900 |



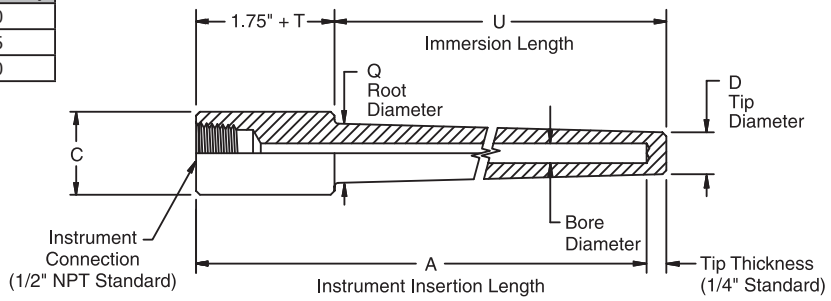

### Straight

| Size (in inches) | Head Diameter "C" (in inches) |
|---|---|
| 3/4 | 1.050 |
| 1 | 1.315 |
| 1-1/2 | 1.900 |




### Tapered

| Size (in inches) | Head Diameter "C" (in inches) |
|---|---|
| 3/4 | 1.050 |
| 1 | 1.315 |
| 1-1/2 | 1.900 |



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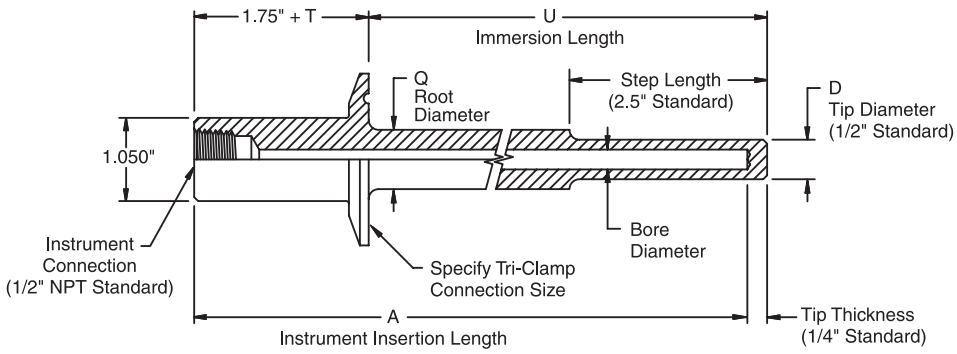
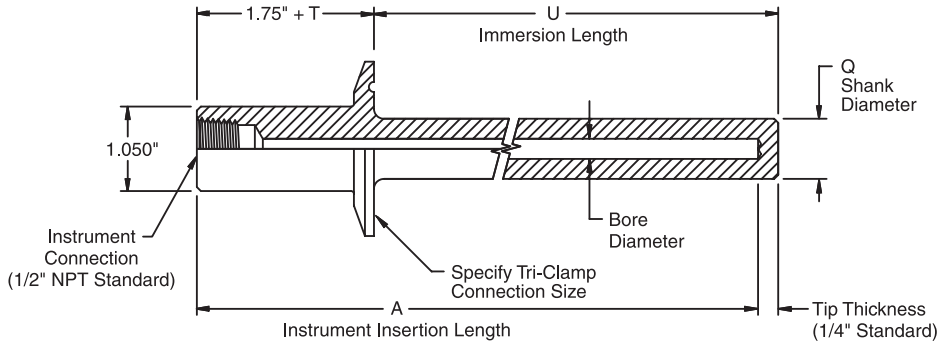
## Figure 5. Sanitary Thermowells

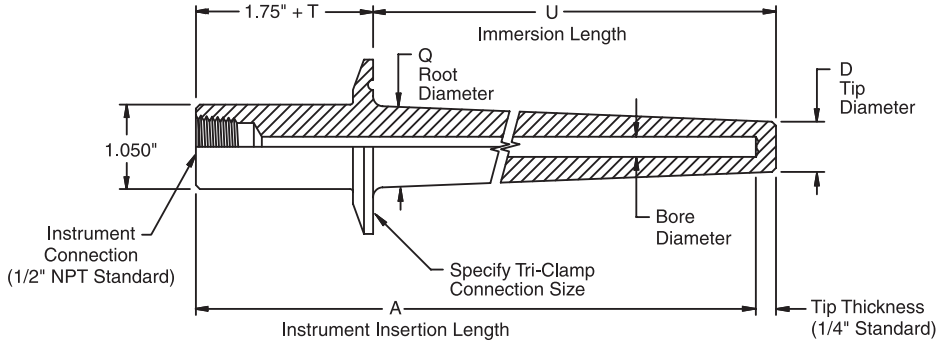
### Stepped




### Straight



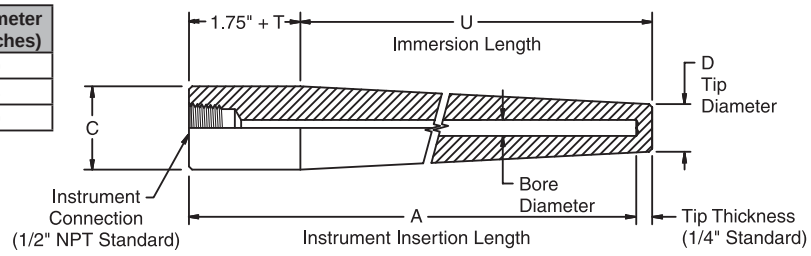

### Tapered




## Figure 6. Weld-InThermowells

### Tapered

| Size (in inches) | Head Diameter "C" (in inches) |
|---|---|
| 3/4 | 1.050 |
| 1 | 1.315 |
| 1-1/2 | 1.900 |



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# 2200 Series – Protection Tubes

## Manufacturing Standards

### Material

In compliance with ASTM specifications or other applicable national standard (i.e., ASME, AWS, etc.)

### Process Connection

Flange: In compliance with ANSI B16.5 prior to fabrication

Bushing: Welded in place

Welded: Bare tube

### Instrument Connection

Male pipe thread in compliance with ANSI B1.20.1-92

### "U" Dimension

±0.50" for immersion lengths <60"
±0.75" for immersion lengths 60" to 96"
±1.00" for immersion lengths >96"

### Tip Thickness

1/4" ±0.050 (unless otherwise specified)

### Welding

**Flange to Base Metal:**
per Parker Texas Thermowell Dwg. TX-A1

**Bushing to Base Metal:**
Fillet weld

**Barstock for Closed-end:**
per Parker Texas Thermowell dwg no. TX-FP-TIP(1)

**Pipe Cap for Closed-end:**
per Parker Texas Thermowell dwg no. TX-B(1)

(1) Full penetration weld locations are subject to minor distortion and internal filler metal slag.

## Terminology

**Process Connection:** External means to connect protection tube to process system. Tubes can be threaded, bolted (to matching flange), or welded in place.

**Instrument Connection:** Means to connect temperature instrument to protection tube. Typically male pipe threaded.

**"U" Dimension:** Length of protection tube immersed into process system. Measured from the base of the process connection to the end tip of the tube.

**"H" Dimension:** Also called "head length." Measured from the base of the process connection to the face of the instrument connection.

**"A" Dimension:** Instrument insertion length into protection tube.



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# 2200 Series – Protection Tubes

## Ordering Information

**Example Model Number:** 2200A240E09A030A-01-07-11

| Series | Material | Immersion Length ("U" Dim.) | Tube Style |
|---|---|---|---|
| 2200 | A | 240 | E |

(Continued on the following page)

| Material | Code |
|---|---|
| 304 SST | A |
| 310 SST | C |
| 316 SST | D |
| 321 SST | F |
| Alloy 20 | G |
| Carbon Steel | H |
| Hastelloy C | J |
| Hastelloy B | K |
| Inconel 600 | M |
| Monel | P |
| Nickel 200 | T |
| Titanium | W |
| Brass | Y |
| Other (please specify) | X |

| Length ("U") (in inches) | Code |
|---|---|
| 12 | 120 |
| 15 | 150 |
| 18 | 180 |
| 21 | 210 |
| 24 | 240 |
| 27 | 270 |
| 30 | 300 |
| 32 | 320 |
| 34 | 340 |
| 36 | 360 |
| 38 | 380 |
| 40 | 400 |
| 42 | 420 |
| 44 | 440 |
| 46 | 460 |
| 48 | 480 |
| 50 | 500 |
| 52 | 520 |
| 54 | 540 |
| 56 | 560 |
| 58 | 580 |
| 60 | 600 |
| 62 | 620 |
| 64 | 640 |
| 66 | 660 |
| 68 | 680 |
| 70 | 700 |
| 72 | 720 |
| 74 | 740 |
| 76 | 760 |
| 78 | 780 |
| 80 | 800 |
| 82 | 820 |
| 84 | 840 |
| 86 | 860 |
| 88 | 880 |
| 90 | 900 |
| 92 | 920 |
| 94 | 940 |
| 96 | 960 |
| 98 | 980 |
| Other (please specify) | XXX |

| Tube Style | Size | Code |
|---|---|---|
| Drilled Barstock | 1/2" O.D. | A |
| | 5/8" O.D. | B |
| | 3/4" O.D. | C |
| | 7/8" O.D. | D |
| | 1" O.D. | E |
| | 1-1/8" O.D. | F |
| | 1-1/4" O.D. | G |

| Tube Style | Size | Schedule | Code |
|---|---|---|---|
| Pipe | 1/4" | 40 | H |
| | | 80 | J |
| | | 160 | K |
| | | XX Heavy | L |
| | 1/2" | 40 | M |
| | | 80 | N |
| | | 160 | P |
| | | XX Heavy | Q |
| | 3/4" | 40 | R |
| | | 80 | T |
| | | 160 | U |
| | | XX Heavy | V |
| | 1" | 40 | W |
| | | 80 | X |
| | | 160 | Y |
| | | XX Heavy | Z |



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# 2200 Series – Protection Tubes

(Continued from the previous page)

| Process Connection | Bore Diameter | Head Length "H" Dim. | Instrument Connection | Options |
|---|---|---|---|---|
| 09 | A | 030 | A | -01<br>-07<br>-11 |

| Process Connection | Code |
|---|---|
| 3/4" NPT | 01 |
| 1" NPT | 02 |
| 1-1/2" NPT | 03 |
| 2" NPT | 04 |
| Welded | 05 |
| 1", Class 150 | 06 |
| 1-1/2", Class 150 | 07 |
| 2", Class 150 | 08 |
| 3", Class 150 | 09 |
| 4", Class 150 | 10 |
| 1", Class 300 | 11 |
| 1-1/2", Class 300 | 12 |
| 2", Class 300 | 13 |
| 3", Class 300 | 14 |
| 4", Class 300 | 15 |
| 1", Class 600 | 16 |
| 1-1/2", Class 600 | 17 |
| 2", Class 600 | 18 |
| 3", Class 600 | 19 |
| 4", Class 600 | 20 |
| Other (please specify) | XX |

| Bore Diameter | Code |
|---|---|
| 0.260" | A |
| 0.385" | B |
| N/A (Pipe Construction) | P |
| Other (please specify) | X |

| Length ("H") in inches* | Code |
|---|---|
| 2.0 | 020 |
| 2.5 | 025 |
| 3.0 | 030 |
| 3.5 | 035 |
| 4.0 | 040 |
| 4.5 | 045 |
| 5.0 | 050 |
| 5.5 | 055 |
| 6.0 | 060 |
| 6.5 | 065 |
| 7.0 | 070 |
| 7.5 | 075 |
| 8.0 | 080 |
| 8.5 | 085 |
| 9.0 | 090 |
| 9.5 | 095 |
| Other (please specify) | XXX |

| Instrument Connection Thread | Code |
|---|---|
| 1/2-14 NPT | A |
| 1/2-14 NPSM | B |
| Other (please specify) | X |

| Option | Code |
|---|---|
| Thermowell material certificate | -01 |
| Thermowell Wake Frequency Calculation (Configuration Data Sheet Required) | -02 |
| Thermowell special internal pressure testing | -03 |
| Thermowell special external pressure testing | -04* |
| Thermowell dye penetration testing | -05 |
| Special cleaning for oxygen service | -06 |
| NACE MR-01-75 approval | -07 |
| Electropolishing | -08 |
| Stellite overlay | -09 |
| Chrome plating | -10 |
| Full penetration weld | -11* |

| Option | Code |
|---|---|
| Concentric serrations of thermowell flange face | -12* |
| Flat face flange | -13* |
| Ring Joint flange | -14* |
| Thermowell special surface finish (12Ra Max) | -15 |
| Special stamping | -17 |
| Plug and chain – stainless steel | -18 |
| Plug and chain – brass | -19 |
| Teflon coating | -20 |
| Weldment X-Ray | -21 |
| Tantalum sheath | -22* |
| Titantium sheath | -23* |
| Positive Material Identification (PMI) test | -24 |

* Available on flanged thermowells only. Only one flange face option allowed.



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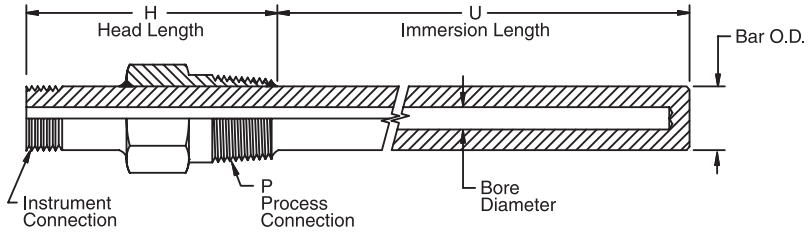
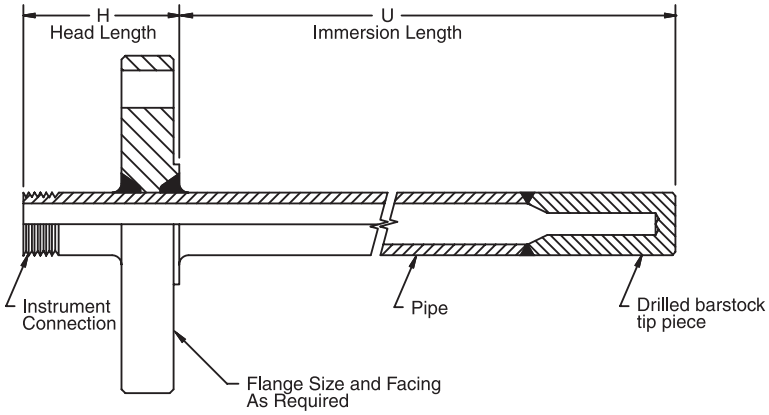
## Figure 7. Drilled Barstock Protection Tubes

### Threaded (Bushing)



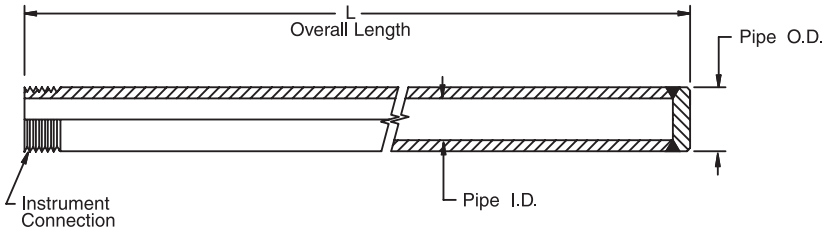

**Available in pipe, drilled barstock, or combination (drilled barstock shown here)**

### Flanged




**Available in pipe, drilled barstock, or combination (combination shown here)**

### Weld-In




**Available in pipe, drilled barstock, or combination (pipe shown here)**



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# 2300 Series – Sample Probes

## Manufacturing Standards

### Bar Stock

Mill Standard +0.000" / -1/32"

### Shank O.D.

±0.010"

### "U" Dimension

±0.050"

### Overall Length

±0.050"

### Shank Surface Finish

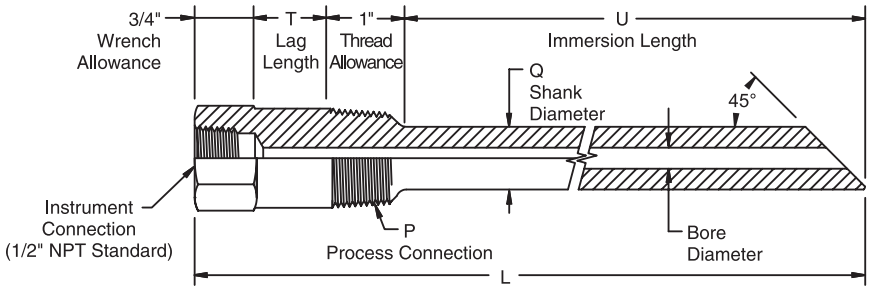
Polished to 16 RMS

### Bore

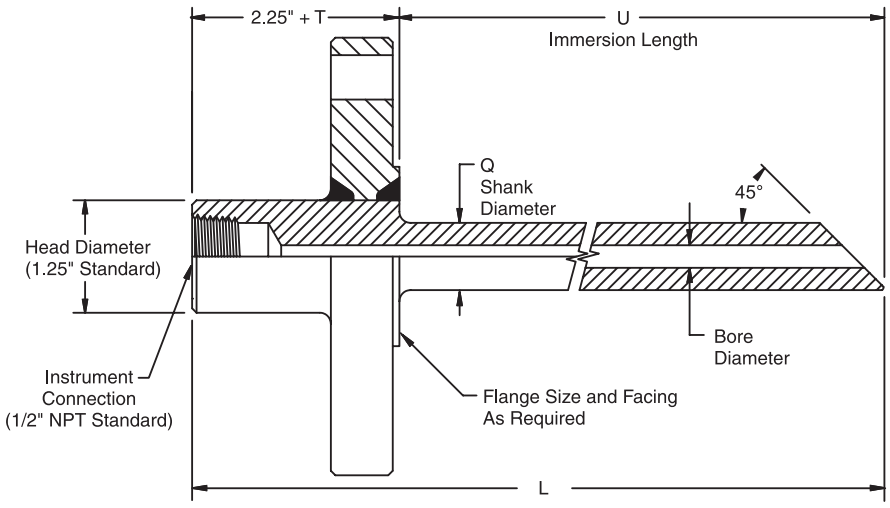
±0.003"

**Figure 8. Sample Probes**

**Threaded**




**Flanged**



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# 2300 Series – Sample Probes

## Ordering Information

**Example Model Number:** 2300A070T21A000AH-01-08

| Series | Material | Immersion Length "U" Dim. | Process Connection |
|---|---|---|---|
| 2300 | A | 070 | T21 |

(Continued on the following page)

| Material | Code |
|---|---|
| 304 SST | A |
| 310 SST | C |
| 316 SST | D |
| 321 SST | F |
| Alloy 20 | G |
| Carbon Steel | H |
| Hastelloy C | J |
| Hastelloy B | K |
| Inconel 600 | M |
| Monel | P |
| Nickel 200 | T |
| Titanium | W |
| Brass | Y |
| Other (please specify) | X |

| Mounting Style | Process Connection | Code |
|---|---|---|
| Threaded | 1/2" NPT | T31 |
| | 3/4" NPT | T32 |
| | 1" NPT | T33 |
| Flanged | 1", Class 150 | F31 |
| | 1-1/2", Class 150 | F32 |
| | 2", Class 150 | F33 |
| | 1", Class 300 | F34 |
| | 1-1/2", Class 300 | F35 |
| | 2", Class 300 | F36 |
| | 1", Class 600 | F37 |
| | 1-1/2", Class 600 | F38 |
| | 2", Class 600 | F39 |
| Other | (please specify) | XXX |

| Length ("U") (in inches) | Code | Length ("U") (in inches) | Code | Length ("U") (in inches) | Code |
|---|---|---|---|---|---|
| 1.5 | 015 | 13.0 | 130 | 26.0 | 260 |
| 2.0 | 020 | 13.5 | 135 | 27.0 | 270 |
| 2.5 | 025 | 14.0 | 140 | 28.0 | 280 |
| 3.0 | 030 | 14.5 | 145 | 29.0 | 290 |
| 3.5 | 035 | 15.0 | 150 | 30.0 | 300 |
| 4.0 | 040 | 15.5 | 155 | 31.0 | 310 |
| 4.5 | 045 | 16.0 | 160 | 32.0 | 320 |
| 5.0 | 050 | 16.5 | 165 | 33.0 | 330 |
| 5.5 | 055 | 17.0 | 170 | 34.0 | 340 |
| 6.0 | 060 | 17.5 | 175 | 35.0 | 350 |
| 6.5 | 065 | 18.0 | 180 | 36.0 | 360 |
| 7.0 | 070 | 18.5 | 185 | 37.0 | 370 |
| 7.5 | 075 | 19.0 | 190 | 38.0 | 380 |
| 8.0 | 080 | 19.5 | 195 | 39.0 | 390 |
| 8.5 | 085 | 20.0 | 200 | 40.0 | 400 |
| 9.0 | 090 | 20.5 | 205 | 41.0 | 410 |
| 9.5 | 095 | 21.0 | 210 | 42.0 | 420 |
| 10.0 | 100 | 21.5 | 215 | 43.0 | 430 |
| 10.5 | 105 | 22.0 | 220 | 44.0 | 440 |
| 11.0 | 110 | 22.5 | 225 | 45.0 | 450 |
| 11.5 | 115 | 23.0 | 230 | 46.0 | 460 |
| 12.0 | 120 | 24.0 | 240 | 47.0 | 470 |
| 12.5 | 125 | 25.0 | 250 | 48.0 | 480 |



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# 2300 Series – Sample Probes

(Continued from the previous page)

| Bore Diameter | Lag Length (“T” Dim.) | Sampler Connection | Shank Length (“D” Dim.) | Options |
|---|---|---|---|---|
| A | 030 | A | H | -01<br>-08 |

| Bore Diameter | Code |
|---|---|
| 0.260" | A |
| 0.385" | B |
| Other (please specify) | X |

| Length (“T”) (in inches) | Code |
|---|---|
| 0.0 | 000 |
| 0.5 | 005 |
| 1.0 | 010 |
| 1.5 | 015 |
| 2.0 | 020 |
| 2.5 | 025 |
| 3.0 | 030 |
| 3.5 | 035 |
| 4.0 | 040 |
| 4.5 | 045 |
| 5.0 | 050 |
| 5.5 | 055 |
| 6.0 | 060 |
| 6.5 | 065 |
| 7.0 | 070 |
| 7.5 | 075 |
| 8.0 | 080 |
| 8.5 | 085 |
| 9.0 | 090 |
| 9.5 | 095 |
| Other (please specify) | XXX |

| Instrument Connection Thread | Code |
|---|---|
| 1/2-14 ANPT | A |
| 1/2-14 NPSM | B |
| Other (please specify) | X |

| Diameter (“D”) (in inches) | Code |
|---|---|
| 0.375 | A |
| 0.400 | B |
| 0.500 | C |
| 0.562 | D |
| 0.625 | E |
| 0.680 | F |
| 0.735 | G |
| 0.750 | H |
| 0.766 | J |
| 0.781 | K |
| 0.860 | L |
| 0.875 | M |
| 0.900 | N |
| 1.000 | P |
| 1.050 | Q |
| 1.063 | R |
| 1.125 | S |
| 1.250 | T |
| 1.315 | U |
| 1.375 | V |
| 1.500 | W |
| 1.625 | Y |
| 1.900 | Z |
| Other (please specify) | X |

| Option | Code |
|---|---|
| Thermowell material certificate | -01 |
| Thermowell Wake Frequency Calculation (Configuration Data Sheet Required) | -02 |
| NACE MR-01-75 approval | -07 |
| Electropolishing | -08 |
| Full penetration weld | -11* |
| Concentric serrations of thermowell flange face | -12* |
| Flat face flange | -13* |
| Ring Joint flange | -14* |
| Thermowell special surface finish (12Ra Max) | -15 |
| Special stamping | -17 |
| Weldment X-Ray | -21 |
| Positive Material Identification (PMI) test | -24 |

* Available on flanged thermowells only. Only one flange face option allowed.



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# Notes



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**4. Warranty:** Seller warrants that items sold hereunder shall be free from defects in material or workmanship. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.**

**NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGNS OR SPECIFICATIONS.**

**5. Limitation Of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.**

**6. Changes, Reschedules and Cancellations:** Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

**7. Special Tooling:** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and not withstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

**8. Buyer's Property:** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property, Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

**9. Taxes:** Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

**10. Indemnity For Infringement of Intellectual Property Rights:** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. Patents, U.S. Trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

**11. Force Majeure:** Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

**12. Entire Agreement/Governing Law:** The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

11/98-P



**Parker Hannifin Corporation**
Instrumentation Products Division
Beaumont, TX USA
http://www.parker.com/ipdus

# Parker's Motion & Control Technologies

**At Parker, we're guided by a relentless drive to help our customers become more productive and achieve higher levels of profitability by engineering the best systems for their requirements. It means looking at customer applications from many angles to find new ways to create value. Whatever the motion and control technology need, Parker has the experience, breadth of product and global reach to consistently deliver. No company knows more about motion and control technology than Parker. For further info call 1-800-C-Parker.**

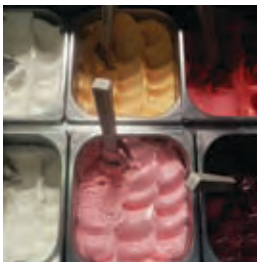
## AEROSPACE

### Key Markets

- Aircraft engines
- Business & general aviation
- Commercial transports
- Land-based weapons systems
- Military aircraft
- Missiles & launch vehicles
- Regional transports
- Unmanned aerial vehicles

### Key Products

- Flight control systems & components
- Fluid conveyance systems
- Fluid metering delivery & atomization devices
- Fuel systems & components
- Hydraulic systems & components
- Inert nitrogen generating systems
- Pneumatic systems & components
- Wheels & brakes



## CLIMATE CONTROL

### Key Markets

- Agriculture
- Air conditioning
- Food, beverage & dairy
- Life sciences & medical
- Precision cooling
- Processing
- Transportation

### Key Products

- $CO^2$ controls
- Electronic controllers
- Filter driers
- Hand shut-off valves
- Hose & fittings
- Pressure regulating valves
- Refrigerant distributors
- Safety relief valves
- Solenoid valves
- Thermostatic expansion valves

## ELECTROMECHANICAL

### Key Markets

- Aerospace
- Factory automation
- Life science & medical
- Machine tools
- Packaging machinery
- Paper machinery
- Plastics machinery & converting
- Primary metals
- Semiconductor & electronics
- Textile
- Wire & cable

### Key Products

- AC/DC drives & systems
- Electric actuators, gantry robots & slides
- Electrohydrostatic actuation systems
- Electromechanical actuation systems
- Human machine interface
- Linear motors
- Stepper motors, servo motors, drives & controls
- Structural extrusions

## FILTRATION

### Key Markets

- Food & beverage
- Industrial machinery
- Life sciences
- Marine
- Mobile equipment
- Oil & gas
- Power generation
- Process
- Transportation

### Key Products

- Analytical gas generators
- Compressed air & gas filters
- Condition monitoring
- Engine air, fuel & oil filtration & systems
- Hydraulic, lubrication & coolant filters
- Process, chemical, water & microfiltration filters
- Nitrogen, hydrogen & zero air generators

## FLUID & GAS HANDLING

### Key Markets

- Aerospace
- Agriculture
- Bulk chemical handling
- Construction machinery
- Food & beverage
- Fuel & gas delivery
- Industrial machinery
- Mobile
- Oil & gas
- Transportation
- Welding

### Key Products

- Brass fittings & valves
- Diagnostic equipment
- Fluid conveyance systems
- Industrial hose
- PTFE & PFA hose, tubing & plastic fittings
- Rubber & thermoplastic hose & couplings
- Tube fittings & adapters
- Quick disconnects

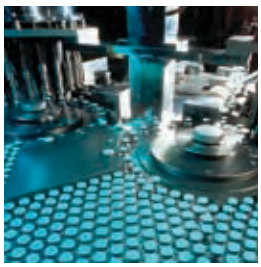
## HYDRAULICS

### Key Markets

- Aerospace
- Aerial lift
- Agriculture
- Construction machinery
- Forestry
- Industrial machinery
- Mining
- Oil & gas
- Power generation & energy
- Truck hydraulics

### Key Products

- Diagnostic equipment
- Hydraulic cylinders & accumulators
- Hydraulic motors & pumps
- Hydraulic systems
- Hydraulic valves & controls
- Power take-offs
- Rubber & thermoplastic hose & couplings
- Tube fittings & adapters
- Quick disconnects



## PNEUMATICS

### Key Markets

- Aerospace
- Conveyor & material handling
- Factory automation
- Life science & medical
- Machine tools
- Packaging machinery
- Transportation & automotive

### Key Products

- Air preparation
- Brass fittings & valves
- Manifolds
- Pneumatic accessories
- Pneumatic actuators & grippers
- Pneumatic valves & controls
- Quick disconnects
- Rotary actuators
- Rubber & thermoplastic hose & couplings
- Structural extrusions
- Thermoplastic tubing & fittings
- Vacuum generators, cups & sensors

## PROCESS CONTROL

### Key Markets

- **Chemical & refining**
- **Food, beverage & dairy**
- **Medical & dental**
- **Microelectronics**
- **Oil & gas**
- **Power generation**

### Key Products

- **Analytical sample conditioning products & systems**
- **Fluoropolymer chemical delivery fittings, valves & pumps**
- **High purity gas delivery fittings, valves & regulators**
- **Instrumentation fittings, valves & regulators**
- **Medium pressure fittings & valves**
- **Process control manifolds**

## SEALING & SHIELDING

### Key Markets

- Aerospace
- Chemical processing
- Consumer
- Energy, oil & gas
- Fluid power
- General industrial
- Information technology
- Life sciences
- Military
- Semiconductor
- Telecommunications
- Transportation

### Key Products

- Dynamic seals
- Elastomeric o-rings
- EMI shielding
- Extruded & precision-cut, fabricated elastomeric seals
- Homogeneous & inserted elastomeric shapes
- High temperature metal seals
- Metal & plastic retained composite seals
- Thermal management

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