

### Overview

Thermowells are hollow tubes closed off on one end and threaded at the other end. They are permanently placed into pipes, tanks or sumps so that temperature measurement probes (immersion sensors) can be inserted into the pipe to measure the contents temperature. The temperature of the contents is transferred through the wall of the thermowell. The thermowell prevents the contents of the pipe from escaping and holds in the pressure of pressurized pipes.

### BAPI Standard Size Thermowell

2.5", 4.5" & 7.5"

### Thermowell Material & Style

Machined Brass - 304 or 316 Stainless Steel • Two-Part Welded - 304 Stainless Steel

Note: 3/4" External Threads Available and other sizes can be ordered as specialty items.

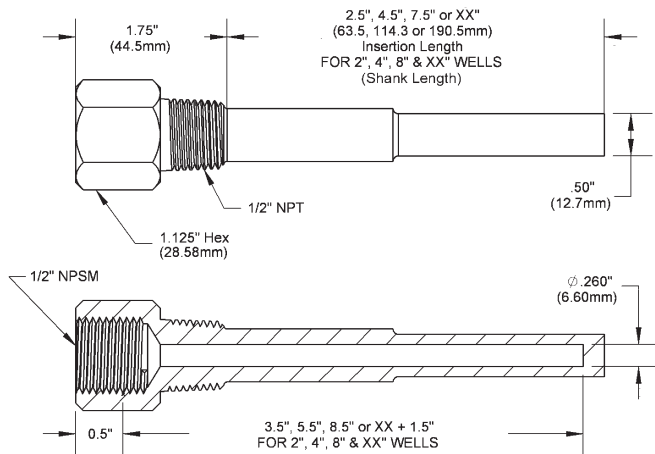


Fig 1: Machined Bar Stock Thermowell

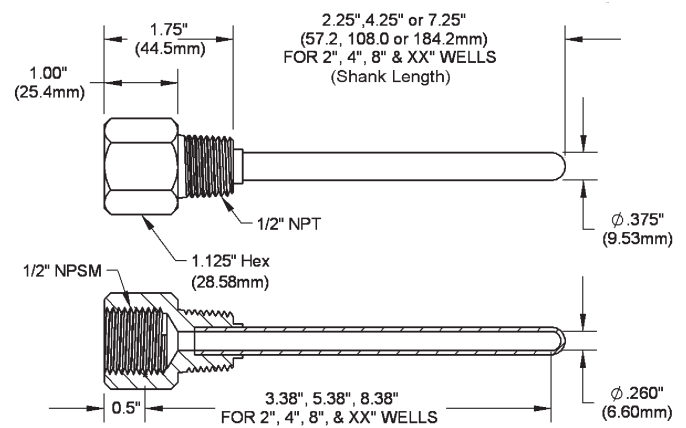


Fig 2: Two-Part Welded Thermowell

### Thermowell Installation

BAPI's immersion probes are designed to be installed in a thermowell. To install a thermowell, a pipe fitter typically drills a 3/4-inch hole into the pipe where the thermowell is needed. A customer-provided fitting, called a Threadolet or Weldolet, is welded to the pipe over the hole. The Threadolet has a 1/2" NPT thread in the center. Thread sealant such as Teflon tape or pipe dope is applied to the 1/2" NPT threads of the thermowell. The thermowell is then inserted into the Threadolet and tightened.

Figure 3 shows a 4" thermowell and 4" immersion probe installed into 12" pipe. Usually thermowells are sized to extend to the center of the pipe; however, shorter thermowells will give proper temperature readings if properly installed.

Since the wall thickness of the pipe commonly used for HVAC plumbing is 1/2-inch, the thermowell sticks four inches into the pipe. The four-inch distance called out by a four-inch thermowell is the distance from the inside surface of the pipe to the end of the thermowell.

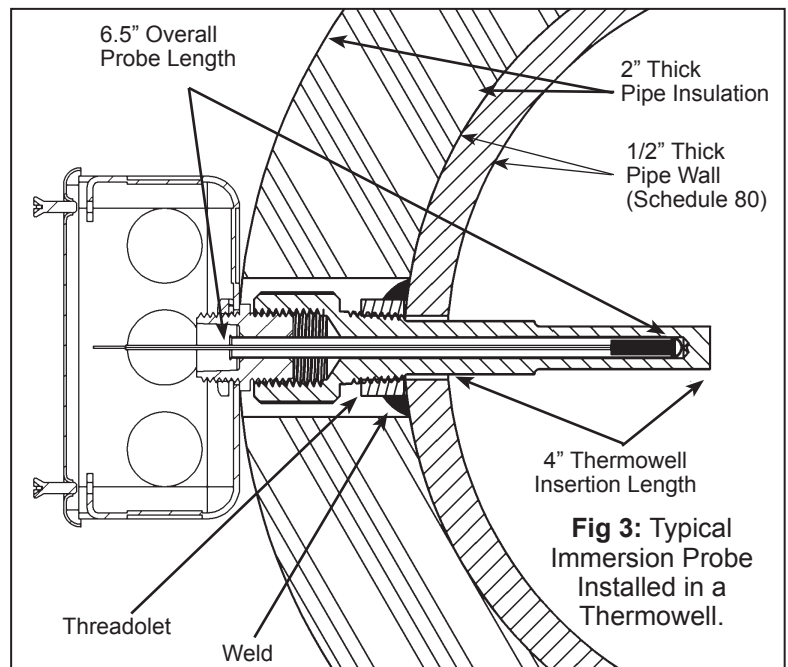


Fig 3: Typical Immersion Probe Installed in a Thermowell.

Specifications subject to change without notice.

### Mounting continued...

#### Pipes Less than Three Inches in Diameter

##### T-Mount

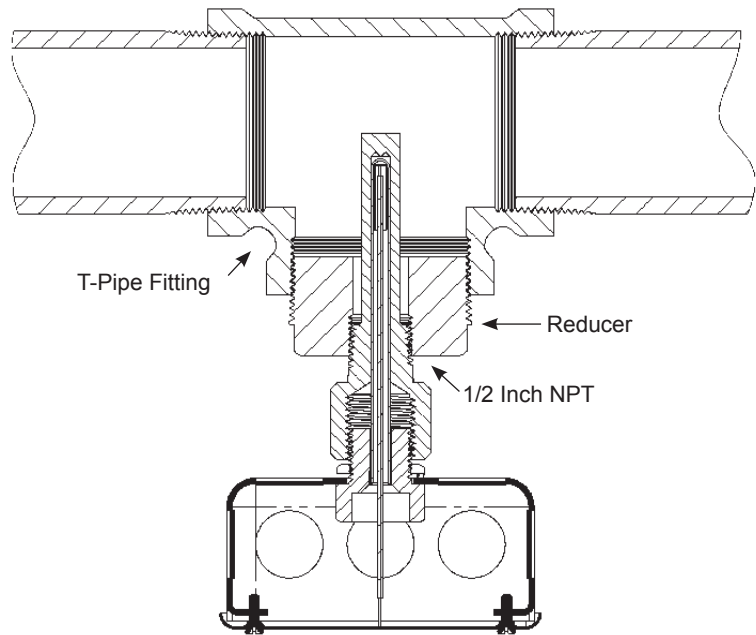
Figure 4 shows how a 2" Tee and a 1/2" to 2" bushing allows a 2" thermowell to measure the temperature of the contents of a 2" water pipe.

Be sure to use a thread sealant on the outside threads of the thermowell.

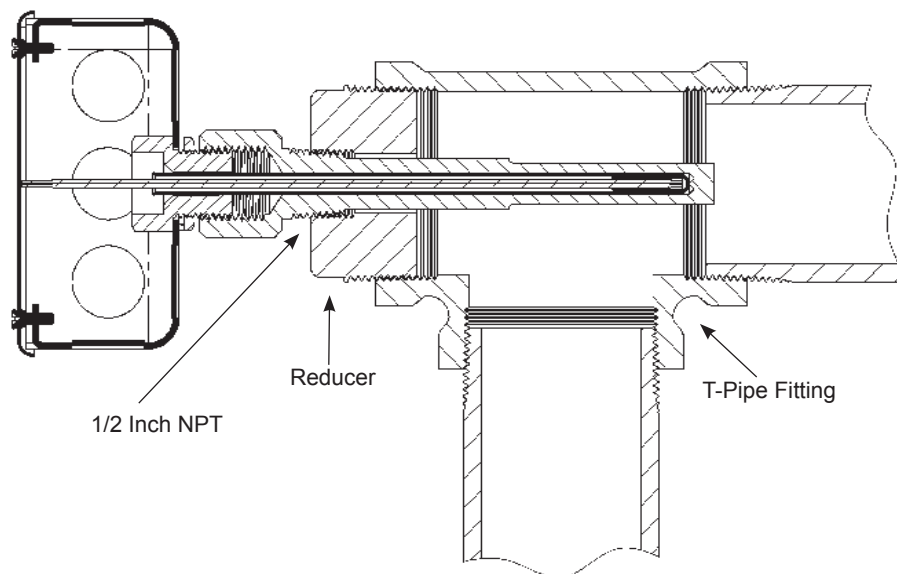
##### Corner Mount

Figure 5 shows how a pipe Tee can be used in an elbow application. A 2" tee and a 1/2" to 2" bushing allows a 4" thermowell to measure the temperature of the contents of a 2" water pipe.

Note: Temperatures in pipes as small as 1-1/4" may be measured by this method. In small pipes, the diameter of the thermowell may become a significant obstruction, so be sure to check for proper flow rates after installation is complete.



**Fig 4: Typical T-Mount**  
2" Thermowell in a 2" Water Pipe in a Tee Configuration



**Fig 5: Typical Corner Mount**  
4" Thermowell in a 2" Water Pipe in an Elbow Configuration

Specifications subject to change without notice.

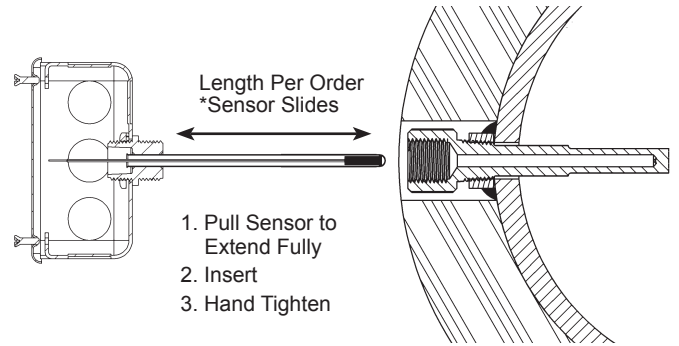
### Mounting continued...

#### IMMERSION SENSOR INSTALLATION

Immersion probes come with a plastic fitting that screws into the threads at the top of the thermowell. Pull the probe away from the plastic fitting until the probe is fully extended.

Insert the immersion probe into the thermowell until the plastic fittings come into contact with the threads in the thermowell. Hand tighten the immersion sensor snugly into the thermowell without too much torque. The unit is designed so that the temperature probe slides back into the enclosure as the sensor contacts the bottom of the thermowell.

Make sure that the tip of the immersion sensor probe is in good contact with the bottom of the thermowell by pushing on the flaired end of the probe until the tip bottoms out in the thermowell.



**Fig 6: Immersion Sensor Before Insertion**

\*As the immersion sensor is hand threaded into the thermowell, the flair end of the probe will be pushed into the enclosure as the probe tip bottoms out in the thermowell. The probe can slide up to 1.6". The Junction Box enclosure is shown above but the process is the same for the other enclosure styles.

**Table 1: Pipe Insertion Recommendations using BAPI Thermowells**

Pipe Size	Schd 40 Wall Thickness	Schd 80 Wall Thickness	Recommended Thermowell Type	Shank Length	Actual Insertion Schd 40	Actual Insertion Schd 80
1/2	0.109	0.147	BA/2"	2.5	2" @ elbow	2" @ elbow
3/4	0.113	0.154	BA/2"	2.5	2" @ elbow	2" @ elbow
1.00	0.133	0.179	BA/2"	2.5	2" @ elbow	2" @ elbow
1 1/2	0.145	0.2	BA/2"	2.5	2" @ elbow	2" @ elbow
2.00	0.154	0.218	BA/2"	2.5	2" @ elbow	2" @ elbow
2 1/2	0.203	0.276	BA/2"	2.5	2" @ elbow	2" @ elbow
3.00	0.216	0.3	BA/2"	2.5	2.28	2.20
4.00	0.237	0.337	BA/2"	2.5	2.26	2.16
5.00	0.258	0.375	BA/2"	2.5	2.24	2.13
6.00	0.28	0.432	BA/4"	4.5	4.22	4.07
8.00	0.322	0.5	BA/4"	4.5	4.18	4.00
10.00	0.365	0.593	BA/4"	4.5	4.14	3.91
12.00	0.406	0.687	BA/8"	7.5	7.09	6.81
14.00	0.437	0.75	BA/8"	7.5	7.06	6.75
16.00	0.5	0.843	BA/8"	7.5	7.00	6.66
18.00	0.563	0.937	BA/8"	7.5	6.94	6.56
20.00	0.593	1.031	BA/8"	7.5	6.91	6.47
24.00	0.687	1.218	BA/8"	7.5	6.81	6.28

Specifications subject to change without notice.



### Choosing the Correct Thermowell

BAPI sells machined thermowells made of Brass, 304 Stainless Steel and 316 Stainless Steel. We also sell two-part welded thermowells made of 304 Stainless Steel. The two-part welded thermowells are not as strong as their machined counterparts. See the entries for Welded S.S. in the following design tables. Additionally, welded stainless steel thermowells should not be used in turbulent flow; ideally they should be three to five pipe diameters from elbows or transitions.

Thermowell Material	Temperature in Degrees Fahrenheit						
	70°F	200°F	400°F	600°F	800°F	1000°F	1200°F
	Pressure Rating (Pounds per Square Inch)						
Brass	5000	4200	1000	-	-	-	-
Welded 304 S.S.	982	820	675	604	550	510	299
304 S.S.	7000	6200	5600	5400	5200	4500	1650
316 S.S.	7000	7000	6400	6200	6100	5100	2500

Thermowell Material	Fluid Type	Insertion Length (inches)		
		1-2"	1-4"	1-8"
		Maximum Fluid Velocity (Feet per Second)		
Brass	Air/Steam	207	75.5	27.3
	Water	59.3	32.2	19.7
Welded 304 S.S.	Air/Steam	169	61	20
	Water	88	20	10
304 S.S.	Air/Steam	300	109	39.5
316 S.S.	Water	148	82.2	-

The values shown in Table Three are based on operating temperatures of 350°F for brass and 1,000°F for stainless steel (S.S.). Slightly higher velocities are possible at lower temperatures.

### Comparing the Wake Frequency and the Resonant Frequency

Table 2 and Table 3 were developed to insure that there will be no thermowell failures due to application stresses. Thermowell failures, in most cases, are not due to the effects of pressure or temperature on the well. The calculations necessary to provide adequate strength, under given conditions, are familiar enough to permit proper choice of wall thickness and material. The values shown in Table 2 are conservative, and intended primarily as a guide.

Less familiar, and more dangerous, are the **vibration effects** to which thermowells are subjected. Fluid, flowing by the well, forms a turbulent wake (called the Von Karman Trail) which has a definite frequency, based on the diameter of the thermowell and the velocity of the fluid. It is important that the thermowell have sufficient stiffness so that the wake frequency will never equal the resonant (natural) frequency of the thermowell itself.

If the resonant frequency of the thermowell coincided with the wake frequency, the thermowell would vibrate to destruction and break off in the piping. Thermowells are also safe if the resonant frequency is thermowell **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 the use of a sufficiently stiff thermowell, BAPI recommends the values given in Table 3 not be exceeded.

Specifications subject to change without notice.