ALLOY
Engineering Company, Inc

Technical Brief

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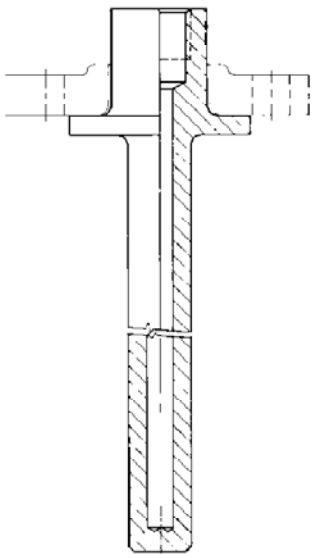
Selection of Thermowells

A thermowell is the pressure-tight receptacle designed to protect sensitive temperature measurement instrumentation from harsh process conditions. Essentially a hollow tube extending into a process flow of steam, gas or liquid, a thermowell routinely endures some of the most corrosive environments in industry. Any failure could result in a damaged plant, or potential injury. It is therefore critical that thermowells are specified and manufactured correctly to withstand the pressure and mechanical stresses that it may be exposed to, as well as any corrosive or erosive media they are likely to meet in a given process environment.

KEY VARIABLES

- Material
- Connection
- Insertion Length
- Bore Size
- Shank Geometry

"A thermowell routinely endures some of the the most corrosive environments in industry."



Material – The Longevity Factor

In general the thermowell material chosen for the installation Is governed mainly by the corrosion conditions the well will face. Recommended materials for various services are based on resistance to specific corrosive environments, temperature, and the mechanical stresses of the process. (see Alloy's Service Guide to Materials). The high polish given to all stainless and Monel® wells provides maximum corrosion resistance and strength. 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 otherwise a brass well would be satisfactory from a corrosion standpoint. Consult the pressure-temperature ratings given for each well type. The standard materials listed for each well series will cover most requirements. Alloy carries a wide variety of special materials in inventory to ensure fast delivery of wells. Materials include special grades of stainless steel, chrome-molybdenum, steel, naval brass, Hastelloy B & C, nickel and titanium.

Connection – The Installation Factor

Over the years, a standardized menu of thermowells has evolved providing wells of threaded, flanged (A.N.S.I. and Van Stone) and socket weld types with standard bore sizes. Threaded wells are all made in readily welded or brazed materials. This is important for installations requiring seal welding or brazing. The pipe thread provides the mechanical strength, the weld merely seals. Flanged wells (other than Van Stone type) consist of a bar stock well which is solidly welded to a top quality flange. Standard construction uses a primary "J" groove weld and a bevel groove secondary weld. Both welds are machined to produce a clean fillet. This double welded construction eliminates possibility of crevice corrosion and stress problems since no open joints are exposed from either inside or outside the installation. Socket welding types of wells are simple to install by merely welding into place. These wells fit A.N.S.I. standard socket weld couplings or flanges. The resulting installation is clean and tight.

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Insertion Length – The Accuracy Factor

The distance from the end of the well to the underside of the thread, or other connection means, (designated as "U") is the insertion length. For best accuracy, this length should be long enough to permit the entire temperature sensitive part of the thermometer bulb to project into the process medium being measured.

A properly installed thermometer bulb will project into liquid an amount equal to its sensitive length plus at least one inch. In air or gas, the bulb should be immersed to its sensitive length plus at least three inches. Thermocouples and thermistors have short sensitive lengths, therefore can use the smallest insertion lengths. Bi-metal thermometers, resistance thermometers and liquid-in-glass thermometers have bulbs with sensitive portions between one and two inches long. Therefore the minimum standard insertion length of 2 ½" must be entirely immersed in liquid for proper accuracy. Filled system thermometer bulbs may have sensitive portions from one to several inches in length. Determine the sensitive length of the bulb before choosing an insertion length. Above all – be sure that dead length, i.e. – that which is required to pass through walls, pipe fittings, etc. is taken into account when choosing the necessary insertion length.

"Selection of a standard bore diameter can produce maximum flexibility within the plant."

Thermowells for a variety of environments.

Bore Size – The Interchangeability Factor

Almost any installation uses several types of temperature measuring instruments. The selection of a standard bore diameter can produce maximum flexibility within the plant. The same well can accommodate either thermocouple, resistance thermometer, bi-metal thermometer, or test thermometer. In general the bore sizes below cover the most commonly used temperature sensing elements as follows:

.260" Diameter Bore:	Bi-metal Themometers (¼" Stem); Thermocouples (#20 Gauge)
.385" Diameter Bore:	Bi-metal Thermometers (3/8" Stem): Thermocouples (#14 Gauge); Liquid-in-Glass Thermometers (armored); other elements having .377" maximum diameter

Tapered or Straight Shank – The Velocity Rating Factor

Tapered shank wells provide greater stiffness for the same sensitivity. The higher strength-to-weight ratio gives these wells a higher natural resonant frequency than for an equivalent straight shank well, permitting operation at higher fluid velocities. The recently released ASME PTC 19.3 Thermowell Strength Standard addresses the wake frequency calculations for step and tapered as well as straight thermowell geometries (see Alloy Technical Brief – Thermowell Velocity Ratings and Wake Calculations)

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