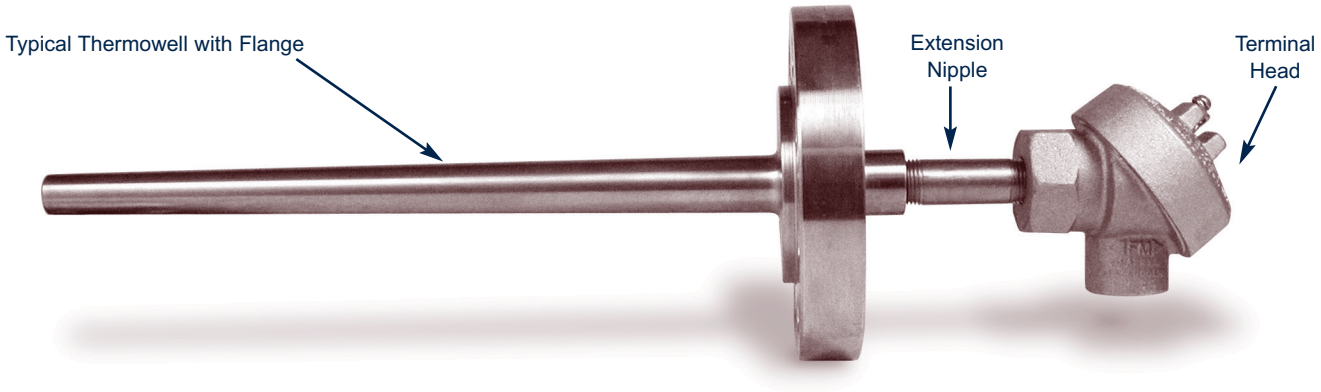

Material - The Longevity Factor

In general, the thermowell material chosen for the installation is governed mainly by the corrosion conditions to which the well is exposed. Recommended materials for various services are given in the corrosion table on pages 67 to 69. The high mirror polish given to all stainless and monel wells provides maximum corrosion resistance.

Sometimes the major consideration is strength rather than corrosion-resistance. For example, a high pressure water service may require a stainless steel well, while from a corrosion standpoint, a brass well would be satisfactory.

Connection - The Installation Factor

In these pages you will find standardized wells of threaded, flanged (A.N.S.I. and Van Stone), and socket welded types with standard bore sizes.

Threaded wells are all made in readily welded or brazed materials 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 permanently 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 since no open joints exposed from either inside or outside the installation.

Socket welding types of wells are simple to install - merely welded into place.These wells fit A.N.S.I. standard socket weld coupling of flanges. The resulting installation is clean and tight.

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 well to project into the temperature medium being measured. A properly installed thermowell will project into the liquid and amount equal to its sensitive length plus at least one inch. In air or gas, the bulb should be immersed into the sensitive length plus at least three inches.

Thermocouples and thermistors have short sensitive lengths and 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 2-1/2" 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 bulb before choosing an insertion length.

Above all - be sure that dead length i.e. - that required to pass thru wall, pipe fittings, etc. is taken into account when choosing the necessary well insertion length.

Bore Size - The Interchangeability Factory

Several types of temperature measuring instruments are used in most installations. The selection of a standard bore diameter provides extreme flexibility; the same well can accommodate thermocouple resistance thermometer, bi-metal thermometer, or test thermometer.

The bore size of wells shown in this catalog cover the most commonly used temperature sensing elements as follows:

.260 Diameter Bore: Bi-metal Thermometers (1/4" stem)
Thermocouples - (#20 Gauge)
Liquid-in-glass Test thermometers (Unarmored)
Other elements having .252" maximum diameter.

.385 Diameter Bore: Bi-metal Thermometers (3.8" Stem)
Thermocouples - (#14 Gauge)
Liquid-in-glass Test thermometers (Armored)
Other elements having .377" maximum diameter.

Tapered or Straight Shank - The Velocity Rating Factor

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

Thermo-Couple Products Co.

INTRODUCTION TO THERMOWELLS

Thermowell Material Selection Guide

Application	Material
Heat Treating	
Annealing	
Up to 704˚C (1300˚F)	Black Steel
Over 704˚C (1300˚F)	Inconel 600,[a] Type 446 SS
Carburizing Hardening	
Up to 816˚C (1500˚F)	Black Steel
1093˚C (1500 to 2000˚F)	Inconel 600,[a] Type 446 SS
Over 1093˚C (200˚F)	Ceramic[b]
Nitriding salt baths	Type 446 SS
Cyanide	Nickel (CP)
Neutral	Type 446 SS
High Speed	Ceramic[b]
Iron and Steel	
Basic oxygen furnace	Quartz
Blast furnaces	
Downcomer	Inconel 600, Type 446 SS
Stove dome	Silicon carbide
Hot blast main	Inconel 600
Stove trunk	Inconel 600
Stove outlet flue	Black steel
Open hearth	
Flues and stack	Inconel 600, Type 446 SS
Checkers	Inconel 600, Cermets
Waste heat boiler	Inconel 600, Type 446 SS
Billet heating slab heating and butt welding	
Up to 1093˚C (2000˚F)	Inconel 600, Type 446 SS
Over 1093˚C (2000˚F)	Silicon ceramic carbide[b]
Bright annealing batch	
Top work temperature	Not required (use bare Type J thermocouple)
Bottom work temperature	Type 446 SS
Continuous furnace section forging	Inconel 600, ceramic[b]
Soaking pits	
Up to 1093˚C (2000˚F)	Inconel 600
Over1093˚C (2000˚F)	Silicon ceramic carbide[b]
Nonferrous Metals	
Aluminum	
Melting	Cast iron (white-washed)
Heat treating	Black steel
Brass or bronze	Not required (use dip-type thermocouple)
Lead	Type 446 SS, black steel
Magnesium	Black steel, cast iron
Tin	Extra heavy carbon steel
Zinc	Extra heavy carbon steel
Pickling tanks	Chemical Lead
Cement	
Exit flues	Inconel 600, Type 446 SS
Kilns, heating zone	Inconel 600

[a] Trademark of the International Nickel Co.
[b] Due to susceptibility to cracking, sudden thermal shocks should be avoided.
[c] Due to susceptibility to cracking, sudden thermal shocks should be avoided.

Thermowell Material Selection Guide

Application	Material
Ceramic	
Kilns	Ceramic[b] and silicon carbide[c]
Dryers	Silicon carbide, black steel
Vitreous enameling*	Inconel 600, Type 446 SS
Glass	
Fore hearths and feeders	Platinum thimble
Lehrs	Black steel
Tanks	
Roof and wall	Ceramic[a]
Flues and checkers	Inconel 600, Type 446 SS
Paper	
Digesters	Type 316 SS, Type 446 SS
Petroleum	
Dewaxing	Type 304, 310, 316, 321, 347 SS carbon steel
Towers	Type 304, 310, 316, 321, 347 SS carbon steel
Tranfer lines	Type 304, 310, 316, 321, 347 SS carbon steel
Factioning column	Type 304, 310, 316, 321, 347 SS carbon steel
Bridgewall	Type 304, 310, 316, 321, 347 SS carbon steel
Power	
Coal-air mixtures	304SS
Flue gases	Black steel, Type 446 SS
Preheaters	Black steel, Type 446 SS
Steel lines	Type 347 or 316 SS
Water Lines	Low carbon steels
Boiler tubes	Types 304, 309 or 310 SS
Gas Producers	
Producers gas	Type 446 SS
Water gas	
Carburetor	Inconel 600, Type 446 SS
Superheater	Inconel 600, Type 446 SS
Tar stills	Low carbon steels
Incinerators	
Up to 1093˚C (2000˚F)	Inconel 600, Type 446 SS
Over 1093˚C (2000˚F)	Ceramic (primary) silicon carbide (secondary)[a]
Food	
Baking ovens	Black steel
Charretort, sugar	Black steel
Vegetables and fruit	Type 304 SS
Chemical	
Acetic acid	
10 to 50% 21˚C (70˚F)	Type 304, Hastelloy C,[d] Monel
50% 100˚C (212˚F)	Type 316, Hastelloy C,[d] Monel
99% 21 to 100˚C (70 to 212˚F)	Type 430, Hastelloy C,[d] Monel
Alcohol, ethyl, methyl	
21 to 100˚C (70 to 212˚F)	Type 304
Ammonia	
All concentration 21˚C (70˚F)	Type 304, 316 SS
Ammonium cloride	
All concentration 100˚C (70˚F)	Type 316 SS, Monel

[d] Trademark of the Cabot Corp.
[e] Trademark of the Driver-Harris Co.
[f] Trademark of the Driver-Harris Co.

INTRODUCTION TO THERMOWELLS

Thermowell Material Selection Guide

Application	Material
Chemical (continued)	
Ammonium nitrate All concentration 21˚C to 100˚C (70 to 212˚F)	Type 316 SS
Ammonium sulphate, 10% to saturated 100˚C (212˚F)	Type 316 SS
Barium chloride, all concentrations, 21˚C (70˚F)	Monel, Hastelloy C
Barium hydroxide, all concentrations, 21˚C (70˚F)	Low carbon steels
Barium sulphite	Nichrome,[c] Hastelloy C
Brines	Monel
Bromine	Tantalum Monel
Butadiene	Type 304 SS
Butane	Type 304 SS
Butylacetate	Monel
Butyl alcohol	Copper, Type 304 SS
Calcium, Chlorate, dilute	Type 304 SS
Calcium hydroxide 10% to 20% 100˚C (212˚F) 50% 100˚C (212˚F)	Type 304 SS, Hastelloy C Type 316 SS, Hastelloy C
Carbolic acid, all, 100˚C (212˚F)	Type 316 SS
Carbon dioxide, wet or dry	2017-T4 aluminum, Monel, nickel
Chlorine gas Dry, 21˚C (70˚F) Moist, -7 to 100˚C (20 to 212˚F)	Type 316 SS, Monel Hastelloy C
Chromic acid, 10% to 20% 100˚C (212˚F)	Type 316 SS, Hastelloy C (all concentrations)
Citric acid 15% 21˚C (70˚F) 15% 100˚C (212˚F) Concentrated,100˚C(212˚F)	Type 304 SS, Hastelloy C (all concentrations) Type 316 SS, Hastelloy C (all concentrations) Type 316 SS, Hastelloy C (all concentrations)
Copper nitrate	Types 304 SS, 316 SS
Copper sulphate	Types 304 SS, 316 SS
Cresols	Types 304 SS
Cyanogen gas	Type 304 SS
Dow therm[f]	Low carbon steels
Ether	Type 304 SS
Ethyl acetate	Monel, Type 304 SS
Ethyl chloride, 21˚C (70˚F)	Type 304 SS, low carbon steel
Ethyl sulphate, 21˚C (70˚F)	Monel
Ferric chloride, 5% 21˚C (70˚F) to boiling	Tantalum, Hastelloy C
Ferric sulphate, 5% 21˚C (70˚F)	Type 304 SS
Ferrous sulphate, dilute, 21˚C (70˚F)	Type 304 SS
Formaldehyde	Types 304 SS, 316 SS
Formic acid, 5% 21˚C to 66˚C (70˚ to 150˚F)	Type 316 SS
Freon	Monel

Material Selection Guide

Application	Material
Chemical (continued)	
Gallic acid, 5% 21˚C to 66˚C (70˚ to 150˚F)	Monel
Gasoline, 21˚C (70˚F)	Type 304 SS, low carbon steel
Glucose, 21˚C (70˚F)	Type 304 SS
Glycerine, 21˚C (70˚F)	Type 304 SS
Glycerol	Type 304 SS
Hydrobromic acid, 98% 100˚C (212˚F)	Hastelloy B
Hydrochloric acid, 1%, 5% 21˚C (70˚F) 1%, 5% 100˚C (212˚F) 25% 21 to 100˚C (212˚F)	Hastelloy C Hastelloy B Hastelloy B
Hydrofluoric acid, 60% 100˚C (212˚F)	Hastelloy C, Monel
Hydrogen peroxide, 21 to 100˚C (212˚F)	Types 316SS, 304 SS
Hydrogen sulphide, wet and dry	Types 316SS
Iodine, 21˚C (70˚F)	Tantalum
Lactic acid 5% 21˚C (70˚F) 5% 66˚C (150˚F) 10% 100˚C 212˚F)	Type 304 SS Type 316 SS Tantalum
Magnesium chloride, 5% 21˚C (70˚F) 5% 100˚C 212˚F)	
Magnesium sulphate, hot and cold	Monel
Muriatic acid, 21˚C (70˚F)	Tantalum
Naptha, 21˚C (70˚F)	Type 304 SS
Natural gas, 21˚C (70˚F)	Type 304 SS
Nickel chloride, 21˚C (70˚F)	Type 304 SS
Nickel sulphate, hot and cold	Type 304 SS
Nitric acid 5% 21˚C (70˚F) 20% 21˚C (70˚F) 50% 100˚C (212˚F) 65% 100˚C (212˚F) Concentrated, 21˚C (70˚F) Concentrated, 100˚C (212˚F)	Type 304 SS, 316 SS Type 304 SS, 316 SS Type 304 SS, 316 SS Type 316 SS Type 304 SS, 316 SS Tantalum
Nitrobenzene, 21˚C (70˚F)	Type 304 SS
Oleic acid, 21˚C (70˚F)	Type 316 SS
Oleum, 21˚C	Type 316 SS
Oxalic acid 5% hot and cold 10% 100˚C (212˚F)	Type 304 SS Monel
Oxygen 21˚C (70˚F)	Steel
Liquid	SS
Elevated temperatures	SS
Palmitic acid	Type 316 SS
Pentane	Type 340 SS
Phenol	Types 304 SS, 316 SS

[a] Trademark of the International Nickel Co.
[b] Due to susceptibility to cracking, sudden thermal shocks should be avoided.
[c] Due to susceptibility to cracking, sudden thermal shocks should be avoided.
[d] Trademark of the Cabot Corp.
[e] Trademark of the Driver-Harris Co.
[f] Trademark of the Driver-Harris Co.

Thermo-Couple Products Co.

INTRODUCTION TO THERMOWELLS

Thermowell Material Selection Guide

Application	Material
Chemical (continued)	
Phosphoric acid 1%, 5% 21˚C (70˚F) 10% 21˚C (70˚F) 10% 100˚C (212˚F) 30% 21 to 100˚C (70 to 212˚F) 85% 21 to 100˚C (70 to 212˚F)	Type 304 SS Type 316 SS Hastelloy C Hastelloy B Hastelloy B
Picric acid, 21˚C (70˚F)	Type 304 SS
Potassium bromide, 21˚C (70˚F)	Type 316 SS
Potassium carbonate, 1% 21˚C (70˚F)	Type 304 SS, Type 316 SS
Potassium chlorate, 21˚C (70˚F)	Type 304 SS
Potassium hydroxide 5% 21˚C (70˚F) 25% 100˚C (212˚F) 60% 100˚C (212˚F)	Type 304 SS Type 304 SS Type 316 SS
Potassium nitrate 5% 21˚C (70˚F) 5% 100˚C (212˚F)	Type 304 SS Type 304 SS
Potassium permanganate, 5% 21˚C (70˚F)	Type 304 SS
Potassium sulphate, 5% 21˚C (70˚F)	Type 304 SS, Type 316 SS
Potassium sulphide, 5% 21˚C (70˚F)	Type 304 SS, Type 316 SS
Propane	Type 304 SS, low carbon steel
Pyrogallic acid	Type 304 SS
Quinine bisulphate, dry	Type 316 SS
Quinine sulphate, dry	Types 304 SS
Seawater	Monel or Hastelloy C
Salicylic acid	Nickel
Sodium bicarbonate All concentrations, 21˚C (70˚F) 5% 66˚C (150˚F)	Types 304 SS Types 304 SS, 316 SS
Sodium carbonate, 5% 21˚C to 66˚C (70˚ to 150˚F)	Types 304 SS, 316 SS
Sodium chloride, 5% 21˚C to 66˚C (70˚ to 150˚F) Saturated 21 to 100˚C (70 to 212˚F)	Types 316 SS Types 316 SS, Monel
Sodium fluoride, 5% 21˚C (70˚F)	Monel
Sodium hydroxide	Types 304 SS, 316 SS, Hastelloy C
Sodium hypochlorite, 5% still	Types 316 SS, Hastelloy C
Sodium nitrate, fused	Type 316 SS
Sodium peroxide	Type 304 SS
Sodium sulphate, 21˚C (70˚F)	Types 304 SS, 316 SS
Sodium sulphide, 21˚C (70˚F)	Type 316 SS
Sodium sulphite, 30% 66˚C (150˚F)	Type 304 SS
Sodium dioxide Moist gas, 21˚C (70˚F) Gas, 302˚C (575˚F)	Type 316 SS Types 304 SS, 316 SS
Sulphur Dry Molten Wet	Type 304 SS Type 316 SS

Thermowell Material Selection Guide

Application	Material
Chemical (continued)	
Sulphuric acid 5% 21 to 100˚C (70 to 212˚F) 10% 21 to 100˚C (70 to 212˚F) 50% 21 to 100˚C (70 to 212˚F) 90% 21˚C (70˚F) 90% 100˚C (212˚F)	Hastelloy B, Type 316 SS Hastelloy B Hastelloy B Hastelloy B Hastelloy D
Tannic acid, 21˚C (70˚F)	Type 304 SS, Hastelloy B
Tartaric acid, 21˚C (70˚F) 66˚C (150˚F)	Type 304 SS Type 316 SS
Toluene	2017-T4 aluminum, low carbon steel
Turpentine	Types 304 SS, 316 SS
Whiskey and wine	Types 304 SS, nickel
Xylene	Copper
Zinc chloride	Monel
Zinc sulphate 5% 21˚C (70˚F) Saturated, 21˚C (70˚F) 25% 100˚C (212˚F)	Types 304 SS, 316 SS Types 304 SS, 316 SS Types 304 SS, 316 SS

Thermo-Couple Products Co.

Reference Charts and Tables on pages 67-69 are courtesy of the American Society for Testing and Materials. Taken from publication STP 47OB, "Manual on the Use of Thermocouples in Temperature Measurement."

[a] Trademark of the International Nickel Co.
[b] Due to susceptibility to cracking, sudden thermal shocks should be avoided.
[c] Due to susceptibility to cracking, sudden thermal shocks should be avoided.
[d] Trademark of the Cabot Corp.
[e] Trademark of the Driver-Harris Co.
[f] Trademark of the Driver-Harris Co.