NOTICE:

Prices and availability are subject to change without notice.

Please contact Marlin Manufacturing before ordering for updated pricing.

PROTECTING TUBES THERMOWELLS

Acets Ac	Acetime	CORRODENT	TEMP. °F.	CONC.	RECOM. MATERIAL	CORRODENT	TEMP °F.	. CONC.	RECOM. MATERIAL	CORRODENT	TEMP.	CONC.	RECOM. MATERIAL
Action Action	Content Cont	Acetic Acid	212	ALL	Monel	Copper Plating Solution	180		304 SS	Oleic Acid	S	EE FATT	Y ACIDS
Activation A	Metapole	Acetic Anhydride	300		Nickel	(Cyanide)				Oxalic Acid	212	ALL	Monel
Mathematical Mat	Mathematical Mat	Acetone	212	ALL	304 SS		75		304 SS	Photographic Bleaching	100	ALL	304 SS
Author Conting	Mathematical Composition Mathematical Compos	Acetylene	400		304 SS	100	200		204.00				Y ACIDS
Name (Polisatisation of Social Circle (Code) 10 (10 (10 (10 (10 (10 (10 (10 (10 (10	Cloude Distribution or South Distribution Office or South Office or South Distribution Office or South Offi	Alcohols	212	ALL	304 SS			***					
Authority Cholson 1	Authority Control 1968 1969 1							ALL		•			
Maminum Chloride 72	Maminum Chloride	•		,,,,,	11001.								
Ammonisunferifier 21	Mammonisulfief 24	Aluminum Chloride	212	ALL	Hast. B			LACQUE		-		ODIOWIC	
Ammonia, Aquanti, Dy	Ammoniush Pythology 24	Aluminum Sulfate	212	ALL	316 SS							4000/	
Ammonium Hydroding (minorium, Age) (minorium Hydroding) 1 (1 minorium) 1 (1 min	Ammonium Hydroding (Ammonia, Age) Ammonium Chloride Ammonium Chloride Ammonium Chloride Ammonium Chloride Ammonium Chloride Ammonium Chloride Ammonium Sulfate Ammonium Sulfat	Ammonia, Dry	212	ALL	304, 316 SS							100%	
Mamonium Nirate	Mannonium Nirate		212	ALL	304, 316 SS		212	ALL	304 SS			A1.1	
Ammonium Nindried 300 50% Monel Ammonium Nintried 200 ALL 304 SS Fatty Acids 50 ALL 316 SS Sodium Blaughhet 212 20% 304 SS Ammonium Sulfate 212 ALL 304 SS Fatric Chioride 75 ALL Hast. C Sodium Blaughhet 212 20% 304 SS Ammy Acatate 300 ALL 304 SS Fatric Chioride 300 ALL 304 SS Sodium Chloride 300 30% All 316 SS Sodium Chromate 212 40% 304	Ammonium Chloride 300 9,0 % Monel 7 Fatty Acids 50 ALL 316 SS Sodium Baluphine 212 20% 904 SS Ammonium Sulfate 300 ALL 304 SS Fatric Chloride 370 4LL 404 SS Sodium Baluphine 212 20% 904 SS Ammonium Sulfate 210 40% 316 SS Sodium Sulfate 210 20% 904 SS Ammonium Sulfate 300 ALL 304 SS	(Ammonia, Aqua)					75		Steel				
Ammonium Niritatia 300 ALL 316 SS Ferric Chloride 75 ALL Hast. Sodium Buliphitae 212 AL 316 SS Ferric Sulfate 300 ALL 304 SS Sodium Chromate 212 AU 316 SS Amy Acetate 300 ALL 316 SS Ferric Sulfate 300 ALL 304 SS Sodium Chromate 212 ALL 316 SS Amy Acetate 300 ALL 304 SS Sodium Chromate 212 ALL 316 SS Amy Acetate 250 SO 304 SS Formic Acid 300 ALL 316 SS Sodium Chromate 212 ALL 316 SS Amy Acetate 250 SO 304 SS Formic Acid 300 ALL 316 SS Sodium Chromate 212 ALL 316 SS Amphater (Industrial and Marine) Fuerina And Marine 300 ALL 316 SS Sodium Chromate 212 ALL 316 SS Formic Acid 300 ALL 316 SS Sodium Chromate 212 ALL 316 SS Sodium Chromate 312 ALL 316	Ammonium Niritate 312 AL 316 SS Ferric Chioride 75 AL Hast. Sodium Bisulphite 212 QN 304 SS Ammonium Niritate 312 AL 316 SS Ferric Chioride 75 AL Hast. Sodium Chioride 212 QN 304 SS Amyl Acetate 300 AL 304 SS Sodium Chrisinate 212 AL 316 SS Amyl Acetate 300 AL 304 SS Sodium Chrisinate 212 AL 316 SS Amyl Acetate 300 AL 304 SS Sodium Chrisinate 212 AL 316 SS Amyl Acetate 300 AL 316 SS Sodium Chrisinate 212 AL 316 SS Amyl Acetate 300 AL 316 SS Sodium Chrisinate 212 AL 316 SS Sodium Chrisinate 312 AL 316 SS Sodium Silicate	Ammonium Chloride	300	50%	Monel			ALL					
Ammonim Sulfate 21	Ammonius Jullatus 212 ALL 316 SS Sodium Carbinate 212 AU 308 SISS 316 SS Sodium Carbinate 212 AU 306 SIS Sodium Carbinate 212 AU 316 SS Sodium Chronide 302 304 SS 316 SS Sodium Chronide 202 ALL 316 SS Sodium Chronide 212 ALL 316 SS 316 SS 316 SS Sodium Chronide 212 ALL 316 SS 316 SSS 316 SSS 31	Ammonium Nitrate	300	ALL	304 SS	**************************************				Companies (Control Control Con			
Amy Acatele	Amyl Acetale	Ammonium Sulfate	212	ALL	316 SS								
Animal 75 Monals 75 Monal	Animale 75 Monels	Amyl Acetate	300	ALL	304 SS					Sodium Carbinate		40%	316 SS
Aghalf Solution	Asphalt 250 354 SS Froon 300 Stell Salt or Brine SEE SOULM-CHOIRDIE Choir	Aniline	75		Monel	A				Sodium Chloride	300	30%	Monel
Manusphere, (Industrial and Martham 1968 304 SS 3	Name Part	Asphalt	250		304 SS			ALL		Sodium Chromate	212	ALL	316 SS
Barium Compounds	Barium Compounds				304 SS					Salt or Brine	SEE S	SODIUM	CHLORIDE
Beneric Part Par	Bear 70 304 SS Gasoline 300 51 Stele Solium Hypochorine 75 76 4st. C September 75 76 75 75	V 400-000 100 100 100 100 100 100 100 100 1		F 044 04						Sodium Cyanide	212	ALL	304 SS
Benzene (Benzol)	Benzane (Benzor)			E CALCII						Sodium Hydroxide	212	30%	316 SS
Benzoic Acid 212	Benzoic Acid									Sodium Hypochlorite	75	10%	Hast. C
Bleaching Powder 70 15% Monel Glycerine 212 ALL Brass Sodium Phosphate 212 10% Steel	Bleaching Powder 70 15% Monel Giycerine 212 ALL Brass Sodium Phosphate 212 10% Steel					Glucose	300		304 SS	Sodium Nitrate	212	40%	304 SS
Borax 212 ALL Brass Hydrophromic Acid 212 ALL Hast. C Sodium Friaginine 212 10% Steel	Borax 212 ALL Brass		212	ALL	316 SS	Glue ph 6-8	300	ALL	304 SS	Sodium Nitrite	75	20%	316 SS
Bordeaux Mixture 200	Bordeaux Mixture 200	Bleaching Powder	70	15%	Monel	Glycerine	212	ALL	Brass	Sodium Phosphate	212	10%	Steel
Boric Acid	Boric Acid 400	Borax	212	ALL	Brass	Hydrobromic Acid	212	ALL	Hast. C	Sodium Silicate	212	10%	Steel
Boric Acid 400	Boric Acid 400	Bordeaux Mixture	200		304 SS		225	ALL	Hast. B	Sodium Sulfate	212	30%	316 SS
Bromine 125	Bromine 125 DRY Mone Hydrocyanic Acid 212 ALL 304 SS Sodium Sulfite 212 304 SS Sodium Thiosulfate 212 ALL 304 SS Sodium Thi	Boric Acid	400	ALL	316 SS		500		204 88	Sodium Sulfide	212	10%	316 SS
Butne 400 ALL Steel Hydrofluoric Acid 212 6% Monel Scale Scale 304 SS Butyl Alcohol 212 Hast. C Hydrogen Fluoride, Dry 175 Steel Steam 304 SS Butyric Acid 212 Hast. C Hydrogen Peroxide 212 40% Monel Stearic Acid SEE HEACT SEE HEACT 100 SEE HEACT Scale Incompleting SEE Jack Steam 304 SS SEE Jack SEE Jack 304 SS SEE Jack Steam 304 SS SEE Jack SEE Jack Monel Steam Sulfur Chloride 75 ALL Hast. C Hydrogen Peroxide 125 10-10% 304 SS Sulfur Chloride 75 DRY 316 SS Calcium Hydroxide 300 20% Hast. C Hydrogen Peroxide 125 ALL 316 SS Sulfur Chloride 75 DRY 316 SS Calcium Hydroxide 500 PSE PENDL Lactore & Thinners 300 ALL 316 SS Sulfur Chloride <	Butne 400	Bromine	125	DRY	Monel	•		A1.1		Sodium Sulfite	212	30%	304 SS
Butyric Acid 212	Set Alcohol Set Alcohol Set Alcohol Alcoho	Butane	400	ALL	Steel					Sodium Thiosulfate	212	ALL	304 SS
Butyric Acid 212	Butyric Acid 212	Butyl Alcohol	S	SEE ALCO	OHOLS			00%		Steam			304 SS
Calcium Bisulphite 75 ALL ALL Hast. C Hydrogen Peroxide 125 10-100% 304 SS Sugar Solutions SEE GLUCOSE Calcium Chloride 212 ALL ALL Hast. C Hydrogen Peroxide 125 10-100% 304 SS Sulfur 500 304 SS Calcium Hydroxide 300 20% Hast. C Kerosene 300 ALL 304 SS Sulfur Chloride 75 DRY 316 SS Calcium Hypochlorite SEE BLEACHING POWDER Lacquers & Thinners 300 ALL 316 SS Sulfur Dioxide 500 DRY 316 SS Carbon Dioxide, Dry 800 ALL Brass Lime 212 ALL 316 SS Sulfur Chloride 500 DRY 316 SS Carbon Dioxide, Dry 800 ALL Brass Lime 212 So M Nickel Sulfuric Acid 212 10-90% Hast. B Carbon Dioxide, Dry 801 ALL Steel 304 SS Magnesium Chloride 212 50% Nickel Sulfuric Acid 212 10-90% Hast. B Carbon Dioxidie 202 304 SS Magnesium Hydroxide (or Oxide) 75 ALL 304 SS Sulfurous Acid 75 20% 316 SS Carbon Tetrachloride 125 ALL Monel Mercuric Chloride 75 10% Hast. C Trianium Tetrachloride 75 ALL 316 SS Chlor	Calcium Bisulphite 75 ALL Hast. C Hydrogen Peroxide 125 10-100% 304 SS Sugar Solutions SEE GLUCOSE Calcium Chloride 212 ALL Hast. C Kerosene 300 ALL Steel Sulfur 500 304 SS Calcium Hydroxide 300 20% Hast. C Kerosene 300 ALL 304 SS Sulfur Chloride 75 DRY 316 SS Calcium Hydroxide SEE BLEACHING POWDEN Lactic Acid 300 ALL 316 SS Sulfur Chloride 500 DRY 316 SS Carbon Chloride SEE PHENOL Lime 212 ALL 316 SS Sulfuric Acid 212 DN 316 SS Carbon Dioxide, Dry 800 ALL Brass Lime 212 ALL 316 SS Sulfuric Acid 212 10% 316 SS Carbon Dioxide, Dry 212 ALL 304 SS Magnesium Chloride 75 ALL 304 SS Sulfuric Acid 212 10% 316 SS <td>Butyric Acid</td> <td>212</td> <td></td> <td>Hast. C</td> <td></td> <td></td> <td>100/</td> <td></td> <td>Stearic Acid</td> <td>SE</td> <td>E FATTY</td> <td>ACIDS</td>	Butyric Acid	212		Hast. C			100/		Stearic Acid	SE	E FATTY	ACIDS
Calcium Chloride 212 ALL Hast. C Kerosene 300 ALL Steel Sulfur Chloride 75 DRY 316 SS Calcium Hydroxide 300 20% Hast. C Lacquers & Thinners 300 ALL 304 SS Sulfur Chloride 75 DRY 316 SS Carbon Loxide SEE PLEXCHING POWDER Lactic Acid 300 ALL 316 SS Sulfur Dioxide 500 DRY 316 SS Carbon Dioxide, Dry 800 ALL Brass Lime 212 ALL 316 SS Sulfur Chloride 500 DRY 316 SS Carbon Dioxide, Dry 800 ALL Brass Lime 212 ALL 316 SS Sulfur Cacid 212 10% 316 SS Carbon Dioxide Water 212 ALL 304 SS Magnesium Chloride 212 50% Nickel Sulfur Cacid 212 10% 316 SS Carbon Dioxilfide 200 304 SS Magnesium Chloride 75 ALL 304 SS	Calcium Chloride 212 ALL All All All Common Chloride ALL All All Common Chloride 300 ALL Steel Sulfur Chloride 75 DRY 316 SS Calcium Hydroxide 300 20% Hast C Lacquers & Thinners 300 ALL 316 SS Sulfur Chloride 75 DRY 316 SS Carbon Loxide Acid SEE BLEACHING POWDER Lactic Acid 300 ALL 316 SS Sulfur Dioxide 500 DRY 316 SS Carbon Loxide, Dry 800 ALL Brass Lime 212 ALL 316 SS Sulfur Chloride 212 10-90% Hast. B Carbonated Water 212 ALL 304 SS Magnesium Chloride 212 50% Nickel Sulfuric Acid, Fuming 175 Hast. C Hast. C Carbon Disulfide 200 304 SS Magnesium Chloride (or Oxide) 75 ALL 304 SS Sulfurous Acid 75 20% 316 SS Carbon Disulfide 200 304 SS Magnesium Hydroxide (or Oxide) 75 ALL 304 SS Sulfurous Acid 75 20% 316 SS Carbon Tetrachloride 125 ALL Monel Mescuric Chloride 75 10% Hast. C Titanium Tetrachloride 75 40% Hast. B Chlorine, Moist 100 ALL Monel Mercuric Chloride 75 10% Hast. C Tannic Acid 75 ALL Hast. B Chloroform, Dry <td>Calcium Bisulphite</td> <td>75</td> <td>ALL</td> <td>Hast. C</td> <td></td> <td></td> <td></td> <td></td> <td>Sugar Solutions</td> <td>5</td> <td>SEE GLU</td> <td>COSE</td>	Calcium Bisulphite	75	ALL	Hast. C					Sugar Solutions	5	SEE GLU	COSE
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Carbolic Acid SEE PHENOL Lactic Acid 300 ALL 316 SS Sulfur Trioxide 500 DRY 316 SS Carbon Dioxide, Dry 800 ALL Brass Lime 212 ALL 316 SS Sulfuric Acid 212 10% 316 SS Carbonated Water 212 ALL 304 SS Magnesium Chloride 212 50% Nickel Sulfuric Acid 212 10% 48t. B Carbon Disulfide 200 304 SS Magnesium Hydroxide (or Oxide) 75 ALL 304 SS Sulfuric Acid, Fuming 175 Hast. C Carbon Tetrachloride 125 ALL Monel Magnesium Sulfate 212 40% 304 SS Titanium Tetrachloride 75 ALL 316 SS Chlorine, Dry 100 Monel Mercuric Chloride 75 10% Hast. C Tannic Acid 75 ALL 316 SS Chlorine, Dry 100 ALL Monel Mercury 700 100% Steel Toluene 75 <td< td=""><td>Carbolic Acid SEE PHENOL Lactic Acid 300 ALL 316 SS Sulfur Trioxide 500 DRY 316 SS Carbon Dioxide, Dry 800 ALL Brass Lime 212 ALL 316 SS Sulfuric Acid 212 10% 316 SS Carbonated Water 212 ALL 304 SS Linseed Oil 75 Steel Sulfuric Acid 212 10% 48s. B Carbonated Beverages 212 304 SS Magnesium Chloride 212 50% Nickel Sulfuric Acid 212 10% 48s. B Carbon Disulfide 200 304 SS Magnesium Hydroxide (or Oxide) 75 ALL 304 SS Sulfurous Acid 75 20% 316 SS Carbon Tetrachloride 125 ALL Monel Magnesium Sulfate 212 40% 304 SS Titanium Tetrachloride 75 ALL 316 SS Chlorine, Dry 100 ALL Monel Mercury 700 100% Steel Toluene 75</td><td>Calcium Hypochlorite</td><td>SEE BI</td><td>LEACHIN</td><td>G POWDER</td><td></td><td></td><td></td><td></td><td>Sulfur Dioxide</td><td>500</td><td>DRY</td><td>316 SS</td></td<>	Carbolic Acid SEE PHENOL Lactic Acid 300 ALL 316 SS Sulfur Trioxide 500 DRY 316 SS Carbon Dioxide, Dry 800 ALL Brass Lime 212 ALL 316 SS Sulfuric Acid 212 10% 316 SS Carbonated Water 212 ALL 304 SS Linseed Oil 75 Steel Sulfuric Acid 212 10% 48s. B Carbonated Beverages 212 304 SS Magnesium Chloride 212 50% Nickel Sulfuric Acid 212 10% 48s. B Carbon Disulfide 200 304 SS Magnesium Hydroxide (or Oxide) 75 ALL 304 SS Sulfurous Acid 75 20% 316 SS Carbon Tetrachloride 125 ALL Monel Magnesium Sulfate 212 40% 304 SS Titanium Tetrachloride 75 ALL 316 SS Chlorine, Dry 100 ALL Monel Mercury 700 100% Steel Toluene 75	Calcium Hypochlorite	SEE BI	LEACHIN	G POWDER					Sulfur Dioxide	500	DRY	316 SS
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In recommending the above materials, consideration has been given to providing good service life without undue cost. Where two or more materials are satisfactory, the least expensive is listed. Consult the factory for information on materials or services not given. Other factors which will influence corrosion rates include: degree and frequency of temperature fluctuation, concentration, arations of fluids, high velocities or abrasives in the fluid stream, flashing or cavitating conditions, etc. Therefore the data presented should be interpreted as one basis for material selection and not as a complete recommendation.

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Marlin

THERMOWELLS GENERAL

Thermowells

Thermowells provide maximum protection for thermal sensors from corrosion, pressure and flow induced stresses. When selecting thermowells these parameters determine the type and material that should be used. In general, thermowells are machined from solid bar stock for "A" dimensions to 24" but for longer lengths a built-up design is used.

General Application Considerations

Select sensor location for representative temperature measurement.

Provide sufficient depth of immersion so that heat transfer along the instrument does not influence temperature measurement.

Select materials that are compatible with corrosive media elements.

Select thermowell with sufficient stiffness to resist destruction from flow induced stresses.

Thermowell Materials

Strength at operating temperature and resistance to corrosion are the primary considerations in material selection. A corrosion guide is supplied in the general Data Section.

General Material Considerations

Carbon Steels can be used to 1300° F (700° C) usually in oxidizing atmospheres.

Austentitic Stainless Steels (300 series) can be used to 1600° F (870° C) mostly in oxidizing atmospheres although type 316 can be used in some reducing environments.

Ferritic Stainless Steels (400 series) can be used to the 1800° F (982° C) — 2100° F (1149° C) range in both oxidizing and reducing atmospheres.

High Nickel Alloys can be used to 2100° F (1149° C) in oxidizing atmospheres.

Material Code	MATERIAL	Melting Point	Recom- mended Operating Atmosphere	Maximum Operating Temp. in Atmosphere	
	STAINLESS STEELS				
304	304	2560	ORNV	1650	
310	310	2560	ORNV	2100	
316	316	2500	ORNV	1700	
321	321	2550	ORNV	1600	
347	347	2600	ORNV	1600	
446	446	2700	ORNV	2000	
CS	Carbon Steel	2500	ON	1300	
INC	Inconel™	2550	ONV	2100	
INX	Inconel X™	2620	ONV	1500	
INY	Incoloy™	2500	ON	1600	
HTX	Hastelloy X™	2300	0	2200	
HTC	Hastelloy C™	2310	0	1800	
HTB	Hastelloy B™	2375	OR	1400	
MON	Monel™	2460	OR	1000	
BR	Brass	1850	0	650	
AL	Aluminum	1220	0	700	
NCK	Nickel	2647	0	1400	
TRN	Tantalum	5425	V	5000	
TIT	Titanium	3035	VN	2000	

O = Oxidizing R = Reducing N = Neutral V = Vacuum

Velocity Rating

Once the selection of material is made attention should be given to the parameter of flow induced stresses. Fluids flowing by a well form a turbulent wake called the Von Karman Trail. This wake has a definite frequency based on the diameter of the well and the fluid velocity. It is important to provide a well with sufficient stiffness so that the wake frequency will never exceed the natural frequency of the well itself. Should the natural frequency of the well coincide with the wake frequency the well would vibrate to destruction. Tapered shank wells provide greater stiffness for the same sensitivity than a straight shank well. The higher strength to weight ratio gives these wells a higher natural frequency and therefore are able to operate at higher fluid velocities. Recommended maximum velocity rating can be found for every standard well length and material catalogued. Ratings are based on operating temperatures as shown in the table below.

Material	Velocity Rating Operating Temperature
Carbon Steel (C1018) 304 SS 316 SS	1000° F (538° C)
Monel	900° F (482° C)
Brass	350° F (177° C)

Single values that appear in the velocity tables may be considered safe for water, steam, air or gas. Double values distinguish between water (parenthesized) and steam, air and gases. These values are intended as general guides to selection. If you have operating conditions requiring special well designs our engineering staff is available to assist you.

Pressure Rating

The limit pressure versus temperature ratings are tabulated for various materials for each thermowell series.

Here is a typical table.

	LIMIT F	RESS (lbs/in			PERAT (°F)	URE		
MATERIAL	CODE			TEMP	ERATUR	E-°F		
MATERIAL	CODE	70°	200°	400°	600°	800°	1000°	1200°
Brass	BR	5000	4200	1000	_	_	_	_
Carbon Steel	CS	5200	5000	4800	4600	3500	1500	_
A.I.S.I. 304	304	7000	6200	5600	5400	5200	4500	1650
A.I.S.I. 316	316	7000	7000	6400	6200	6100	5100	2500
Monel	MON	6500	6000	5400	5300	5200	1500	_

Selection of material and/or equipment is at the sole risk of the user of this publication. The data presented does not and should not preclude professional engineering design and consulting for your particular application. Marlin Manufacturing Corporation, its distributors, representatives, and the contributors to this publication specifically deny any warranty expressed or implied.



THERMOWELLS MECHANICAL APPLICATION CONSIDERATION

Process Connection supports and/or seals the thermowell into the process system.

Types:

Threaded one piece well with NPT threads

(may require welding or brazing

for seal).

Flanged Welded a primary J groove weld and a

bevel groove secondary weld join the flange to the well. Flanges are

made to specification.

Lap Joint flanges are made to specification.

Socket Weld fits A.S.A. standard socket weld couplings for field installation.

is the inside diameter of the thermowell in

Bore Size is the inside diameter of the thermowell in which the temperature sensor will be located. Standard sizes are .260" or .385" with a \pm .002" tolerance.

Instrument Connection supports and/or seals the temperature sensor into the thermowell bore. Standard connection is a ½" NPS thread. An optional brass or stainless steel captive cap is available for keeping the well bore clean when not in use.

Shank Constructions

Straight the outside diameter of the well is

consistent over its immersion length.

Reduced Diameter the outside diameter at the end of

well is reduced for greater sensor

sensitivity.

Tapered the outside diameter of the well

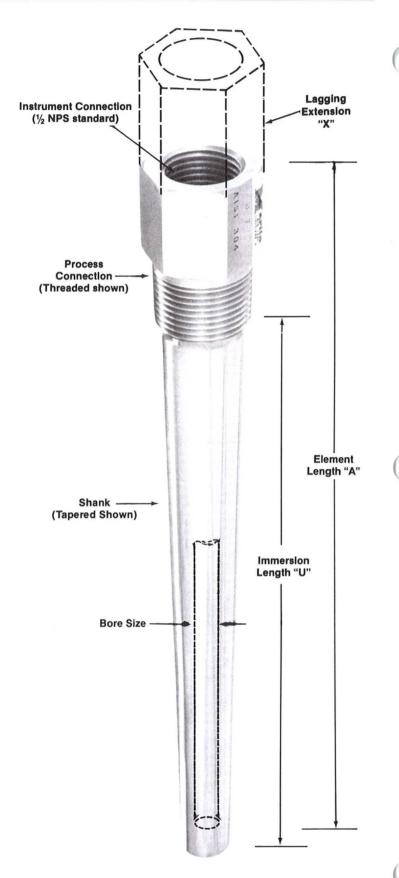
decreases along the immersion length for greater stiffness. (see

Velocity Ratings)

Immersion Length is the distance along the shank from the end of the well to the underside of the process connection. Immersion length implies that this is the portion of the well that sees the fluid or gas that is being monitored. Care must be taken so that dead lengths (required lengths to pass through walls, pipe fittings, etc.) and proper sensitivity lengths (lengths required for proper temperature measurement of the sensor) are taken into account.

Lagging Extension Length is the distance along the shank from the top side of the process connection to the termination connection of the well. If needed dead lengths (i.e.-that required to pass through walls, pipe fittings etc.) should be taken into account.

Note: For special thermowells please send your prints and/or specifications — Marlin will promptly quote price and delivery.





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