Made in USA

Sheath Material Selection Guide

CORROSION POLICY

TEMPCO cannot warrant any electric immersion heater against failure by sheath corrosion if such failure is the result of operating conditions beyond the control of the heater manufacturer. The facts and recommendations appearing in the TEMPCO catalog or any other literature published by TEMPCO are based on our own research and the research of others, and are believed to be accurate. We cannot anticipate all conditions under which this information and our products, or the products of other manufacturers in combination with our products, may be used.

We accept NO responsibility for results obtained by the application of this information or the safety and suitability of our products, either alone or in combination with other products. It is the responsibility of the Purchaser to make the ultimate choice of sheath material based on his/her knowledge of the chemical composition of the corrosive solution, character of materials entering the solution, and controls, which he/she maintains, on the process.

Examples of process variables that can affect heater sheath selection

- Solution chemistry
- Solution contamination
- Temperature
- Flow rate (velocity) past heater
- Heater watt density
- Heating cycle (time-on, time-off)
- Galvanic behavior
- Degree of aeration

SHEATH MATERIAL SELECTION GUIDE

Key to Notes in Sheath Material Selection Guide:

1. This solution contains a mixture of various chemical compounds whose identity and proportions are unknown or subject to change. Check with chemical supplier to confirm suitability of sheath material chosen.
2. Caution–flammable material.
3. Chemical composition varies widely. Check supplier for specific recommendations.
4. Direct immersion heaters not practical. Use clamp-on heaters on outside surface of cast iron pot.
5. Element surface loading should not exceed 20 watts per square inch.
6. For concentrations greater than 15%, element surface loading should not exceed 20 watts per square inch.
7. See suggested watt density chart.
8. Remove crusts at liquid level.
9. Clean often.
10. Passivate stainless steel, Inconel® and Incoloy®.

Maximum Recommended Watt Densities for Various Materials

Material Being Heated	Maximum Operating Temperature °F	Maximum Watt Density W/in²
Acid Solutions	180	40
Alkaline Solutions, Oakite	212	40
Ammonia Pltg. Solution	50	25
Asphalt, Tar or Heavy Compounds	200-500	4-10
Caustic Soda 2%	210	45
10%	210	25
75%	180	25
Degreasing Solution Vapor	275	20
Electroplating Solution	180	40
Ethylene Glycol	300	30
Fatty Acids	150	20
Fuel Oils		
Light Grade	180	25-30 circ.
Heavy (Bunker C)	160	8
Gasoline	300	23
Glycerine	500	10

Material Being Heated	Maximum Operating Temperature °F	Maximum Watt Density W/in²
Machine Oil SAE 30	250	15-20 non-circ.
Metal Melting Pot	500-900	20-27
Mineral Oil	400	16
Molasses	100	4-5
Molten Tin	600	20
Oil Draw Bath	600	20
Paraffin or Wax	150	16
Potassium Hydroxide	160	25
Propylene Glycol	150	20
Steel Tubing Cast Into Aluminum	500-750	50
Steel Tubing Cast Into Iron	750-1000	55
Trichlorethylene	150	20
Water (Process)	35-150	100-125 circ.
		75-100 non-circ.
	212	75 circ.
		50 non-circ.

Media Being Heated	Element Sheath Material: Iron & Steel	Gray Cast Iron	Cast Iron Ni-Resist	Aluminum	Copper	Lead	Monel 400	Nickel 200	304, 321, 347 Stn. Stl.	316 Stn. Stl.	Type 20 Stn. Stl.	Incoloy® 800	Inconel® 600	Titanium	Hastelloy B	Quartz	Graphite	Teflon®	*Notes
Acetaldehyde					A					A	A								Note 2
Acetic Acid, Crude	X		C	F	F	X	F	F	F	F		C	C						
Pure			X	A	F	F	A	F				C	C						
Vapors			X	C	F	X	F	F				C	C	F					
150 PSI; 400°F				C	F	X	F	F				C	C						
Aerated	X	X	X	C	X	X	X	X	X	F	F		X	A					
No Air		X	X	C	F	X	A	F	C	F	F		X	A					
Acetone	C	X	F	F	A	A	A	A	A	A	A	A	A	A	A	A			Note 2
Actane™ 70																A	A		Note 1
Actane™ 80																A	A		Note 1
Actane™ Salt																A			Note 1
Alboloy Process	A																		
Alcoa™ R5 Bright Dip																A		A	Note 1
Alcohol	F	F		F	A	A	A	A	F	A	A	A	A	A	A	A	A		Note 2
Allyl Alcohol		A	A	F	A	F	A	A	A	A	A	A	A	A					
Alcorite™															A				Note 1
Alkaline Cleaners									A										Note 1
Alkaline Soaking Cleaners	A																		Note 1
Alodine™										A									Note 1
Aluminum (Molten)	CONSULT TEMPCO																		
Aluminum Acetate	X	X			F	A	F	F	F	A	A		F	A	A				
Aluminum Bright Dip																A		A	Note 1
Aluminum Chloride	X	X		X	X	X	X	X	X	X	X	X	X	X	A	A	A	A	Note 1
Aluminum Cleaners	C	C		X	X	X	A	A	A	A	F	A	A	F		X	X		Notes 1, 9
Aluminum Potassium Sulfate (Alum)		X	X	X	A	F	F	F	X	C	F		F	F					
Aluminum Sulfate	X	X	X	X	X	F	X	X	F	F	F	X	X	A		A	A		Note 1
Ammonia	X	X		C	X	C	X	X	X	X	X	C	F	A	A	A	A		
Ammonia (Anhydrous) (Gas)	F				X				A	A									
Cold	C		A	A	A	F	A	A	A	A	A		A	A					
Hot	C		C		A	X	A	A	C	C	A		A						
Ammonia and Oil	A																		
Ammonium Acetate	A	F	F	A	X	X	A	A	A	A	A	A	A						
Ammonium Chloride	X	X	F	X	X	X	F	F	X	C	C	C	C	A		A	A	A	
Ammonium Hydroxide	F	F	F	C	X	F	X	A	A	A	A	A	A	A		X	A		
Ammonium Nitrate	F	X	C	F	X	X	X	X	A	A	A	X	X	X		A	A		
Ammonium Persulfate	X	X		X	X	C	X	X	F	F	F		X			A	A	A	
Ammonium Sulfate	X	X	F	X	X	F	F	F	C	F	F	F	F	A		A	A		
Amyl Acetate	F				A		A	A	A	A	A	A		A					
Amyl Alcohol	A	F	F	C	A		A	F	A304	A	A	A	A	A		A			Note 2
Aniline	F	A		F	X	F	F	F	A304	A	A	F	F	A		A	A		
Aniline, Oil	A			X	X				A	A									
Aniline, Dyes							A		A	A									

Corrosion Resistance Ratings:

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* *See Key to Notes in Material Selection Guide on Page 16-12.*

CONTINUED

Recommended Sheath Materials

Media Being Heated	Element Sheath Material																		
	Iron & Steel	Gray Cast Iron	Cast Iron Ni-Resist	Aluminum	Copper	Lead	Monel 400	Nickel 200	304, 321, 347 Stn. Stl.	316 Stn. Stl.	Type 20 Stn. Stl.	Incoloy® 800	Inconel® 600	Titanium	Hastelloy B	Quartz	Graphite	Teflon®	*Notes
Anodizing Solutions (10%)																			
Chromic Acid 96°F	C								A	A				A					
Nickel Acetate						C	A	F											
Nigrosine Black Dye							F	F											
Sodium Hydroxide Alkaline	A				A			A		A	A	A		A					
Sulfuric Acid 70°F						A					A								
ARP™ 28																	A	A	Note 1
ARP™ 80 Blackening Salt																	A		Note 1
Arsenic Acid	X	X		X	X	X	X	X	C	F	F	X	X	X		A	A	A	
Asphalt	A	A		X	X	X	X	A	A	A	A	A	A	A		A	A		
Barium Chloride				X				A	F	F			A						
Barium Hydroxide	F	F		X	X	X	F	A	F	A	A	F	F	X		A	A		
Barium Sulfate	F	F	F		F	F	F	F	F	F	F	F	F	A		A	A		
Barium Sulfite									F										
Black Nickel																A		A	Note 5
Black Oxide									A										Note 5
Bleaching Solution 1½ lb. Oxalic Acid per Gallon of H_2O at 212°F							A		F										
Bonderizing™ (Zinc Phosphate)	C		F						A	A									
Boric Acid	X	X		X	C	C	C	C	C	C	C	C	C	A	A	A	A	A	
Brass Cyanide									A										Note 1
Bright Nickel														A		A			Notes 1, 5
Brine (Salt Water)							A						F						
Bronze Plating	A								A										Note 1
Butanol	A	A		F	A	A	A	A	A	A	A	A	A	A		A	A	A	Note 2
Cadmium Black																A			Note 1
Cadmium Fluoborate																	A	A	Note 1
Cadmium Plating									A			A	A						Note 1
Calcium Chlorate	F	F		F	C	C	F	F	F	F	F	F	F			A			
Calcium Chloride	F	F		C	F	X	F	F	F	F	F	F	F	A	A	A	A	A	
Carbon Dioxide—Dry Gas	X	X	A	A	A	F	A	A	A	A	A	A	A	X		A	X	X	
Carbon Dioxide—Wet Gas	X	X	C	A	X	F	A	A	A	A	A	A	A	X		A	X	X	
Carbon Tetrachloride	X	X	C	X	C	A	A	A	C	F	F	A	A	A		A			
Carbonic Acid	C	C		C	C	X	C	C	A	F	A	F	A	A		A	A	A	
Castor Oil	A	A		A	A	A	A	A	A	A	A	A	A	A		A	A	A	
Caustic Etch	A	A		X	X		A	A	A	A	X	X	X	A		X	A	X	
Caustic Soda (Lye) (Sodium Hydroxide) 2%	F	F	F	X	F	X	A	A	X	F	A	A	A	A					
10–30%, 210°F	F	F	A	X	F	X	A	A	A	A	A	A	A	A					
76%, 180°F	X	X	X	X	X	X	F	A	F	F	F	A	A	F					
Chlorine Gas: Dry	X	X	F	X	X	X	F	C	C	C	F	C	F	X		A	F	F	Note 2
Wet	X	X	X	X	X	X	X	X	X	X	X	X	X	F		A	X	X	Note 2
Chloroacetic Acid	X	X		X	X	X	F	F	X	X		C	C	A		A	A	A	
Chromic Acetate																A			Note 1

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Recommended Sheath Materials

Media Being Heated	Element Sheath Material: Iron & Steel	Gray Cast Iron	Cast Iron Ni-Resist	Aluminum	Copper	Lead	Monel 400	Nickel 200	304, 321, 347 Stn. Stl.	316 Stn. Stl.	Type 20 Stn. Stl.	Incoloy® 800	Inconel® 600	Titanium	Hastelloy B	Quartz	Graphite	Teflon®	*Notes
Chrome Plating	X	X		X	X	F	X	X	X	X	X	X	X	A		A	A	X	
Chromic Acid	X	C	X	X	X	F	X	X	X	X	X	X	X	A		A	A	X	
Chromylite																A			Note 1
Citric Acid	X	X	C	C	C	X	F	F	C	C	F	F	F	A	A	A	A	A	
Clear Chromate										A									Note 1
Cobalt Acetate at 130°F							F	F	A	A		F	F						
Cobalt Nickel																A			Notes 1, 6
Cobalt Plating									A							A			Note 1
Coconut Oil							F	A											
Cod Liver Oil				A				A	A	A	A	A	A						
Copper Acid														A		A			Note 1
Copper Bright									A	A									Note 1
Copper Bright Acid																A			
Copper Chloride	X	X		C	X	C	X	X	X	X	X	X	X	A		A	A	A	
Copper Cyanide	A	A		X	X		C	X	F	F	F	X	X			A	A	A	
Copper Fluoborate							F	F	F	F	F	F	F				A	A	
Copper Nitrate	X	X	X	X	X		X	X	F	F	F	X	X			A	A	A	
Copper Plating	A																		
Copper Pyrophosphate									A										Note 1
Copper Strike	A	A							A										Note 1
Copper Sulfate	X	X	F	X	C	A	X	X	F	F	A	C	X	A		A	A	A	
Creosote	A	F	F	C	F	X	F	F	F	F	F	F	F			A			Note 2
Cresylic Acid	C	C		C	C	X	F	F	F	A	A	C	F	F		A	A	A	Note 2
Deoxidine™									A										
Deoxlyte™									A										
Deoxidizer (Etching)																A			Note 1
Deoxidizer (3AL-13)									A	A									Note 1, Non-Chromate
Dichromic Seal	X	X																	
Diethylene Glycol	F	A		F	F	A	F	F	A	A	A	F	F	A		A	A	A	
Diphenyl 300° - 350°F	A	A	A	A	A	A	A	A	A		A		A						
Disodium Phosphate	A																		
Diversey™ DS9333																A			Note 1
Diversey™ 99	A																		
Diversey™ 511																A			Notes 1, 5
Diversey™ 514																	A	A	Note 1
Dowtherm™ A	A																		
Electro-Polishing																A			Note 1
Electroless Nickel														A		A			Note 1
Electroless Tin (Acid)																A			Note 1
(Alkaline)										A				A					Note 1
Enthone Acid-80																	A	A	Note 1
Ether	F	F		F	F	F	F	F	F	F	A	F	F	A		A			Note 2
Ethyl Chloride	F	F		F	A	F	F	A	F	F	A	F	A	A		A	A	A	Note 2

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Ethylene Glycol	A	F		A	F	X	F	F	F	F	F	F	F	A		A	A	A	Note 5
Fatty Acids	X	X		A	X	X	F	F	F	A	A	F	F	A		A	A		
Ferric Chloride	X	X	X	X	X	X	X	X	X	X	X	X	X	A		A	A	A	
Ferric Nitrate	X	X		X	X		X	X	F	F	A	X	X			A	A		
Ferric Sulfate	X	X	X	X	X	A	X	C	F	F	F	C	C	A		A	A		
Fluorine Gas, Dry	C	X		X	X	X	A	A	C	C	C	C	A	A		C	X		
Formaldehyde	X	X	F	F	F	X	F	F	A	A	A	F	F	A		A	A		
Formic Acid	X	X		X	F	X	C	C	X	X	A	F	C	X		A	A		
Freon	A	A	A	A	A	A	A	A	A	A	A	A	A						
Fuel Oil	A	A		A	A	A	F	F	A	A	A	F	F	A					Notes 2, 3, 7
Fuel Oil - Acid	X	X		X	X	A	C	C	C	F	A	C	C	A					Notes 2, 3, 7
Gasoline - Refined	A	A	A	A	A	A	F	F	A	A	A	F	F			A	A		Notes 2, 5
Gasoline - Sour	C	C		C	C	A	X	X	F	F	A	X	X			A	A		Notes 2, 3, 5
Glycerine, Glycerol	F	C	F	A	F	F	A	A	A	A	A	A	A			A	A		
Gold Acid	A													A		A			Note 1
Gold Cyanide									A	A									Note 1
Grey Nickel														A		A		A	Notes 1, 5
Holdens 310A Tempering Bath								A											
Hot Seal Sodium Dichromate										A									Note 1
Houghtone Mar Tempering Salt	C							C											
Hydrocarbons - Aliphatic	A	A		A	A		A	A	A	A	A	A	A			A	A		Note 2
Hydrocarbons - Aromatic	A	A		A	A		A	A	A	A	A	A	A			A	A		Note 2
Hydrochloric Acid < 150°F	X	X	X	X	X	X	X	X	X	X	X	X	X	X		A	A		
> 150°F	X	X		X	X	X	X	X	X	X	X	X	X	X		A	A	A	
Hydrocyanic Acid	X	X		F	X	X	F	F	F	F	F	F	F			A	A		
Hydrofluoric Acid, Cold < 65%	X	X	X	X	X	X	C	X	X	X	X	X	X	X		X	A	A	Note 5
> 65%	F	X	X	X	X	X	C	X	X	X		X	X	X					
Hydrofluoric Acid, Hot < 65%	X			X	X	X	C	X	X										
> 65%	X			X	X	X	C	X	X	X		X	X	X					
Hydrogen Peroxide	X	X	X	A	X	X	C	F	F	F	F	F	F	A		A	X		
Indium																A		A	Note 1
Iridite™ #4-75, #4-73, #14, #14-2, #14-9,#18-P										A									Note 1
Iridite™ #1, #2, #3, #4-C, #4PC&S, #4P-4, #4-80, #4L-1, #4-2, #4-2A, #4-2P, #5P-1, #7-P, #8, #8-P, #8-2, #12-P, #15, #17P, #18P																A			Note 1
Iridite™ Dyes #12L-2, #40, #80																A		A	Note 1
Irilac™																A		A	Note 1
Iron Fluoborate																	A	A	Note 1
Iron Phosphate (Parkerizing)	C		F						A	A									
Isoprep™ Deoxidizer #187, #188										A									Note 1
Isoprep™ #191 Acid Salts																	A	A	Note 1

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Since 1972

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Isoprep™ Acid Aluminum Cleaner #186										A									Note 1
Isopropanol	C				A		A	A	A	A	A		A						
Jetal™									A										Note 1
Kerosene	A			A	A		A	A	A	A	A	A	A				A		Note 2
Kolene								A											
Lacquer Solvent	F	A	A	A	F	A	F	F	A	A	A	F	F	A		A			Note 2
Lead Acetate	X	X		X	X	X	A	A	A	A	A	A	A	A		A	A		
Lead Acid Salts									A										Note 1
Lime Saturated Water	F	F		X	F	X	F	F	F	A	F	F	F			X	A		
Linseed Oil	X	A		F	F	X	F	F	A	A	A	F	F			A	X		Note 2
Magnesium Chloride	X	C	F	X	F	X	F	A	F	F	A	F	A	A		A	A		
Magnesium Hydroxide	A	A	A	F	A	A	F	A	A	A	A	A	A			A	A		
Magnesium Nitrate	F	F		F	F	C	F	F	F	F	F	F	X	F		A	A		
Magnesium Sulfate	F	F	F	F	F	A	A	A	F	F	A	F	A	A		A	A		
MacDermid™ M629																	A	A	Note 1
Mercuric Chloride	X	X	X	X	X	X	X	X	X	X	X	X	X	F		A	A		
Mercury	A	A	A	X	X	X	F	F	F	A	A	A	F	X		A			
Methyl Alcohol (Methanol)	F	F		C	F	F	A	A	F	A	A	F	A	A		A	A		Note 2
Methyl Bromide	C	C		X	F	F	F	F	A	A	A	F	F	A		A			
Methyl Chloride	C	C		X	A	C	C	C	C	C	C	C	C	A		A	A		
Methylene Chloride	X	C		C	C	F	C	F	C	F	A	C	F	A		A	A		
Mineral Oil	A	A		A	A	A	A	A	A	A	A	A	A	A		A	A		
Muriato																A		A	Note 1
Naptha	A	F	F	A	A	A	A	A	A	A	A	A	A	A		A	A	A	Note 2
Napthalene	A	A	A	F	F	A	F	F	A	A	A	F	F	A					Note 2
Nickel Acetate Seal										A									Note 1
Nickel Chloride	X	X	X	X	X	C	C	X	X	C	C	C	F	F		A	A	A	Notes 1, 5
Nickel Copper Strike (Cyanide Free)									A	A									Note 1
Nickel Plate - Bright						A								A		A		A	Notes 1, 5
Nickel Plate - Dull						A										A		A	Notes 1, 5
Nickel Plate - Watts Solution														A		A		A	Notes 1, 5
Nickel Sulfate	X	X	X	X	F	F	C	F	F	F	F	C	F			A	A	A	
Nitric Acid, Crude	X				X	X	X	X	C	C		X	X			A		A	
Concentrated	X				X	X	X	X	F	F		X	X			A		A	
Diluted	X				X	X	X	X	A	A		X	X			A		A	
Nitric Hydrochloric Acid	X	X		X	X	X	X	X	X	X	X	X	X	X		A	A	A	
Nitric 6% Phosphoric Acid										C						A		A	Note 1
Nitric Sodium Chromate										A						A		A	Note 1
Nitrobenzene	A	A	A	A	F	X	A	A	A	A	A	A	A	A		A			Note 2
Oakite™ #67									A										Note 1
Oakite™ #20, 23, 24, 30, 51, 90	A																		
Oleic Acid	C	C	C	C	C	X	F	F	C	F	A	F	A	F		A	A	A	

CAUTION

CORROSION POLICY

TEMPCO cannot warrant any electric immersion heater against failure by sheath corrosion if such failure is the result of operating conditions beyond the control of the heater manufacturer. The facts and recommendations appearing in the TEMPCO catalog or any other literature published by TEMPCO are based on our own research and the research of others, and are believed to be accurate. We cannot anticipate all conditions under which this information and our products, or the products of other manufacturers in combination with our products, may be used.

We accept NO responsibility for results obtained by the application of this information or the safety and suitability of our products, either alone or in combination with other products. It is the responsibility of the Purchaser to make the ultimate choice of sheath material based on his/her knowledge of the chemical composition of the corrosive solution, character of materials entering the solution, and controls, which he/she maintains, on the process.

Recommended Sheath Materials

Media Being Heated	Element Sheath Material																		
	Iron & Steel	Gray Cast Iron	Cast Iron Ni-Resist	Aluminum	Copper	Lead	Monel 400	Nickel 200	304, 321, 347 Stn. Stl.	316 Stn. Stl.	Type 20 Stn. Stl.	Incoloy® 800	Inconel® 600	Titanium	Hastelloy B	Quartz	Graphite	Teflon®	*Notes
Oxalic Acid	X	X	X	F	F	X	C	F	X	X	F	X	F	X		A	A	A	
Paint Stripper (High Alkaline Type)	A																		Note 1
Paint Stripper (Solvent Type)										A									Notes 1, 2
Paraffin	A	A		A	A		F		A	A	A								Notes 2, 7
Parkerizing™ (See Iron Phosphate)																			
Perchloroethylene	F	F		C	F	F	A	A	F	F	F	F	A	A		A			
Perm-A-Clor™									A										
Petroleum - Crude < 500°F	F	F	A	A	C	C	A	C	A	A	A					A	A		Notes 2, 3, 7
> 500°F	A		A	A	X	X	X	X	A										
> 1000°F	X			X	X	X	X	X	A347										
Phenol	F	F		F		X	F		C	F	F	F	F	A	A				
Phosphate										A								X	Notes 1, 5, 9
Phosphate Cleaner									A									X	Notes 1, 5, 9
Phosphatizing										A								X	Notes 1, 5, 9
Phosphoric Acid, Crude	C			X	X	C	X	X	C										
Pure < 45%	X	X	X	C	C	C	F	C	C	C	F	A	A	X					
> 45% Cold	X	X	X	X	F	C	F	C	A	F	F	A		X					
> 45% Hot	X	X	X	X	C	X	C	X	X	X	F	A	F	X					
Photo Fixing Bath							C		A										
Picric Acid	X	X		X	X	X	X	X	F	F	F	C	C			A	A	A	
Potassium Acid Sulfate																A		A	Note 1
Potassium Bichromate	C	F	F	F		F	F	F	A347	A	A	F		F	A	A		A	
Potassium Chloride	C	X	F	X	C	C	F	F	C	F	A	C	F	A		A	A		
Potassium Cyanide	C	X	F	X	X	X	C	F	F	F	F	F	F	X		A	C	A	
Potassium Dichromate									A347										
Potassium Hydrochloric																A		A	Note 1
Potassium Hydroxide	X	X		X	C	X	F	A	C	C	C	C	F	X		X	A	A	
Potassium Nitrate	F	F	F	A	F	F	F	F	F	F	F	F	F	A		A	A		
Potassium Sulfate	C	C	C	A	F	A	A	F	A	A	A	F	F	A		A	A	A	
Prestone™ 350°F	A						A												
R5 Bright Dip For Copper Polish at 180°F										A									
Reynolds Brightener																A		A	Note 1
Rhodium Hydroxide																A		A	
Rochelle Salt Cyanide	A								A										Note 1
Ruthenium Plating																A		A	Note 1
Silver Bromide	X	X		X	X		C	C	X	X	C			A		A	A	A	
Silver Cyanide	C	C		X	X		F		A	A	A	A				A			
Silver Lume									A										Note 1
Silver Nitrate	X	X		X	X	X	X	X	C	C	F	C	C	A		A	A		
Soap Solutions	A	A	A	X	C		A		A	A	A								Note 3
Sodium - Liquid Metal	C	X		X	X	X	F	A	A			A	A			X	X		

Corrosion Resistance Ratings:

A = *Good*
F = *Fair*
C = *Depends on Conditions*
X = *Unsuitable*
Blank = *Data Not Available*

* *See Key to Notes in Material Selection Guide on Page 16-12.*

Media Being Heated	Element Sheath Material: Iron & Steel	Gray Cast Iron	Cast Iron Ni-Resist	Aluminum	Copper	Lead	Monel 400	Nickel 200	304, 321, 347 Stn. Stl.	316 Stn. Stl.	Type 20 Stn. Stl.	Incoloy® 800	Inconel® 600	Titanium	Hastelloy B	Quartz	Graphite	Teflon®	*Notes
Sodium Bisulfate	X	X	X	C	F	C	C	F	X	X	A		F						
Sodium Bromide	F	C		X	F	F	F	F	C	F	F	F	F			A	A	A	
Sodium Carbonate	C	C		X	A	X	F	F	F	F	A	F	F	A		C	A	A	
Sodium Chlorate	X	X		F	A	F	A	A	F	F	F	F	A	A		A	A	A	
Sodium Chloride	C	X	F	X	F	F	A	F	X	X	C	F	A	C		A	A		
Sodium Citrate	X	X		X	X	X			F	F	F					A	A	A	
Sodium Cyanide	C	F	C	X	X	X	C	C	A	A	A	A	A	C		A	C		
Sodium Dichromate (Sodium Bichromate)	F	F	F	C	X				F	F	F			C		A			
Sodium Hydroxide (See Caustic Soda)																			
Sodium Hypochlorite	X	X	X	X	X	X	X	X	X	X	F	X	X	A	A	A	A	A	
Sodium Nitrate	F	F	A	C	C	C	F	F	A	A	A	A	A	A		A	A		
Sodium Peroxide	F	A	F	C	X	X	F	F	F	F	F		F						
Sodium Phosphate	C	C	F	X	F	F	A	C	F	A	F	F	A	A		A	A	A	
Sodium Salicylate	F	C	F		F		F	F	F	F	F	F	F			A	A	A	
Sodium Silicate	A	F	A	X	F	X	A	A	A	A	A	A	A	A		A	A	A	Note 4
Sodium Stannate	C	C	C				F	F	F	F	F	F	F			A		A	
Sodium Sulfate	F	C		F	F	F	F	F	X	F	F	F	F	C		A	A	A	
Sodium Sulfide	C	X	C	C	X	A	F	F	X	C	C	C	C	C		C	A	A	
Solder Bath	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	Note 4
Soybean Oil									A										
Sannostar™																A		A	Note 1
Steam < 500°F	A			A	A	C	A	A	A			A	A						
500° - 1000°F	C			C	C	X	C	C	A			A	A						
> 1000°F	X			X	X		X	X	A			A	A						
Stearic Acid	C	C	C	C	X	X	F	F	C	A	A	F	F	F		A	A		
Sugar Solution	A	A		A	A	A	A	A	A	A	A	A	A	A		A	A	A	Note 7
Sulfamate Nickel														A		A		A	Note 1
Sulfamic Acid	X	X		X					X	X						A		A	
Sulfur	C	X	C	A	X	X	F	C	C	F	F	A	A	A		A	A		
Sulfur Chloride	X	X	C	X	X	F	X	C	C	X	C	C	F			A	X	A	
Sulfur Dioxide	C	C		C	C	F	X	X	C	F	F	C	C	A		A	A		
Sulfuric Acid < 10% Cold	X		X	C	A	F	F	C	X	C	F		X						
Hot	X	X	X	C	X	X	X	X	X	X	X		F						
10 - 75% Cold	X			X	F	F	C	C	X	X	F		X	X					
Hot	X			X	X	F	C	X	X	X	C		X	X					
75 - 95% Cold	F	F	F	X	F	F	X	X	F	F	F			X					
Hot	X	X	X	X	X	C	X	X	X	X	X			X					
Fuming	C	X	C	X	X	X	X	X	F	C	C	C	C						
Sulfurous Acid	X	X		C	X	A	X	X	X	C	F		C	A					
Tannic Acid	C	C		C	C	X	C	C	C	A	A		A	A		A			
Tar	A			A					A			A	A						
Tartaric Acid		X	F	C		C	F	C	C	A	F		F	F					

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CONTINUED

Recommended Sheath Materials

Made in USA

Media Being Heated	Element Sheath Material																		
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Tetrachlorethylene	F	F		C	F	F	A	A	F	F	F	F	A	A		A			
Therminol™ FR1 8-12 W/Sq. In. 640°F	A																		
Thermoil Granodine™	F																		
Tin (Molten)	F	F		X	X	X	X	X	F	F	X		X	A			X	X	Note 4
Tin - Nickel Plating																A		A	Note 1
Tin Plating - Acid																	A	A	Note 1
Tin Plating - Alkaline	A								A										Note 1
Toluene	A	A	A	A	C	A	A	A	A	A	A	A	A	A					
Triad Solvent	C																		
Trichloroethane	A	C	C	F	F	F	F	F	A	F	F	F	F	A		A	A		
Trichloroethylene	F	C	C	F	C	X	C	C	F	F	F	F	A	A		A	A		
Triethylene Glycol	A	A	A	A	A	A	A	A	A	A	A	A	A	A		A			
Trioxide (Pickle)																A		A	Note 1
Trisodium Phosphate	A	A		X	C	X	C	C	C	C	C					X	F	X	
Turco™ 2623	A																		
Turco™ 4008, 4181, 4338										A									Note 1
Turco™ Ultrasonic Solution										A									Note 1
Turpentine	C	C	C	A	F	A	A	A	A	A	A		A						
Ubac™																A			Note 1
Udylite #66														A		A		A	Notes 1, 5
Unichrome™ CR-110																A		A	Note 1
Unichrome™ 5RHS																A		A	Note 1
Urea Ammonia Liquor 48°F	A																		
Vegetable Oil	C		C	F	X	X	A	A	A	A	A	A							
Vinegar	C			C			A		F	A									
Water, Acid Mine Containing Oxidizing Salts	X		C	C	C	C	X	C	A										
No Oxidizing Salts	C		A	A			A		X										
Water, Deionized	X	X		X	X		A	A	A	A	A	A	A						Note 10
Demineralized	X	X		X	X		A	A	A	A	A	A	A						Note 10
Distilled	X	X			X	X	C	A				A	A						Note 10
Potable	X	C	A	A	A	X	A	A	C	F	A	A	A	A		A			
Return Condensate	A		A	A	A	A			A	A		A							
Sea	X	X	A	X	X	A	A		C	C	A	F	F	A		A	A		
Watt's Nickel Strike																A			Note 1
Whiskey and Wines	X		C		A		A	A	A	A	A	A	A						Note 2
Wood's Nickel Strike																A			Note 1
Yellow Dichromate										A						A			Note 1
X-Ray Solution									A										
Zinc (Molten)				X	X	X	X	X	X	X	X	X	X	X				X	
Zinc Chloride	C	C	C	X	X		F	F	X	X	F	X	F	C		A	A	A	
Zinc Phosphate										A								X	Notes 1, 5
Zinc Plating Acid																A			Note 1
Zinc Plating Cyanide	A								A										Note 1
Zinc Sulphate	C	X	A	C	F	A	F	C	C	C	C		F	A					
Zincate™	A								A										Note 1

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