







CORROSION GUIDE										
RATINGS	SHEATH MATERIALS								SUGGESTED Watt-Density (W/in ²) (SEE NOTE 12)	
A - BEST/GOOD B - NEXT BEST FOR "A" C - DEPENDS ON CONDITIONS X - INCOMPATIBLE BLANK - NO DATA	COPPER	INCOLOY 800	MONEL	304SS, 321SS	316SS	PTFE	C276 HASTELLOY	TITANIUM		
SOLUTIONS	RATINGS									NOTES
Acetic Acid (100%)	X	B	BC	BC	A	A	A	A	25	
Acetic Acid (50%)	X	B	B	C	A	A		A	15	
Acetone (100%)	A	A	A	BC	A	A	BC	A		NOTE: 2
Actane 70™						A	BC			NOTE: 1
Actane 80™						A				NOTE: 1
Actane Salt™	CONTACT SALES									
Alcoa Bright Dip R5™						A				NOTE:
Allyl Alcohol	A	A	A	A	A	A	B	B		NOTE: 2
Alcohol	A	A	A	B	A	A	B	A	25	NOTE: 2
Alcorite™										NOTE: 1
Alkaline Cleaners				B		X			30-40	NOTE: 1
Alkaline Soaking Cleaners				B					30-40	NOTE: 1
Alodine™	CONTACT SALES									
Aluminum (Molten)	CONTACT SALES									
Aluminum Bright Dip						A				NOTE: 1, 9
Aluminum Chloride (Aqueous)	A	X	X	X	X	A	A	B		NOTE: 1
Aluminum Cleaners	X	A	A	A	A			B		NOTE: 1
Aluminum Sulphate (Sat.)	X	BC	X	BC	BC	A	BC	A		NOTE: 1
Alum	X	BC	X	X	BC	A	BC	A		NOTE: 1
Ammonia (Anhydrous)	X	C	A	B	A	A	A	A		
Ammonia (Gas)	X	C	X	A	A	A	A	A		
Ammonium Bifluoride	X	X	B	X	B	A	B	X		
Ammonium Chloride (50%)	X	C	A	C	C	A	A	A		
Ammonium Hydroxide (25%)	X	A	X	A	A	A	B	A		
Ammonium Nitrate	X	BC	X	A	A	A		C		
Ammonium Persulphate	X	C	X	C	B	A				


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SOLUTIONS	RATINGS								NOTES	
Ammonium Sulphate (<40%)	X	A	B	C	B	A	B	A		
Amyl Alcohol	A	A	BC	B	B	A	B	A	25	NOTE: 2
Aniline	X	B	B	A	B	A	B	A		
Anodizing	X	B	X	X	A	A	A	X		
ARP 28™					X	A				NOTE: 1
ARP 80™ Blackening Salt										NOTE: 1
Arsenic Acid	C	B	X	B	B	A	C	X		
Asphalt	X	B	X	BC	B	A	B	A	5-10	NOTE: 2
Barium Hydroxide (Sat.)	X		C	B	B	A	B	AC		
Barium Sulphate	B		B	B	B	A	B	A	55	
Beer	B		A	AC	A	A	A	B	30-40	
Black Nickel						A			25	NOTE: 5
Black Oxide				A					25	NOTE: 5
Black Liquor	X		BC	BC	BC	A	C		15	
Bleach 5.5% Cl, Clorox™				BC	BC	A	AC		15-25	
Bonderizing™					A	X				NOTE: 1, 5
Boric Acid	C		BC	BC	BC	A	A	A		
Brass Cyanide				A						NOTE: 1
Bright Nickel								A	25	NOTE: 1, 5
Brine (Salt Water)	BC		B	C	B		A		55	NOTE: 9, 10
Bronze Plating				A						NOTE: 1
Butyl Alcohol (Butanol)	A		A	A	A	A	B	B		NOTE: 2
Cadmium Black										NOTE: 1
Cadmium Fluoborate						A				NOTE: 1
Cadmium Plating				A						NOTE: 1
Calcium Chlorate	B		B	BC	BC	A	B	B		
Calcium Chloride (Sat.)	B	B	B	BC	BC	A	A	A	25	

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SOLUTIONS	RATINGS								NOTES	
Carbon Dioxide - Dry Gas	BC	A	A	A	A	A	A	AC	10-25	
Carbon Dioxide - Wet Gas	X	A	A	BC	BC	A	B	BC	10-25	NOTE: 2
Carbon Tetrachloride	AC	A	A	A	A	A	AC	A	25	NOTE: 1
Carbonic Acid (Phenol)	X	AC	AC	A	A	A	A	A		NOTE: 1
Castor Oil	AC	A	A	BC	BC		A	A	25	NOTE: 1
Caustic Etch	C	A	A	A	A		BC	A	15-25	NOTE: 6
Caustic Soda	X	B		AC	AC	A		AC		NOTE: 6, 8
Chlorine Gas - Dry	C	A	AC	C	BC	B	B	X		
Chlorine Gas - Wet	X	X	C	X	X	A	BC	X		
Chloroacetic Acid	X	C	C	X	X		AC	A		
Chromic Acetate						X				NOTE: 1
Chromic Acid (40%)	X	X	X	BC	B		B	A		
Chromic Anodizing										NOTE: 1
Chromylite										NOTE: 1
Citric Acid (Conc.)	X	AC	B	BC	A	A	A	A		NOTE: 1
Clear Chromate					A			A		NOTE: 1
Cobalt Nickel										NOTE: 1, 6
Cod Liver Oil		A		A	A				25	NOTE: 1
Copper Acid						A				NOTE: 1
Copper Bright				A						NOTE: 1
Copper Bright Acid										NOTE: 1
Copper Chloride	X	B	X	X	X	A	B	A		
Copper Cyanide	X	B	X	B	B	A	A	AC		
Copper Fluoborate		B	B	B	B	A				
Copper Nitrate	X	BC	X	A	A	A	C	B		
Copper Pyrophosphate				A						NOTE: 1
Copper Strike				A						NOTE: 1
Copper Sulphate	X	B	X	B	B	A	B	A		


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SOLUTIONS	RATINGS								NOTES	
Creosote	BC	B	B	B	B		B	A	5-15	NOTE: 2
Cresylic Acid 50%		C	X	B	A	A	B	B		NOTE: 2
Deionized Water	X	A		A	A					NOTE: 10
Deoxidizer (Etching)										NOTE: 1
Deoxidizer (3AL-13 Non-Chrome)				A	A					NOTE: 1
Detergents	A	B		A	B	A	AC	A	40-55	
Dichromic Sea				A	A					NOTE: 1
Diethylene Glycol	B	B	B	A	A	A	B	A		NOTE: 1
Diversey-DS9333™										NOTE: 1
Diversey-511™										NOTE: 1, 5
Diversey-514™						A				NOTE: 1
Dowtherm™ (Diphenyl)	C	A	B	A	A		A		25	NOTE: 5
Dur-Nu™								A	25	NOTE: 1, 5
Electro Cleaner				A						NOTE: 1
Electropolishing										NOTE: 1
Electroless Nickel						A		A		NOTE: 1
Electroless Tin (Acid)						A				NOTE: 1
Electroless Tin (Alkaline)					A			A		NOTE: 1
Enthone Acid - 80						A				NOTE: 1
Ethers, General	B	A	B	A	A	A	B	B		NOTE: 2
Ethyl Chloride	B	A	B	A	A	A	B	A		NOTE: 2
Ethylene Glycol	B	A	B	B	A	A	A	A	25-30	NOTE: 5
Fatty Acids	C	AC	B	BC	A	A	A	A	25	
Ferric Chloride	X	X	X	X	X	A	BC	A		
Ferric Nitrate (< 50%)	X	BC	X	BC	B	A	BC	AC		
Ferric Sulphate	C	C	C	BC	AC	A	A	A		
Fluoborate						A				NOTE: 1
Fluoboric Acid	X		B	BC	AC	A	A	X		

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SOLUTIONS	RATINGS								NOTES	
Fluorine Gas (Dry)	X	C	AC	AC	A	C	BC	X		
Formaldehyde (< 50%)	B	B	B	AC	AC	A	B	A		
Formic Acid (10 - 85%)	C	B	B	AC	B	A	A	C		
Freon (F-11, F-12, F-22)	B	A	AC	A	A		B		3-9	
Fruit Juices (Pulp)		A	AC	BC	B	A	A	A	30-40	
Fuel Oil (Normal)	B	A	B	A	A		B	A	5-15	NOTE: 2, 3, 7
Fuel Oil (Acid)	X	C	C	B	B			A	5-10	NOTE: 2, 3, 7
Gasohol	B	B	B	B	B		B		25	
Gasolene (Refined)	B	B	B	B	B		B		25	NOTE: 2, 5
Gasolene (Sour)	X	C	X	B	B	A	B		25	NOTE: 2, 3, 5
Glycerin (Glycerol)	A	A	A	A	A	A	A	A		
Grey Nickel						A		A	23-26	NOTE: 1, 5
Hydrocarbons-Aliphatic	A	A		A	A		A		23-26	NOTE: 2
Hydrocarbons-Aromatic	A	A	A	A	A		A		23-26	NOTE: 2
Hydrochloric Acid (Dilute)	X	BC	A	X	X	A	AC	B	20-30	
Hydrochloric Acid (50%)	X	X	BC	X	X	A	BC	X	15-25	
Hydrocyanic Acid (10%)	X	B	X	B	B	A				
Hydrofluoric Acid (Dilute)	X	X	B	X	X	A	A	X	25	NOTE: 5
Hydrogen Peroxide (90%)	X	B	X	AC	AC		A	B	25	
Indium			B			A				NOTE: 1


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SOLUTIONS	RATINGS									
Iridite™ - #4 - 75, #4 - 73, #14, #14 - 2, #14 - 9, #18 - P 1 Iridite™ - #1, #2, #3, #4-C, #4PC&S, #4P-4, #4-80, #4L-1, A #4-2, #4-2A, #4-2P, #5P-1, #7, #7-P, #8, #8-P, #8-2, #12-P, #15, #17P, #18P	CONTACT SALES									
Iridite™ Dyes - #12L-2, #40, #80						A				NOTE: 1
Irillac™						A				NOTE: 1
Iron Fluoborate						A				NOTE: 1
Iron Phosphate (Parkerizing™)					A	A	B	A		
Isoprep™ Deoxidizer #187, #188					A					NOTE: 1
Isoprep™ Cleaner #186					A					NOTE: 1
Isoprep™ #191 Acid Salts						A				NOTE: 1
Jetal™				A						NOTE: 1
Jet Fuel JP-4				BC	B		A	A		
Kerosene	BC	A	B	B	B		B		25	NOTE: 2
Lacquer Solvents	A	B	B	A	A			A	25	NOTE: 2
Lead Acetate	X	A	B	B	B	A	B	A		
Lead Acid Salts			B	B						NOTE: 1
Lime Saturated Water	B	B		B	B	C	A		25-40	
Linseed Oil	B	A	B	A	A	A			10-15	NOTE: 2
Lubricating Oil	A	A	B	B	A		B	A	25	NOTE: 7
Machine Oil		A	B	B	B		B	A	25	NOTE: 7
Magnesium Chloride	B	B	B	C	B	A	A	A		
Magnesium Hydroxide	B	B	B	A	B	A	A	A		
Magnesium Nitrate	B	A	B	B	A	A	B	B		
Magnesium Sulfate	BC	B	A	B	B	A	B	B		
McDermid™ #629				C						NOTE: 1
Mercuric Chloride	X	X	X	X	B	A	B	B		
Mercury	X	A	B	A	A	A	A	A	25-30	

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SOLUTIONS	RATINGS									
Methyl Alcohol (Methanol)	B	A	A	B	B	A	A	A		NOTE: 2
Methyl Bromide	B	B	B	BC	A	A		A		
Methyl Chloride	B	C	B	AC	A	A	B	A		
Methylene Chloride	C	BB	AC	B	AC	A	A	A		
Milk	C	A	C	A	A		A		30-40	
Mineral Oil	B	AC	A	AC	AC	A		A	25	
Muriatic Acid	X	BC		X	X	A		B		
Naphtha	A	A	A	A	A	A		A		NOTE: 2
Nickel Acetate					A					NOTE: 1
Nickel Chloride	X	B	B	BC	BC	A	A	A	23	NOTE: 1, 5
Nickel Plate-Bright				C	C	A		B	23	NOTE: 1,5
Nickel Plate-Dull				C	C	A		B	23	NOTE: 1, 5
Nickel Plate - Watts Solution						A		A	23	NOTE: 1, 5
Nickel Sulphate	C	C	C	B	B	A				
Nickel Copper Strike				AC	AC					NOTE: 1
Nitric Acid (20%)	X	AC	X	AC	AC	A	AC	A	15	
Nitric & Hydrochloric Acid	X	X	X	BC	BC	A		X	15	
Nitric & 6% Phosphoric Acid					A	A			15	NOTE: 1
Nitric & Sodium Chromate					A	A				NOTE: 1
Nitric & Sulfuric Acid (50% - 50%)		X	X	AC	AC	A			15	
Nitrobenzene	BC	B	B	B	B	A	B	A		NOTE: 2
Oakite™ #67				AC					30-40	NOTE: 1
Oleic Acid	B	AC	BC	AC	AC	A	B	AC		
Olive Oil	B		B	B	B		AC	A	25	
Oxalic Acid (50%)	B	AC	B	X	B	A	B	X		
Paint Stripper (High Alkaline)									30-40	NOTE: 1
Paint Stripper (Solvent)					A				25	NOTE: 1, 2
Paraffin	A	A	B	A	A		A		5-15	NOTE: 2, 7
Parkerizing™					A	A		A		
Peanut Oil					B		A		25	
Perchloroethylene	B	A	A	AC	AC		B	A	23	
Petroleum Oils (Refined)	B		A	AC	AC				25	NOTE: 2, 3, 7
Petroleum Oils (Sour)	X		X	B	B				15-25	NOTE: 2, 3, 7

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SOLUTIONS	RATINGS									NOTES
Phenol (Carbolic Acid)	X	AC	AC	AC	AC	A	A	A		
Phosphates (Generic)				BC	AC		B		25-40	NOTE: 1, 5, 9
Phosphate Cleaners				BC	AC	X	B		25-40	NOTE: 1, 5, 9
Phosphatizing					AC	X			25	NOTE: 1, 5, 9
Phosphoric Acid (25% - 50%)	AC	C	C	AC	BC	A		X	25	NOTE: 5, 9
Picric Acid	X	BC	X	BC	B	A	B			
Plating Solutions - Brass					B	A	AC	A	25-35	NOTE: 1
Plating Solutions - Cadmium					B	A	AC	A	25-35	NOTE: 1
Plating Solutions - Chrome (25%)	X	BC	X	BC	B	A	AC	X	25-35	NOTE: 1
Plating Solutions - Chrome (40%)	X	X	X	BC	B	A	AC	A	15-20	NOTE: 1
Plating Solutions - Cobalt				A					25-35	NOTE: 1
Plating Solutions - Copper						A	AC	AC	25-35	NOTE: 1
Plating Solutions - Gold (Cyanide)				AC	AC	A	AC	AC	15-20	NOTE: 1
Plating Solutions - Gold (Acid)								A	25-35	NOTE: 1
Plating Solutions - Nickel				AC	AC	A	AC	A	15-20	NOTE: 1
Plating Solutions - Silver				AC	AC	A	AC	A	15-20	NOTE: 1
Plating Solutions - Tin					C	A	AC	X	25-35	NOTE: 1
Plating Solutions - Tin-Nickel						A			25-35	NOTE: 1
Plating Solutions - Tin-Alkaline				A					15-20	NOTE: 1
Plating Solutions - Zinc						A	AC	A	25-35	NOTE: 1
Plating Solutions - Zinc Acid									15-20	NOTE: 1
Plating Solutions - Zinc Cyanide				A					15-20	NOTE: 1
Potassium Aluminum Sulphate	C			C	BC	A	BC	A		NOTE: 1
Potassium Bichromate	C	B	B	B	B	A	B	AC		
Potassium Chloride (30%)	X	B	AC	AC	A		B	A		
Potassium Cyanide (30%)	X	B	B	B	B	A	B	X		

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SOLUTIONS	RATINGS									
Potassium - Hydrochloric Solution						A				NOTE: 1
Potassium Hydroxide (27%)	C	B	B	BC	B	A	B	X		
Potassium Nitrate (80%)	BC	B	B	BC	B		B	A		
Potassium Sulphate (10%)	BC	BC	A	A	A	A	A	A		
Reynolds Brightener						A				NOTE: 1
Rhodium Hydroxide						A				
Rochelle Salt - Cyanide				A						NOTE: 1
Ruthenium Plating						A				NOTE: 1
Silicon Oils	AC			B	B				25	
Silver Bromide (10%)	X	AC	C	X	X	A	AC	A		
Silver Cyanide	X	AC	BC	AC	AC	A	AC	A		
Silver Lume				AC						NOTE: 1
Silver Nitrate	X	BC	X	B	AC	A	AC	AC		
Soap Solutions	BC	AC	BC	BC	BC	A	AC		55	NOTE: 3
Sodium Bichromate (Neutral)	C	B		B	B	A	B	C		
Sodium Bisulphate	BC	BC	BC	BC	BC	A	B	BC		
Sodium Bromide (10%)	BC	B	B	C	BC	A	B	C		
Sodium Carbonate	B	AC	A	BC	B	A	AC	A		
Sodium Chlorate	X	AC	AC	BC	B	A	A	A		
Sodium Chloride	X	A	AC	C	C	A	B	A		NOTE: 11
Sodium Citrate	X	AC	B	BC	B	A	BC	A		
Sodium Cyanide	X	BC	X	AC	AC	A	BC	C	30-40	
Sodium Dichromate (Hot Seal)	X			BC	BC	A	AC	A		NOTE: 1
Sodium Hydroxide (50%)	X	B	AC	AC	AC	A	AC	AC	15	NOTE: 6, 8
Sodium Hypochlorite (20%)	X	X	X	X	X	A	X	A	20	
Sodium Nitrate	C	A	BC	AC	AC	A	BC	AC	23	NOTE: 5
Sodium Peroxide (10%)	X	B	B	BC	B	A	B			
Sodium Phosphate (Neutral)	B	B	B	B	B	A	B	B		
Sodium Salicylate		B	B	B	B	A				
Sodium Silicate	X	AC	A	BC	B	A	B	A		NOTE: 4
Sodium Sulfate	BC	AC	BC	AC	A	A	B	C		
Sodium Sulfide (< 50%)	X	AC	B	BC	BC	A	B	C		

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SOLUTIONS	RATINGS									
Sodium Stannate		B	B	B	B	A				
Sodium Thiosulfate (Hypo)	X	B	BC	B	B	A	BC	AC		
Solder Bath	X	X	X	X	X	X	X	X		NOTE: 4
Steam (Medium Pressure)	BC	A	AC	BC	BC		B		10-15	
Stearic Acid	BC	AC	C	BC	A		A	A		
Sugar Solution	A	A	A	AC	A	A	A	A	10-25	NOTE: 7
Sulfamate Nickel						A		A		NOTE: 1
Sulfamic Acid	C			BC		A		AC		
Sulfur	X	A	BC	A	A		A	A		
Sulfur Chloride (Dry)	X	AC	X	BC	BC	A	B			
Sulfur Dioxide (Dry)	BC	AC	B	BC	BC		B	A	15-25	
Sulfur Dioxide (Wet)	X	BC	X	X	BC		AC	A	10-20	
Sulfuric Acid (10% - 50%)	X	BC	X	X	X	A	AC	X	15	
Sulfuric Acid (98%)	X	BC	X	X	BC	A	AC	X	15	
Sulfurous Acid	X	A	X	X	BC	A	B	A		
Tannic Acid	C	B	B	BC	BC	A	B	AC		
Tin (Molten)	X		X	X	X	X			20	NOTE: 4
Trichloroethane	A	A	A	A	A		A	A		
Trichlorethylene	BC	AC	A	BC	BC	A	A	A	25	
Triethylene Glycol	A	A	A	A	A		A		25	
Trioxide (Pickle)						A				NOTE: 1
Trisodium Phosphate	BC		BC	AC	A	A	AC			
Turco™ 4181 (Alkaline Cleaner)					A					NOTE: 1
Turco™ 4008 (Descaler)					A				25	NOTE: 1, 5
Turco™ 4338 (Oxidizer)					A					NOTE: 1,7
Turco™ Ultrasonic Solution					A					NOTE: 1
Ubac™										NOTE: 1
Udylite™ #66						A		A	25	NOTE: 1, 5
Unichrome™ CR-110						A				NOTE: 1
Unichrome™ 5RHS						A				NOTE: 1
Vegetable Oil	BC	A	B	B	B		AC		25	
Water, Deionized	X	A	C	A	A		B		50-75	NOTE: 10
Water, Demineralized	X	A	C	A	A		B		50-75	NOTE: 10
Water, Pure (Distilled)	X	A	A	A	A		A		50-75	NOTE: 10
Water, Process	B	A	B	BC	BC	A	B	A	50-75	NOTE: 10, 11

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SOLUTIONS	RATINGS									NOTES
Water, Potable	B	A	B	BC	BC	A	B	A	50-75	NOTE: 10, 11
Water, Salt Brine	BC	AC	B	C	BC		A		55	NOTE: 10, 11
Water, Sea	BC	AC	A	C	BC	A	AC	A	55	NOTE: 10, 11
Watts Nickel Strike										NOTE: 1
Whiskey	BC		A	A	A		AC		55	NOTE: 2
Wines	BC		B	A	A		A		55	
Wood's Nickel Strike										NOTE: 1
Yellow Dichromate					A					NOTE: 1
Zinc (Molten)	X	X	X	X	X	X		X		
Zinc Chloride	X	BC	BC	X	B	A	B	B		
Zinc Phosphate					A	X			25	NOTE: 1, 5
Zincate™				A						NOTE: 1

NOTES:

1. This solution involves a mixture of various chemical compounds whose identity and proportions are unknown or subject to change without prior knowledge. Check supplier to confirm choice of sheath materials plus alternate sheath materials that may be used.
2. Caution – Flammable materials that may be used.
3. Chemical composition varies widely. Check supplier for specific recommendations
4. Direct immersion heaters not practical. Use clamp-on heaters on outside surface.
5. Element watt density should not exceed 20 watts/sq. in.
6. For concentrations greater than 15%, element watt density should not exceed 20 watts/sq. in.
7. See suggested watt density chart.
8. Remove crusts at liquid level.
9. Clean often
10. Do not exceed 12 watts/sq. in.
11. Passivate stainless steel and Incoloy.
12. PTFE heaters should not exceed 10 watts/sq. in.