



# COPPER SHEATHED CABLE AND CORROSION

Copper sheathed cables are noted for their general resistance to chemical corrosion as compared to most other metals. However, as with all metals, there are certain environments which will be detrimental.

Copper is susceptible to oxidizing acids such as nitric, sulfurous, and concentrated sulfuric acid. Similarly, it is attacked by oxidizing salts. Ions that are susceptible to reduction include ferric, stannic, and mercuric. Although resistant to attack by most dry gases, it is susceptible to corrosion by wet fluorine, chlorine, bromine, iodine, and ammonia. Sulfur compounds have a strong tendency to attack it. For applications involving corrosion, contact Pentair Thermal Management or consult a corrosion handbook.

When copper is in contact with a metal more active in electrochemical potential, through an electrolyte, corrosion of the metal may be stimulated. The common metals most likely to be affected are aluminum, magnesium, zinc, and, in some cases, galvanized steel. In actual practice the surface area of the cable or cathode is so small in comparison to the anodic metal that very little corrosion will take place. For example, the cable is often used on aluminum and galvanized steel towers without any serious corrosion problem occurring. Again, the surface area is so small in comparison that, for most applications, this type of corrosion can be ignored.

Stress corrosion cracking is a combination of both stress and corrosion which causes metal embrittlement and cracking. Since the cables must be bent during installation, they invariably contain sufficient surface stress so that when exposed to particular corrosive agents, cracking can occur. For this type of corrosion with copper, the only known corrosive agent is ammonia or ammonia-bearing materials called amines. For ammonia to cause this type of cracking, traces of moisture and carbon dioxide, as normally found in the atmosphere, are also required. This type of corrosion cracking has been encountered where urine has been in contact with the cable during installation. There is very little apparent surface corrosion; however, the cable sheath becomes brittle and may eventually crack with the slightest stress. In any case, this particular type of corrosion has been relatively rare.

Where the copper sheath could be corroded, an extruded HDPE polymer jacket can be supplied.

**TABLE 1 JACKET MATERIAL AVAILABLE FOR MI CABLE**

Jacket material	Typical thickness		Flammability (ASTM D635)	Maximum operating temperature (continuous)	Minimum installation temperature
	(in)	(mm)			
Polyethylene	0.040	1.0	FT4	120°C (248°F)	-40°C (-40°F)

The following table lists various materials and their resistance to chemicals under average conditions. However, it is intended only as a guide and does not imply a guarantee due to the number of variable conditions which may be encountered.

**TABLE 2 CORROSION RESISTANCE TABLE**

Chemical	Material						
	Copper	Cupro Nickel	Alloy 825	304 Stainless	Inconel 600	Polyethylene	PVC
Acetic Acid	S	E	E	S	S	S	S
Acetic Anhydride	S	S	E	S	S	N	N
Acetone	S	E	E	E	E	N	N
Acetylene	N	N	E	E	S	N	E
Alcohols	E	E	E	E	-	S	E
Alum	S	E	E	N	S	E	E
Alumina	E	E	E	N	N	-	E
Aluminum Chloride	S	S	E	N	-	E	E
Aluminum Hydroxide	E	E	E	E	-	S	E
Aluminum Sulfate	S	E	E	N	S	E	E
Ammonia, Absolutely dry	N	E	E	E	E	E	E
Ammonia, moist	N	S	E	E	E	N	N
Ammonium Hydroxide	N	S	E	E	E	E	E
Ammonium Chloride	S	S	E	N	S	E	E
Ammonium Nitrate	N	S	E	E	S	E	E
Ammonium Sulfate	S	S	E	S	S	E	E
Amyl Acetate	S	S	E	E	E	N	N
Amyl Alcohol	E	E	E	-	-	E	S
Aniline	N	N	E	E	E	S	N
Aniline Dyes	N	N	E	E	E	N	N
Asphalt	E	E	E	E	-	-	E
Atmosphere, Industrial	E	E	E	E	E	E	E
Atmosphere, Marine	S	E	E	N	S	E	E
Atmosphere, Rural	E	E	E	E	E	E	E
Barium Carbonate	E	E	E	E	E	E	E
Barium Chloride	S	S	E	S	S	E	E
Barium Hydroxide	N	E	E	S	E	E	E
Barium Sulfate	N	E	E	E	-	E	E
Barium Sulfide	N	S	E	E	-	E	S
Beer	S	E	E	E	E	E	E
Beet Sugar Syrups	E	E	E	E	-	-	E
Benzine	E	E	E	E	E	N	N
Benzoic Acid	E	E	E	S	-	E	E
Benzol	E	E	E	E	E	E	N
Black Liquor, Sulphate Process	S	S	E	S	N	-	E
Bleaching Powder, wet	S	S	S	N	N	-	N
Borax	S	E	E	E	E	E	E
Bordeaux Mixture	E	E	-	E	-	-	-
Boric Acid	S	E	E	S	E	E	E

Ratings: E – The material should be suitable under most conditions.  
 S – The material offers fair corrosion resistance. It may be considered in place of a material with an “E” rating when some property other than corrosion resistance governs its use.  
 N – The material is not suitable.

**TABLE 2 CORROSION RESISTANCE TABLE**

Chemical	Material						
	Copper	Cupro Nickel	Alloy 825	304 Stainless	Inconel 600	Polyethylene	PVC
Brines	S	E	E	-	S	E	E
Bromine, dry	E	E	E	N	-	N	N
Bromine, moist	S	S	S	N	E	N	N
Butane	E	E	E	E	E	-	E
Butyl Alcohol	S	S	E	-	-	E	S
Butyric Acid	S	S	E	E	S	N	N
Calcium Bisilite	S	S	E	S	N	S	E
Calcium Chloride	S	S	E	E	E	E	E
Calcium Hydroxide	S	E	E	S	E	E	E
Calcium Hypochlorite	S	S	S	N	S	E	E
Cane Sugar Syrups	E	E	E	E	E	-	E
Carbolic Acid	S	S	E	S	E	E	E
Carbon Dioxide, dry	E	E	E	E	E	E	E
Carbon Dioxide, moist	S	E	E	S	E	E	E
Carbonated Water	S	E	E	E	-	E	-
Carbonated Beverages	S	E	E	E	E	E	E
Carbon Disulfide	N	-	E	E	-	N	N
Carbon Tetrachloride, dry	E	E	E	E	E	N	S
Carbon Tetrachloride, moist	S	E	E	S	E	N	N
Castor Oil	E	E	E	E	E	E	E
Chlorine, dry	S	E	E	S	-	S	N
Chlorine, moist	N	S	S	N	N	N	N
Chloroacetic Acid	S	S	E	N	S	-	S
Chloroform, dry	E	E	E	E	E	N	N
Chromic Acid	N	N	E	N	N	S	S
Cider	S	S	E	S	-	E	E
Citric Acid	S	E	E	S	-	E	E
Coffee	E	E	E	E	-	-	-
Copper Chloride	N	N	E	S	N	E	E
Copper Nitrate	N	N	E	E	N	E	E
Copper Sulfate	S	E	E	E	S	E	E
Corn Oil	E	E	E	E	E	E	E
Cottonseed Oil	E	E	E	E	E	E	E
Creosote	S	E	E	N	-	N	N
Crude Oil	E	E	E	E	-	-	-
Ethers	E	E	E	E	E	N	N
Ethyl Acetate	E	E	E	S	S	N	N
Ethyl Alcohol	E	E	E	E	-	E	E
Ethyl Chloride	S	S	E	E	E	N	N

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**TABLE 2 CORROSION RESISTANCE TABLE**

Chemical	Material						
	Copper	Cupro Nickel	Alloy 825	304 Stainless	Inconel 600	Polyethylene	PVC
Ethylene Glycol	E	E	E	E	-	E	S
Ferric Chloride	N	N	S	N	N	E	E
Ferric Sulfate	N	N	E	E	E	E	E
Ferrous Chloride	N	S	S	N	N	E	E
Ferrous Sulfate	S	S	E	S	-	E	E
Formaldehyde	S	E	E	S	E	E	S
Formic Acid	S	S	E	N	S	E	N
Freon	E	E	E	E	-	E	E
Fruit Juices	S	S	E	E	E	E	E
Fuel Oil	S	E	E	N	S	N	S
Furfural	E	E	E	E	S	N	N
Gasoline	E	E	E	E	E	N	N
Gelatine	E	E	E	E	E	-	E
Glucose	E	E	E	E	E	E	E
Glue	E	E	E	-	-	-	-
Glycerine	S	E	E	E	E	E	E
Hydrobromic Acid	N	N	S	N	N	E	E
Hydrocarbons, Pure	E	E	E	E	E	E	E
Hydrochloric Acid	N	N	S	N	N	E	E
Hydrocyanic Acid, dry	S	S	S	N	S	S	N
Hydrofluosilicic Acid	S	S	E	N	S	-	S
Hydrogen	E	E	E	E	-	E	E
Hydrogen Peroxide	N	N	E	S	E	S	E
Hydrogen Sulfide, dry	N	E	E	S	S	E	E
Hydrogen Sulfide, moist	N	N	E	S	S	E	E
Kerosene	E	E	E	E	E	N	E
Lacquers	E	E	E	S	-	-	-
Lacquer Solvents	E	E	E	-	-	-	-
Lactic Acid	S	E	E	S	S	E	S
Lime	S	E	E	S	-	-	E
Line-Sulfur	N	N	-	E	-	-	E
Linseed Oil	S	S	E	E	S	S	E
Magnesium Chloride	S	S	E	S	E	E	E
Magnesium Hydroxide	E	E	E	E	S	E	E
Magnesium Sulfate	S	E	E	E	E	E	E
Mercury	N	N	E	E	E	E	E
Mercury Salts	N	N	E	E	S	E	E
Methyl Alcohol	S	S	E	E	E	E	S
Methyl Chloride, dry	S	E	E	E	E	N	N

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	Copper	Cupro Nickel	Alloy 825	304 Stainless	Inconel 600	Polyethylene	PVC
Milk	S	E	E	E	E	E	E
Mine Water	N	-	E	E	-	E	E
Natural Gas	E	E	E	E	E	-	-
Nitric Acid	N	N	E	S	N	S	N
Nitrogen	E	E	E	-	S	-	-
Oleic Acid	S	S	E	N	E	N	E
Oxalic Acid	S	S	E	N	E	E	E
Oxygen	E	E	E	E	E	-	E
Palmitic Acid	S	S	E	N	-	S	E
Paraffin	E	E	E	E	-	-	-
Phosphoric Acid	S	S	E	N	S	S	E
Potassium Carbonate	E	E	E	E	E	E	E
Potassium Chloride	S	E	E	N	E	E	E
Potassium Chromate	E	E	E	S	E	E	E
Potassium Cyanide	N	N	E	E	E	E	E
Potassium Dichromate, Acid	N	N	E	E	S	E	E
Potassium Hydroxide	S	E	E	S	E	E	E
Potassium Sulfate	E	E	E	E	E	E	E
Propane	E	E	E	E	-	-	E
Rosin	S	E	E	E	-	-	-
Sea Water	S	E	E	N	S	E	E
Sewage	E	E	E	-	-	E	E
Silver Salts	N	N	E	E	-	E	E
Soap Solutions	E	E	E	E	-	E	E
Sodium Bicarbonate	E	E	E	S	S	E	E
Sodium Bisulfate	S	E	E	S	S	E	E
Sodium Bisulfite	S	S	E	S	S	E	E
Sodium Carbonate	E	E	E	E	E	E	E
Sodium Chloride	S	E	E	N	E	E	E
Sodium Chromate	E	E	E	-	-	-	-
Sodium Cyanide	N	N	E	E	-	E	E
Sodium Dichromate, Acid	N	N	E	-	-	E	E
Sodium Hydroxide(Caustic Soda)	S	E	E	S	E	E	E
Sodium Hypochlorite	S	S	S	N	N	E	E
Sodium Nitrate	S	E	E	S	E	E	E
Sodium Peroxide	S	S	E	E	E	-	E
Sodium Phosphate	E	E	E	E	E	-	E
Sodium Silicate	S	E	E	E	E	-	-
Sodium Sulfate	E	E	E	E	S	E	E

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	Copper	Cupro Nickel	Alloy 825	304 Stainless	Inconel 600	Polyethylene	PVC
Sodium Sulfide	N	N	E	N	S	E	E
Sodium Sulfite	S	S	E	E	S	E	E
Sodium Thiosulfate	N	N	E	E	E	E	E
Steam	E	E	E	E	-	E	-
Stearic Acid	S	E	E	S	E	E	E
Sugar Solutions	E	E	E	-	-	E	E
Sulfur, dry	S	E	E	S	S	E	E
Sulfur, molten	N	N	S	S	N	-	N
Sulfur Chloride, dry	E	E	E	S	-	-	E
Sulfur Dioxide, dry	E	E	E	E	E	S	E
Sulfur Dioxide, moist	S	N	E	S	N	S	N
Sulfur Trioxide, dry	E	E	E	-	-	E	E
Sulfuric Acid, 80-95%	N	S	E	N	N	N	S
Sulfuric Acid, 40-80%	N	N	E	N	N	N	E
Sulfuric Acid, 40%	N	S	E	N	S	E	E
Sulfurous Acid	S	N	E	N	N	E	E
Tannic Acid	S	E	E	E	-	E	E
Tar	E	E	E	-	-	-	-
Tartaric Acid	S	E	E	S	S	S	E
Toluene	E	E	E	E	E	N	N
Trichloroacetic Acid	S	S	E	E	-	-	-
Trichlorethylene, dry	E	E	E	S	S	N	N
Trichlorethylene, moist	S	E	E	S	S	N	N
Turpentine	E	E	E	S	E	N	E
Varnish	E	E	E	E	-	-	-
Vinegar	S	E	E	S	E	E	E
Water, Potable	S	E	E	E	-	E	E
Zinc Chloride	S	S	E	N	-	E	E
Zinc Sulfate	S	E	E	S	-	E	E

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