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**PRODUCT  
DATA SHEET**
**Corrosion of Copper  
& Copper Alloys**
**Copper Alloys**

(Copper Development Association Publication No 106)

'R' = the material is resistant to the named chemical up to the temperature shown, subject to limitations indicated by the footnotes (at end).

'X' = the material is not recommended.

'n/a' = data is not available

Temperature, °C	Aluminium Bronze			Brass (a)			Copper			Copper-Nickel 90/10 alloys (b)			Gunmetal and Bronze (c)		
	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°
Acetaldehyde	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Acetic acid (10%)	R	R	R	X	X	X	R	R	R	R	R	R	R	R	R
Acetic acid (glac./anh.)	R	R	R	X	X	X	R	R	R	R	R	X	R	R	R
Acetic anhydride	R	R	R	X	X	X	R	R	R	R	R	R	R	R	X
Aceto-acetic ester	R	R	R	R <sup>11</sup>	X	X	R	R	R	R	R	R	R	R	R
Acetone	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Other ketones	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Acetonitrile	R <sup>6</sup>	X	X	X	X	X	R <sup>6</sup>	X	X	R <sup>6</sup>	X	X	R <sup>6</sup>	X	X
Acetylene	X	X	X	R	R	R <sup>11</sup>	X	X	X	X	X	X	X	X	X
Acetyl salicylic acid	R	R	R	n/a	n/a	n/a	R <sup>6</sup>	X	X	R	R	R	R	R	R
Acid fumes	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	X	X	X	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	R <sup>1</sup>	X	X	X
Alcohols (mostly fatty)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Aliphatic esters	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Alkyl chlorides	n/a	n/a	n/a	X	X	X	R	R	R	R	R	R	R	R	R
Alum	R	R	R	X	X	X	R	R	R	R	R	R	R	R	R
Aluminium chloride	R <sup>4</sup>	R <sup>4</sup>	X	X	X	X	R	R	R	R	R	X	R	R	R
Aluminium sulphate	R	R	R	R <sup>13</sup>	R <sup>13</sup>	X	R <sup>13</sup>	R <sup>4.13</sup>	R <sup>4.13</sup>	R	R	R	R <sup>13</sup>	R <sup>13</sup>	R <sup>13</sup>
Ammonia, anhydrous	R	R	R	X	X	X	R	R	R <sup>12</sup>	R	R	R	R	R	R
Ammonia, aqueous	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ammonium chloride	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Amyl acetate	R	R	R	X	X	X	R	R	R	R	R	R	R	R	R
Aniline	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Antimony trichloride	n/a	n/a	n/a	X	X	X	n/a	n/a	n/a	n/a	n/a	n/a	R	X	X
Aqua regia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Aromatic solvents	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Ascorbic acid	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Temperature, °C	Aluminium Bronze			Brass (a)			Copper			Copper-Nickel 90/10 alloys (b)			Gunmetal and Bronze (c)		
	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°
Beer	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Benzaldehyde	R	R	R	n/a	n/a	n/a	R	R	R	R	R	R	R	R	R
Benzene, pure	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Benzoic acid	R	R	R	R	R	R	X	X	X	R	R	R	X	X	X
Benzoyl peroxide	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Boric acid	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Brines, saturated	R	R	R	X	X	X	R	R	R <sup>4</sup>	R	R	R	R	R	X
Bromide (K) solution	R	R	R	X	X	X	R	R	X	R	R	R	R	R	X
Bromine	R <sup>4</sup>	X	X	X	X	X	X	X	X	R <sup>3</sup>	R <sup>3</sup>	R <sup>3</sup>	X	X	X
Bromine liquid, tech.	R	X	X	R	X	X	R	X	X	R	X	X	R	X	X
Bromine water, sat.aq.	R	X	X	R	X	X	X	X	X	X	X	X	X	X	X
Butyl acetate	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Calcium chloride	R	R	R	X	X	X	R	R	R	R	R	R	R	R	R
Carbon disulphide	R	X	X	R	R	R	R	R	R	R	R	X	R	R	R
Carbonic acid	R	R	R	X	X	X	X	X	X	R	R	R	X	X	X
Carbon tetrachloride	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Caustic soda & potash	R	X	X	X	X	X	R	R	R	R	R	X	R	R	R
Cellulose paint	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Chlorates of Na, K, Ba	R	R	R	X	X	X	R	R	R	R	R	X	R	R	R
Chlorine, dry	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Chlorine, wet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Chlorides of Na, K, Mg	R	R	R	X	X	X	R	R	R <sup>4</sup>	R	R	R	R	R	R
Chloroacetic acids	n/a	n/a	n/a	X	X	X	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chlorobenzene	R	R	R	n/a	n/a	n/a	n/a	n/a	n/a	R	R	R	R	R	R
Chloroform	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Chlorosulphonic acid	R <sup>4</sup>	R <sup>4</sup>	R <sup>4</sup>	n/a	n/a	n/a	X	X	X	R	R	R	X	X	X
Chromic acid (80%)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Citric acid	R	R	R	X	X	X	R	R	R	R	R	R	R	R	R
Copper salts (most)	R	R	R	X	X	X	X	X	X	R	X	X	R	R	R
Cresylic acids (50%)	R	R	R	X	X	X	R	R	R	R	R	X	R	R	R
Cyclohexane	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Detergents, synthetic	n/a	n/a	n/a	R	R	R	R	R	R	R	R	R	R	R	R
Emulsifiers (all conc.)	R	R	R	n/a	n/a	n/a	R	R	R	R	R	R	n/a	n/a	n/a
Esters	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Ether	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Fatty acids (>C6)	R	R	R	X	X	X	R	R	R	R	R	R	R	R	R
Ferric chloride	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ferrous sulphate	R <sup>4</sup>	R <sup>4</sup>	R <sup>4</sup>	X	X	X	X	X	X	R	X	X	X	X	X
Fluorinated refrigerants	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Fluorine, dry	R	R	R <sup>3</sup>	X	X	X	R	R	R	R	R	R	R	R	R
Fluorine, wet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fluorosilic acid	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Formaldehyde (40%)	R	R	R	R	X	X	R	R	R	R	R	R	R	R	R

Temperature, °C	Aluminium Bronze			Brass (a)			Copper			Copper-Nickel 90/10 alloys (b)			Gunmetal and Bronze (c)		
	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°
Formic acid	R	R	R	n/a	n/a	n/a	R	R	R	R	R	R	R	R	R
Fruit juices	R	R	R	X	X	X	R	R	R	R	R	R	R	R	R
Gelatine	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Glycerine	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Glycols	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Glycol, ethylene	R	X	X	R	X	X	R	R	R	R <sup>14</sup>	R <sup>14</sup>	R <sup>14</sup>	R	R	R
Glycollic acid	R <sup>6</sup>	X	X	R <sup>6</sup>	X	X	R <sup>6</sup>	X	X	R <sup>6</sup>	X	X	R <sup>6</sup>	X	X
Hexamethylene diamine	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hexamine	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hydrazine	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hydrobromic acid (50%)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hydrochloric acid (10%)	R	X	X	X	X	X	X	X	X	R	X	X	X	X	X
Hydrochloric acid (conc.)	R <sup>9</sup>	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hydrocyanic acid	R <sup>4</sup>	R <sup>4</sup>	R <sup>4</sup>	X	X	X	X	X	X	X	X	X	X	X	X
Hydrofluoric acid (40%)	R <sup>9</sup>	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hydrofluoric acid (75%)	R <sup>9</sup>	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hydrogen peroxide (30%)	X	X	X	X	X	X	X	X	X	R	X	X	X	X	X
Hydrogen peroxide (30-90%)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hydrogen sulphide	R <sup>3</sup>	R	R	R <sup>3</sup>	R	R	R <sup>3</sup>	R	R	R <sup>3</sup>	R <sup>3</sup>	R <sup>3</sup>	R <sup>3</sup>	R	R
Hypochlorites	R	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hypochlorite (Na 12-14%)	R	R	R	R	R	R	R	R	R	X	X	X	X	X	X
Iso-butyl acetate	R	R	X	X	X	X	R	R	X	R	R	R	R	R	R
Lactic acid (90%)	n/a	n/a	n/a	X	X	X	X	X	X	R	R	X	R <sup>2</sup>	R <sup>2</sup>	X
Lead acetate	X	X	X	X	X	X	X	X	X	R	R	X	X	X	X
Lead perchlorate	R	R	R	R	R	R	R	R	R	X	X	X	X	X	X
Lime (CaO)	n/a	n/a	n/a	n/a	n/a	n/a	R	R	R	R	R	R	R	R	R
Maleic acid	R	X	X	R	X	X	R <sup>8</sup>	R <sup>8</sup>	X	R	R	X	n/a	n/a	n/a
Manganate, potassium	R	R	R	X	X	X	X	X	X	X	X	X	R <sup>9</sup>	R <sup>9</sup>	X
Meat juices	X	X	X	X	X	X	X	X	X	n/a	n/a	n/a	X	X	X
Mercuric chloride	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mercury	R	R	R	R	R	R	R	R	R	X	X	X	X	X	X
Methanol	R	R	R	R <sup>11</sup>	R <sup>11</sup>	R <sup>11</sup>	R	R	R	R	R	R	R	R	R
Methylene chloride	R	R	X	X	X	X	X	X	X	R	R	R	R	R	R
Milk & milk products	R	R	R	X	X	X	R	R	R	R	R		R	R	R
Moist air	R <sup>5</sup>	R <sup>5</sup>	R <sup>5</sup>	R <sup>5</sup>	R	X	R <sup>5</sup>	R	R	R	R	R	R	R	R
Molasses	X	X	X	X	X	X	X	X	X	R	R	R	R <sup>5</sup>	R	R
Monoethanolamine	R	R	R	R	R	R	R	R	R	X	X	X	X	X	X
Naphtha	n/a	n/a	n/a	n/a	n/a	n/a	R	R	R	R	R	R	R	R	R
Naphthalene	n/a	n/a	n/a	X	X	X	X	X	X	R	R	R	n/a	n/a	n/a
Nickel salts	R <sup>10</sup>	R <sup>10</sup>	R <sup>10</sup>	X	X	X	X	X	X	R	R	R	R	R	R
Nitrates of Na, K, NH <sub>3</sub>	X	X	X	X	X	X	X	X	X	R <sup>10</sup>	R <sup>10</sup>	X	X	X	X

Temperature, °C	Aluminium Bronze			Brass (a)			Copper			Copper-Nickel 90/10 alloys (b)			Gunmetal and Bronze (c)		
	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°
Nitric acid (<25%)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nitric acid (50%)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nitric acid (90%)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nitric acid, fuming	R	R	R	R	R	R	R	R	R	X	X	X	X	X	X
Nitrite (Na)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Nitrobenzine	R	X	X	R	X	X	R	X	X	R	R	R	R	R	R
Oil, diesel	R	R	R	R	R	R	R	R	R	R	X	X	R	X	X
Oils, essential	R	R	X	R	R	X	R	R	X	R	R	R	R	R	R
Oils, lube + aromatic ads.	R	R	R	R	R	R	R	R	R	R	R	X	R	R	X
Oils, mineral	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Oils, vegetable & animal	R	R	R	n/a	n/a	n/a	R	R	R	R	R	R	R	R	R
Oxalic acid	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	R	R	R	R	R	R
Ozone	R	R	R	R	R	R	R	R	R	n/a	n/a	n/a	n/a	n/a	n/a
Paraffin wax	X	X	X	n/a	n/a	n/a	X	X	X	R	R	R	R	R	R
Perchloric acid	R	R	R	R	R	R	R	R	R	X	X	X	X	X	X
Petroleum spirits	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Phenol	R	R	R	X	X	X	R	R	R	R	R	R	R	R	R
Phosphoric acid (20%)	R	R	R	X	X	X	X	X	X	R	R	X	X	X	X
Phosphoric acid (50%)	R	R	R	X	X	X	X	X	X	R	R	X	X	X	X
Phosphoric acid (95%)	R <sup>3</sup>	R <sup>3</sup>	R <sup>3</sup>	X	X	X	X	X	X	R	X	X	X	X	X
Phosphorus chlorides	n/a	n/a	n/a	X	X	X	X	X	X	R	X	X	X	X	X
Phosphorous pentoxide	R	R	R	n/a	n/a	n/a	R	R	R	n/a	n/a	n/a	X	X	X
Phthalic acid	X	X	X	X	X	X	X	X	X	R	R	R	R	R	R
Picric acid	n/a	n/a	n/a	X	X	X	X	X	X	R	R	R	R	R	R
Pyridine	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	X	X	X
Salicyl aldehyde	R	R	R	R <sup>9</sup>	R	R	R	R	R	n/a	n/a	n/a	n/a	n/a	n/a
Sea water	R	R	R	n/a	n/a	n/a	R	R	R	R	R	R	R	R	R
Silicic acid	R	R	R	R	R	R	R	R	R	X	X	X	n/a	n/a	n/a
Silicone fluids	X	X	X	X	X	X	X	X	X	R	R	R	R	R	R
Silver nitrate	R	R	R <sup>2</sup>	R	R	R	R	R	R	X	X	X	X	X	X
Sodium carbonate	X	X	X	X	X	X	X	X	X	R	R	R	R	R	R
Sodium peroxide	R	R	R	R	R	R	R	R	R	R	X	X	X	X	X
Sodium silicate	X	X	X	X	X	X	X	X	X	R	R	R	R	R	R
Sodium sulphide	R <sup>3</sup>	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Stannic chloride	R	R	X	n/a	n/a	n/a	R	R	R	X	X	X	X	X	X
Starch	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Sugar soln, syrups, jams	n/a	n/a	n/a	X	X	X	X	X	X	R	R	R	R	R	R
Sulphamic acid	R	R	R	R	R	R	R	R	R	n/a	n/a	n/a	X	X	X
Sulphates (Na, K, Mg, Ca)	R	R	R	X	X	X	R	R	R	R	R	R	R	R	R
Sulphites	n/a	n/a	n/a	n/a	n/a	n/a	X	X	X	R	R	R	R	R	R

Temperature, °C	Aluminium Bronze			Brass (a)			Copper			Copper-Nickel 90/10 alloys (b)			Gunmetal and Bronze (c)		
	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°	20°	60°	100°
Sulphonic acids	X	X	X	X	X	X	X	X	X	n/a	n/a	n/a	n/a	n/a	n/a
Sulphur	R	R	R	R	R	R	R	R	R	X	X	X	X	X	X
Sulphur dioxide, dry	R	R	R	X	X	X	X	X	X	R	R	X	R	R	R
Sulphur dioxide, wet	R	R	R	X	X	X	R <sup>4</sup>	R <sup>4</sup>	X	X	X	X	X	X	X
Sulphur dioxide, (96%)	R <sup>3</sup>	R	R	R <sup>3</sup>	R	R	R <sup>3</sup>	R	R	R	R <sup>4</sup>	X	R <sup>4</sup>	R <sup>4</sup>	R <sup>4</sup>
Sulphur trioxide	R	R	R	X	X	X	R	R	R	R <sup>3</sup>	R	X	R <sup>3</sup>	R	R
Sulphuric acid (<50%)	R	R <sup>9</sup>	X	X	X	X	X	X	X	R	X	X	X	X	X
Sulphuric acid (70%)	R <sup>9</sup>	X	X	X	X	X	X	X	X	R	X	X	X	X	X
Sulphuric acid (95%)	X	X	X	X	X	X	X	X	X	R	X	X	X	X	X
Sulphuric acid, fuming	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sulphur chlorides	R	R	R	n/a	n/a	n/a	R	R	R	X	X	X	X	X	X
Tallow	R	R	R	R	R	R	R	R	R	R	R	R	n/a	n/a	n/a
Tannic acid (10%)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Tartaric acid	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Trichlorethylene	R	R	X	R	R	X	R	R	X	R	R	R	R	R	R
Urea (30%)	R	R	R	X	X	X	X	X	X	R	R	X	R	R	n/a
Vinegar	R <sup>7</sup>	R	X	X	X	X	R <sup>7</sup>	R	X	R	R	R	X	X	X
Water, distilled	R	R	R	R	R	R	R	R	R	R	R	R	R <sup>7</sup>	R	R
Water, soft	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Water, hard	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Wetting agents (to 5%)	n/a	n/a	n/a	n/a	n/a	n/a	R	R	R	R	R	R	R	R	R
Yeast	R	R	R	X	X	X	X	X	X	n/a	n/a	n/a	R	R	R
Zinc chloride	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

### Footnotes

(a) Brass: some type of brass have less corrosion resistance than is shown on the chart, others have more, e.g. aluminium brass.

(b) Copper-nickel alloys: Based on behaviour of Cu/Ni 90/10; 70/30 may be generally more resistant.

(c) Gunmetal: The data refer only to high tin gunmetals.

- |   |  |    |                               |
|---|--|----|-------------------------------|
| 1 | Depending on the acid                                      | 8  | May discolour liquid/ product |
| 2 | Fair resistance  | 9  | Depending on type             |
| 3 | Anhydrous  | 10 | Not ammonium                  |
| 4 | Not aerated solutions                                      | 11 | Provided more than 70% copper |
| 5 | Depending on composition                                   | 12 | Water less than 150ppm        |
| 6 | Over 85%   | 13 | Pure solution                 |
| 7 | In absence of dissolved O <sub>2</sub> and CO <sub>2</sub> | 14 | With stabilizer               |

This chart provides general information on the corrosion resistance of copper and copper alloys. Please consult Austral Wright Metals for advice on your specific application.