

# Metals and Corrosion Resistance

A major problem in process industry is corrosion of metals in pipes, valves and other constructions. This guide indicates acceptable combinations of more or less aggressive fluids and common used metal materials.

Remember that corrosion is a complicated issue depending on combinations of materials and fluids, fluid temperatures, the surrounding environment and galvanic currents.

This table should be used as a guide only: 1 for "Good", 2 for "Be Careful" and 3 for "Not Useable".

Fluid	Carbon Steel	Cast Iron	302 and 304 Stainless Steel	316 Stainless Steel	Bronze	Durimet	Monel	Hasteloy B	Hasteloy C	Titanium	Cobalt base alloy 6	416 Stainless Steel
Acetaldehyde	1	1	1	1	1	1	1		1			1
Acetic acid. air free	3	3	2	2	2	1	2	1	1	1	1	3
Acetic acid. aerated	3	3	1	1	1	1	1	1	1	1	1	3
Acetic acid. vapors	3	3	1	1	2	2	2		1	1	1	3
Acetone	1	1	1	1	1	1	1	1	1	1	1	1
Acetylene	1	1	1	1		1	1	1	1		1	1
Alcohols	1	1		1	1	1	1	1	1	1	1	1
Aluminum Sulfate	3	3	1		2	1	2	1	1	1		3
Ammonia	1	1	1	1	3	1	1	1	1	1	1	1
Ammonium chloride	3	3	2	2	2	1	2	1	1	1	2	3
Ammonium Nitrate	1	3	1	1	3	1	3	1	1	1	1	3
Ammonium Phosphate	4	3	1	1	2	2	2	1	1	1	1	2
Ammonium Sulfate	3	3	2	1	2	1	1	1	1	1	1	3
Ammonium Sulfite	3	3	1	1	3	1	3		1	1	1	2
Aniline	3	3	1	1	3	1	2	1	1	1	1	3
Asphalt	1	1	1	1	1	1	1	1	1		1	1
Beer	2	2	1	1	2	1	1	1	1	1	1	2
Benzene (benzol)	1	1	1	1	1	1	1	1	1	1	1	1
Benzoic acid	3	3	1	1	1	1	1		1	1		1
Boric acid	3	3	1	1	1	1	1	1	1	1	1	2
Butane	1	1	1	1	1	1	1	1	1		1	1
Calcium Chloride (alkaline)	2	2	3	2	3	1	1	1	1	1		3
Calcium hypochlorite	3	3	2	2	2	1	2	3	1	1		3

Carbolic acid	2	2	1	1	1	1	1	1	1	1	1	
Carbon dioxide, dry	1	1	1	1	1	1	1	1	1	1	1	1
Carbon dioxide, wet	3	3	1	1	2	1	1	1	1	1	1	1
Carbon disulfide	1	1	1	1	3	1	2	1	1	1	1	2
Carbon tetrachloride	2	2	2	2	1	1	1	2	1	1		3
Carbonic acid	3	3	2	2	2	1	1	1	1			1
Chlorine gas	1	1	2	2	2	1	1	1	1	3	2	3
Chlorine gas, wet	3	3	3	3	3	3	3	3	2	1	2	3
Chlorine, liquid	3	3	3	3	2	2	3	3	1	3	2	3
Chromic acid	3	3	3	2	3	3	1	3	1	1	2	3
Citric acid		3	2	1	1	1	2	1	1	1		2
Coke oven gas	1	1	1	1	2	1	2	1	1	1	1	1
Copper sulfate	3	3	2	2	2	1	3		1	1		1
Cottonseed oil	1	1	1	1	1	1	1	1	1	1	1	1
Creosote	1	1	1	1	3	1	1	1	1		1	1
Ethane	1	1	1	1	1	1	1	1	1	1	1	1
Ether	2	2	1	1	1	1	1	1	1	1	1	1
Ethyl chloride	3	3	1	1	1	1	1	1	1	1	1	2
Ethylene	1	1	1	1	1	1	1	1	1	1	1	1
Ethylene glycol	1	1	1	1	1	1	1				1	1
Ferric chloride	3	3	3	3	3	3	3	3	2	1	2	3
Formaldehyde	2	2	1	1	1	1	1	1	1	1	1	1
Formic acid		3	2	2	1	1	1	1	1	3	2	3
Freon wet	2	2	2	1	1	1	1	1	1	1	1	
Freon dry	2	2	1	1	1	1	1	1	1	1	1	
Furfural	1	1	1	1	1	1	1	1	1	1	1	2
Gasoline	1	1	1	1	1	1	1	1	1	1	1	1
Glucose	1	1	1	1	1	1	1	1	1	1	1	1
Hydrochloric acid, aerated	3	3	3	3	3	3	3	1	2	3	2	3
Hydrochloric acid, air free	3	3	3	3	3	3	3	1	2	3	2	3
Hydrofluoric acid, aerated	2	3	3	2	3	2	3	1	1	3	2	3
Hydrofluoric acid, air free	1	3	3	2	3	2	1	1	1	3		3
Hydrogen	1	1	1	1	1	1	1	1	1	1	1	1
Hydrogen peroxide		1	1	1	3	1	1	2	2	1		2
Hydrogen sulfide, liquid	3	3	1	1	3	2	3	1	1	1	1	3
Magnesium Hydroxide	1	1	1	1	2	1	1	1	1	1	1	1

Mercury	1	1	1	1	3	1	2	1	1	1	1	1
Methanol	1	1	1	1	1	1	1	1	1	1	1	1
Methyl ethyl ketone	1	1	1	1	1	1	1	1	1		1	1
Milk	3	3	1	1	1	1	1	1	1	1	1	3
Natural gas	1	1	1	1	1	1	1	1	1	1	1	1
Nitric acid	3	3	1	2	3	1	3	3	2	1	3	3
Oleic acid	3	3	1	1	2	1	1	1	1	1	1	1
Oxalic acid	3	3	2	2	2	1	2	1	1	2	2	2
Oxygen	1	1	1	1	1	1	1	1	1	1	1	1
Petroleum oils	1	1	1	1	1	1	1	1	1	1	1	1
Phosphoric acid, aerated	3	3	1	1	3	1	3	1	1	2	1	3
Phosphoric acid, air free	3	3	1	1	3	1	2	1	1	2	1	3
Phosphoric acid vapors	3	3	2	2	3	1	3	1		2	3	3
Picric acid	3	3	1	1	3	1	3	1	1			2
Potassium chloride	2	2	1	1	2	1	2	1	1	1		3
Potassium hydroxide	2	2	1	1	2	1	1	1	1	1		2
Propane	1	1	1	1	1	1	1	1	1	1	1	1
Rosin	2	2	1	1	1	1	1	1	1		1	1
Silver Nitrate	3	3	1	1	3	1	3	1	1	1	2	2
Sodium acetate	1	1	2	1	1	1	1	1	1	1	1	1
Sodium carbonate	1	1	1	1	1	1	1	1	1	1	1	2
Sodium chloride	3	3	2	2	1	1	1	1	1	1	1	2
Sodium chromate	1	1	1	1	1	1	1	1	1	1	1	1
Sodium hydroxide	1	1	1	1	3	1	1	1	1	1	1	2
Sodium hypochloride	3	3	3	3	3	2	3	3	1	1		3
Sodium thiosulfate	3	3	1	1	3	1	3	1	1	1		2
Stannous chloride	2	2	3	1	3	1	2	1	1	1		3
Stearic acid	1	3	1	1	2	1	2	1	1	1	2	2
Sulfate liquor	1	1	1	1	3	1	1	1	1	1	1	
Sulfur	1	1	1	1	3	1	1	1	1	1	1	1
Sulfur dioxide, dry	1	1	1	1	1	1	1	2	1	1	1	2
Sulfur trioxide, dry	1	1	1	1	1	1	1	2	1	1	1	2
Sulfuric acid, aerated	3	3	3	3	3	1	3	1	1	2	2	3
Sulfuric acid, air free	3	3	3	3	2	1	2	1	1	2	2	3

Sulfurous acid	3	3	2	2	2	1	3	1	1	1	2	3
Tar	1	1	1	1	1	1	1	1	1	1	1	1
Trichloroethylene	2	2	2	1	1	1	1	1	1	1	1	2
Turpentine	2	2	1	1	1	1	2	1	1	1	1	1
Vinegar	3	3	1	1	2	1	1	1	1		1	3
Water, boiler feed	2	3	1	1	3	1	1	1	1	1	1	2
Water, distilled	1	1	1	1	1	1	1	1	1	1	1	2
Water, sea	2	2	2	2	1	1	1	1	1	1	1	3
Whiskey	3	3	1	1	1	1	2	1	1	1	1	3
Wine	3	3	1	1	1	1	2	1	1	1	1	3
Zinc chloride	3	3	3	3	3	1	3	1	1	1	2	3
Zinc sulfate	3	3	1	1	2	1	1	1	1	1	1	2

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