Galvanic Corrosion

Galvanic corrosion occurs when two dissimilar metals are in contact in the presence of an electrolyte, which is a medium through which an electrical current can flow (i.e. moisture). The rate of corrosion depends upon the amount and concentration of the electrolyte as well as the difference in electrical potential (anodic-cathodic relationship) of the metals as shown in the Glavanic Corrosion Chart below.

A highly anodic material in contact with another highly cathodic material will corrode much more quickly than two highly cathodic materials or when the materials used are closer together on the Galvanic Corrosion Chart. The metal in the higher position on the chart corrodes at a faster rate. This occurs due to the conduction of electrons through the metals from anode (+) to cathode (-), and a conduction of ions through the electrolyte solution, with salt water being even more damaging due to the high concentration of dissolved salts. It is important to know from which the dissimilar metals the current will flow when selecting materials.

When corrosion does occur, the anodic material is the most likely to corrode, whereas the cathodic material is the least likely to corrode. To reduce the likelihood of galvanic corrosion in a fastened joint, it's recommended to choose materials that are grouped together in the Galvanic Corrosion Chart. Recommendations include:

+ 1. Select materials that are as close together as possible in the Galvanic Corrosion Chart.

+ 2. Provide a barrier between the two metals, such as a non-metallic washer or gasket, paint or jointing compound.

+ 3. Design the fastener as the cathode so that the cathodic area is as small as possible to the anode area.

+ 4. Use a metallic finish on the fastener that is close on the chart to the mating metal.

+ 5. Use a non-conductive and inert finish on the fastener.

Electric
Current
Flows from
Positive (+) Anode
to
Negative (-) Cathode

Galvanic Corrosion Chart

Corroded End (+)
(Anodic, Least Noble)

Magnesium
Magnesium Alloys
Zinc
Beryllium
Aluminum 1100, 3003, 3004, 5052, 6053
Cadmium
Aluminum 2017, 2024, 2117
Mild Steel 1018, Wrought Iron
Cast Iron, Low Alloy, High Strength Steel
HSLA Steel, Cast Iron
Chrome Iron (Active)
430 Stainless Steel (Active)
302, 303, 321,347, 410, 416 Stainless Steel (Active)
Ni-Resist
316, 317 Stainless Steel (Active)
Carpenter 20Cb-3 Stainless Steel (Active)
Aluminum Bronze (CA687)
Hastelloy C (Active), Inconel 625 (Active), Titanium (Active)
Lead-Tin Solder
Lead
Tin
Inconel 600 (Active)
Nickel (Active)
60% Ni 15% Cr (Active)
80%Ni 20% Cr (Active)
Hastelloy B (Active)
Naval Brass (CA464), Yellow Brass (CA268)
Red Brass (CA230), Admiralty Brass (CA443)
Copper (CA102)
Manganese Bronze (CA675), Tin Bronze (CA903, 905)
410, 416 Stainless Steel (Passive), Phosphor Bronze (CA521, 524)
Silicon Bronze (CA651, 655)
Nickel Silver (CA 732, 735, 745,752, 754,757,765,770, 794)
Copper – Nickel 90-10
Copper – Nickel 80-20
430 Stainless Steel (Passive)
Copper – Nickel 70-30
Nickel Aluminum Bronze (CA630, 632)
Monel 400, K500

Silver Solder
Nickel (Passive)
60% Ni 15% Cr (Passive)
Inconel 600 (Passive)
80% Ni 20% Cr (Passive)
Chrome Iron (Passive)
302, 303, 304, 321, 347 Stainless Steel (Passive)
316, 317 Stainless Steel (Passive)
Carpenter 20Cb-3 Stainless Steel (Passive), Incoloy 825 (Passive)
Silver
Titanium (Passive), Hastelloy C & C276 (Passive), Inconel 625 (Passive)
Graphite
Zirconium
Gold
Platinum

Protected End (-)
(Cathodic or Most Noble)