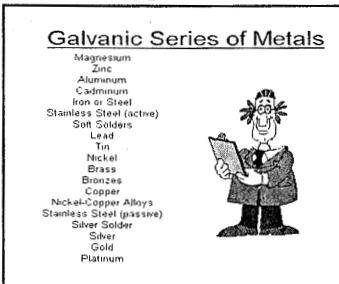


Ask Dr. Galv

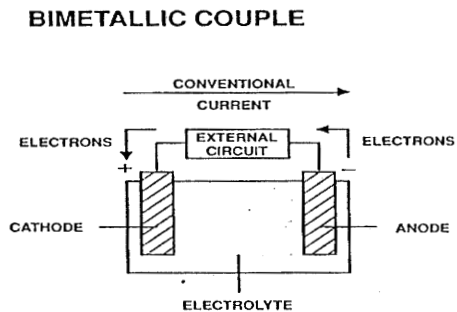
Dear Dr. Galv: I have some parts that I am going to put together into an assembly and some of the parts are hot dip galvanized and the others are either aluminum or stainless steel. Is this assembly going to be okay or do I have to do something to separate the different types of metal?



The presence of two dissimilar metals in an assembly is not always a sign of trouble but it could be a problem. When two metals are in direct contact, there is the potential for the

formation of a bimetallic couple. There are four elements necessary for the contact metals to experience corrosion: (1) One of the metals must act as the anode and generate electrons that can create an electrical current flow. (2) The other metal must act as a cathode and collect these flowing electrons. This metal is the protected partner of the corrosion cell. (3) There must be an electrolyte material covering these two metals at the area where they are touching to complete the electrical current path. This electrolyte material must be able to conduct ions from one metal to the other; and (4) There must be a return current path which in almost all cases is a direct contact between the two metals. The following diagram shows all of the parts of the bimetallic couple.

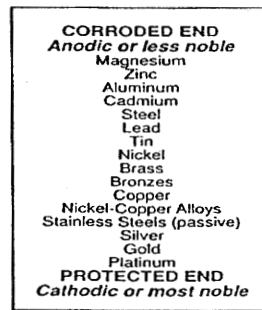
Figure 1



The potential for any particular metal to become a cathode or an anode is represented by the Galvanic Series of Metals. The metals that are higher on the chart will lose their ions or corrode when connected to metals that are lower on the chart. As you can see from zinc's high place on the chart, it is the corrosion protection material of choice for most applications. The other materials are all cathodic to zinc and therefore will be protected by zinc's presence.

Figure 2

ARRANGEMENT OF METALS IN GALVANIC SERIES



Any one of these metals and alloys will theoretically corrode while offering protection to any other which is lower in the series, so long as both are electrically connected.

In actual practice, however, zinc is by far the most effective in this respect.

Back to the question about zinc coated steel in an assembly with other metallic materials. As in all design and fabrication situation, the problem is not as simple as just looking it up on a chart. The zinc has been applied to the steel to provide corrosion protection for the underlying base steel. If zinc is in contact on the surface with a more cathodic metal and the zinc becomes part of a bimetallic couple and corrodes, then the zinc is not performing its designed function of protecting the base steel. The formation of a bimetallic couple needs four elements in order to form. The existence of two dissimilar metals in direct contact can be no problem whatsoever if there is no electrolytic material present. In most atmospheric applications the only potential electrolytic material that can be present is rainwater or dew. Both of these forms of water are poor electrolytic materials since they do not contain many salts and ions which would make them conductive. On the other hand, marine environments and areas where the melting snow includes road salts can be very good electrolyte materials. Bimetallic couples are more easily formed in immersion situations where the assembly will be under water when it is in service. Salt water is especially tough on two dissimilar metals in contact. The best guide as to how two dissimilar metals will react under different environments is found in the publication, *Galvanizing for Corrosion Protection: A Specifier's Guide* (page 34, Figure 20). The performance of zinc in contact with most of the common building metals is rated for most environments. This figure is easy to understand and provides a good reference sheet to fax to those who are concerned with the potential of forming a bimetallic cell.

The final answer to those who want to assemble systems with dissimilar metals that will be immersed in service is to electrically isolate the two pieces by inserting an insulating material between them. The breaking of the contact between the two metals will effectively stop any possibility of forming a bimetallic cell. Most plastics are good insulating materials. For salt water immersion, the most common insulator is a piece of rubber.