

Sport Aviation Q&A

Q: What are some considerations to keep in mind relating to corrosion (and its control) as I design and build my homebuilt airplane?

In an earlier article I described some of the corrosion issues with the various metal materials that are commonly used in the assembly of homebuilt aircraft. In this edition, I will describe some aspects of a specific method of corrosion known as galvanic corrosion.

Galvanic corrosion is not often thought about in homebuilder's circles, not just by the builders, but even by designers. This type of corrosion can be insidious, however, as it can result in damage and even structural failure without warning.

So what is the cause of this? Well, in order to fully understand it, we would need to delve into the atomic structure of different molecules that make up the materials. For this article, it will suffice to state that each material has a specific potential to react with other metals. This potential is based upon the arrangement of electrons in the cloud surrounding the nucleus of the atom. If two materials have a similar potential, there is a low risk of corrosion occurring. If the difference is greater, the potential for corrosion is much greater. There are two additional components necessary for the corrosion to occur – some type of electrolyte and an electrical path. When these components all come together, there is an electrical current set up which transfers electrons from one material to the other, resulting in the corrosion.

So, how can you reduce the risk of this happening to your airplane? To start with, be careful when selecting materials that will be in contact with each other. The following chart shows the potential of many common materials.

Anode End (Most Active)	Magnesium and magnesium alloys Zinc Galvanized steel Aluminum alloys 5052, 3004, 3003, 1100, 6053 Cadmium Alclad 35 Aluminum alloys 2117, 2017, 2024 Iron, cast iron, and low-carbon steel Chromium stainless steel Ni-resist – high Ni cast iron 410 stainless steel – active 50-50 lead-tin solder 304 stainless steel – active 316 stainless steel – active Lead Tin
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	Inconel – active
	Nickel – active
	Chlorimet 2
	Hastelloy B
	Cupronickels
	Bronzes
	Copper
	Brasses
	Silver solder
	Inconel alloy 600 – passive
	Nickel – passive
	Monel
	410 stainless steel – passive
	304 stainless steel – passive
	316 stainless steel – passive
	Incoloy alloy 825
	Inconel alloy 625
	Chlorimet 3
	Hastelloy C
	Silver
	Titanium
	Graphite
Cathode End	Gold
(most noble)	Platinum

If materials are placed together in an assembly which are relatively close to one another in the chart, the risk of corrosion will be low. In other words, try to design with the chart in mind. If you are a builder and not a designer, double check the materials that are specified or supplied with your plans or kit.

A couple of common examples of hazardous situations that I have seen on homebuilt airplanes are:

- Attaching bare aluminum parts to unprotected carbon fiber parts. The fix for this would be to either place a protective coat of paint on either one or both of the mating surfaces, or place an insulating ply of fiberglass over the carbon surface. It is also important to look at what fasteners are used. Never use an aluminum fastener (a rivet, for example) through carbon components. As can be seen in the chart, carbon (graphite) is about as far away from aluminum as you can get.
- Connecting aluminum parts together with a monel rivet. This could be fixed by coating the rivet with zinc oxide primer and installing it while it is still ‘wet’. Another option would be to use an aluminum rivet, if it could be shown that this would carry the loads required.

In conclusion, galvanic corrosion is something that should be in the back of your mind when you are building your aircraft. With a little bit of forethought and planning, this type of corrosion may be stopped before it even has a chance to begin.