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Galvanic Reaction **Between Metals**

Galvanic Corrosion

A galvanic reaction, also known as galvanic corrosion or bimetallic corrosion, occurs when two different metals come into contact in the presence of an electrolyte (such as water or saltwater). This reaction can lead to the deterioration of one or both metals involved. The severity of the reaction depends on the specific metals involved, their relative positions in the galvanic series, and the conductivity of the electrolyte.

Galvanic corrosion is an important thing to think about when choosing metal paneling, trim, joist hangers, and fasteners.

Minimizing Galvanic Corrosion

Use metals that are not dissimilar. Generally, metals close together in the Galvanic Series list do not strongly affect one another. The farther apart any two metals are on the list, the stronger the corroding effect on the more active metal.

Ensure that dissimilar metals are not electrically connected by water. Keep small anodes from contacting large cathodes. Corrosion rates are determined by the surface area of the anode in relation to the cathode. The smaller the anode's surface area relative to the cathode's surface area, the more concentrated the flow of electrons at the anode, making the corrosion rate faster. The larger the anode's surface area in relation to the cathode, the more spread out the flow of electrons and the slower the rate of the anode's corrosion

The application of a protective metallic coating, known as a sacrificial coating, can provide galvanic protection to the base metal when the coating is measurably more anodic than the base metal. Galvanic corrosion will occur with the anodic material when the base material is exposed. The extent to which a sacrificial coating can continue to protect the base metal is directly related to the thickness of the coating. Metallic coatings that are not sacrificial, as well as paint coatings, plastic, or other non-metallic barriers, can significantly reduce galvanic corrosion. But when using a paint coating, it's essential to know that if a small scratch in the paint lets the base metal show, the base metal could quickly corrode if it becomes the anode in a reaction with a nearby dissimilar metal with a large surface area.

Preventing Corrosion in Fasteners

Galvanic corrosion is a concern when using metal fasteners such as bolts, screws, and welds. Because fasteners have a much smaller surface area than the materials they fasten, fasteners that take on the role of the anode will be at risk of rapid corrosion and thus should be avoided. To minimize the risk of fasteners' galvanic corrosion, match the fastener's surface metal with that of the metal it will fasten. The most desired combination is a large anode with a small cathode; in other words, fasteners such as bolts and screws should be made of metal less likely to corrode or be more cathodic.

It's important to consider galvanic reactions when selecting and combining different metals in applications where they may come into contact, especially in environments where electrolytes are present.

The following chart can be used to guide the selection of fasteners based on galvanic action:

Base Metal	Fastener Metal					
	Zinc & Galvanized Steel	Aluminium & Aluminium Alloys	Steel & Cast Iron	Brasses, Copper Bronzes, Monel	Martensitic Stainless (type 410)	Austenitic Stainless Steel (type 302/304, 303, 305)
Zinc & Galvanized Steel	A	B	B	C	C	C
Aluminium & Aluminium Alloys	A	A	B	C	Not recommended	B
Steel & Cast Iron	AD	A	A	C	C	B
Teme (Lead Tin) Plated Steel Sheets	ADE	AE	AE	C	C	B
Brasses, Copper, Bronzes, Monel	ADE	AE	AE	A	A	B
Ferritic Stainless Steel (type 430)	ADE	AE	AE	A	A	A
Austenitic Stainless Steel (type 302/304)	ADE	AE	AE	AE	A	A

Key:
A: corrosion of the base metal is not increased by the fastener. | **B:** corrosion of the base metal is marginally increased by the fastener.
C: corrosion of the base metal may be markedly increased by the fastener metal. | **D:** plating on the fastener is rapidly consumed, leaving the bare fastener metal. | **E:** corrosion of the fastener is increased by the base metal.

Corrosion of Panels and Trim in Contact with Treated Wood

Do not allow aluminum, aluminum-coated, and galvalume-coated components to come into direct contact with wood preservatives containing copper, mercury, or fluorides. Avoid direct contact between bare metal panels and treated lumber where condensation frequently forms on the metal surface in contact with the lumber or where the wood treatment is more noble than the metal surface. Use an appropriate barrier to separate metal components and treated lumber.

Citations:

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2. David R. Bonhoff, "Metal Panel and Trim Installation Tolerances," July 2005
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