

INDUSTRIAL FASTENERS INSTITUTE

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Galvanic Compatibility (Corrosion)

Quality engineering and design requires an understanding of material compatibility. **Galvanic corrosion** (sometimes called dissimilar metal corrosion) is the process by which the materials in contact with each other oxidizes or corrodes. There are three conditions that must exist for galvanic corrosion to occur. First there must be two electrochemically dissimilar metals present. Second, there must be an electrically conductive path between the two metals. And third, there must be a conductive path for the metal ions to move from the more anodic metal to the more cathodic metal. If any one of these three conditions does not exist, galvanic corrosion will not occur. Often when design requires that dissimilar metals come in contact, the galvanic compatibility is managed by finishes and plating. The finishing and plating selected facilitate the dissimilar materials being in contact and protect the base materials from corrosion.

For harsh environments, such as outdoors, high humidity, and salt environments fall into this category. Typically there should be not more than 0.15 V difference in the "Anodic Index". For example; gold - silver would have a difference of 0.15V being acceptable.

For normal environments, such as storage in warehouses or non-temperature and humidity controlled environments. Typically there should not be more than 0.25 V difference in the "Anodic Index".

For controlled environments, such that are temperature and humidity controlled, 0.50 V can be tolerated. Caution should be maintained when deciding for this application as humidity and temperature do vary from regions.

Metallurgical Category	Anodic Index (V)
Gold, solid and plated, Gold-platinum alloy	0.00
Rhodium plated on silver-plated copper	0.05
Silver, solid or plated; monel metal. High nickel-copper alloys	0.15
Nickel, solid or plated, titanium alloys, Monel	0.30
Copper, solid or plated; low brasses or bronzes; silver solder; German silvery high copper-nickel alloys; nickel-chromium alloys	0.35
Brass and bronzes	0.40
High brasses and bronzes	0.45
18% chromium type corrosion-resistant steels	0.50
Chromium plated; tin plated; 12% chromium type corrosion-resistant steels	0.60
Tin-plate; tin-lead solder	0.65
Lead, solid or plated; high lead alloys	0.70
Aluminum, wrought alloys of the 2000 Series	0.75
Iron, wrought, gray or malleable, plain carbon and low alloys steels	0.85
Aluminum, wrought alloys other than 2000 Series aluminum, cast alloys of silicon type	0.90
Aluminum, cast alloys other than silicon type, cadmium, plated and chromate	0.95
Hot-dip-zinc plate; galvanized steel	1.20
Zinc, wrought; zinc-base die-casting alloys; zinc plated	1.25
Magnesium & magnesium-base alloys, cast or wrought	1.75
Beryllium	1.85

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