GALVANIC CORROSION - COMPATIBLE METALS CHARTS

To minimize galvanic corrosion, select fasteners based on their material compatibility with the substrates. The closer together the material are on the chart to the right, the less galvanic action will occur. Metals listed on the top of the chart (anodic) will corrode faster than the metals on the bottom of the chart (cathodic).
Contact a corrosion specialist to determine the best material for your application.

Anodic Index	Index (Volts)
Silver, solid or plated; monel metal. High nickel-copper alloys	0.15
Nickel, solid or plated, titanium and 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 alloy steels	0.85
Aluminum, wrought alloys other than 2000 Series aluminum, cast alloys of the 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

Galvanic Compatibility
When design requires that dissimilar metals come in contact, galvanic compatibility can be managed by finishes and plating which protects the base materials from corrosion.

- Harsh environments, such as outdoors, high humidity, and salt environments. Typically there should be not more than 0.15 V difference in the "Anodic Index". For example; silver - nickel would have a difference of 0.15V being acceptable.
- Normal environments like non-temperature and humidity controlled environments. Typically there should not be more than 0.25 V difference in the "Anodic Index".
- 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.

Active (Anodic) Most Likely To Corrode
Magnesium
Magnesium alloys
Zinc (hot-dip, die cast, or plated)
Aluminium 1100, 3003, 3004, 5052, 6053
Tin (plated)
Lead
Steel 1010
Iron (cast)
Stainless steel 410 (active)
Copper (plated, cast, or wrought)
Nickel (plated)
Chromium (Plated)
Stainless steel 301,304,310 (active)
Stainless steel 430 (active)
Tungsten
Brass
Nickel-silver (18% Ni)
Stainless steel 316L (active)
Bronze 220
Copper 110
Red Brass
Stainless steel 347 (active)
Copper-nickel 715
Admiralty brass
Stainless steel 202 (active)
Bronze, Phosphor
Monel 400
Stainless steel 201 (active)
Stainless steel 321 (active)
Stainless steel 316 (active)
Stainless steel 309 (active)
Stainless steel 17-7PH (passive)
Silicone Bronze 655
Stainless steel 301,304,321 (passive)
Stainless steel 201,286 (passive)
Stainless steel 316L (passive)
Stainless steel 202 (passive)
Titanium
Nobel (Cathodic) Lest Likely To Corrode

Fastener Material Selection Based on the Galvanic Series of Metals

Table developed using information supplied by AISI Committee of Stainless Steel Producers.

Key

A. The corrosion of the base metal is not increased by the fastener.
B. The corrosion of the base metal is slightly increased by the fastener.
C. The corrosion of the base metal may be considerably increased by the fastener material.
D. The plating on the fastener is rapidly consumed.
E. The corrosion of the fastener is increased by the base metal.

		FASTENER MATERIAL			
		STEEL Zinc Plated	STAINLESS STEEL Type 410	STAINLESS STEEL Type 302, 304, 316	ALUMINUM
BASE METAL	Zinc | Galvanized | ZN/Al Coated Steel	A	C	C	B
	Aluminum	A	[1]Not Recommended	B	A
	Steel / Cast Iron	A,D	C	B	A
	Brass, Copper, Bronze	A,D,E	A	B	A,E
	Stainless Steel 300 Series	A,D,E	A	A	A,E

Footnotes

1. Because aluminum can expand a large distance, the high hardness of 410 SS case harden screws may lead to screw to failure due to lack of ductility or stress corrosion cracking.

NOTE: Organic coating to the screw will improve the corrosion resistance. Environments can affect the rate of corrosion and change the activity of the metals.

Revised by TFC: 1221JS

Special Note: Preservative-Treated Lumber Applications

ACQ, Penta, CA or CBA preservative-treated lumber can be incompatible with certain types of fasteners. In those cases where any type of metal roof or wall cladding materials are being attached to preservative treated lumber, the following fasteners are not compatible: zinc plated screws, zinc-alloy headed screws, stainless capped screws, aluminum, copper and copper alloy. When attaching metal panels to those types of preservative-treated lumber, a moisture barrier should be used between the lumber and the panel material. Metal panel fasteners that are compatible with preservative-treated lumber are stainless steel fasteners, or hot dip galvanized nails manufactured to ASTM A153 class D or heavier. Other types of fasteners coated with proprietary anti-corrosive technologies are also available for use with preservative-treated lumber. In addition, zinc-plated screws can be used in CCA and MCQ pressure-treated lumber.