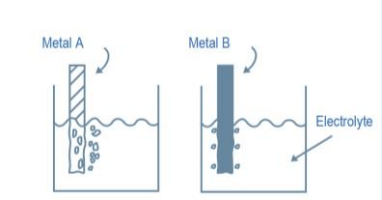
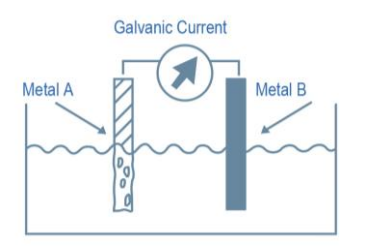
Galvanic protection

Galvanic or sacrificial protection of a steel substrate by an active metal coating relies on the existence of a galvanic cell and the resulting flow of galvanic current.

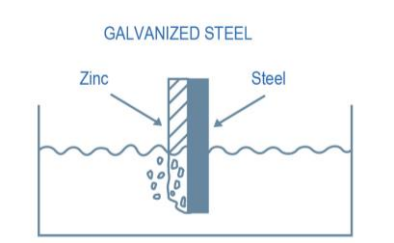
Different metals, when placed in the same electrolyte (water, condensation etc.) adopt different electrode potentials. A galvanic cell is then formed, and galvanic protection results when two dissimilar metals (i.e. with different potentials, see Table 1) are in electrical contact. In the presence of an electrolyte, electrons will flow between the two metals and this is known as a galvanic current (Figure 1b). This leads to increased corrosion of the more active metal and decreased corrosion of the more noble metal when compared to the corrosion behaviour of the two metals whilst separated (Figure 1a). The galvanic current produced by the corrosion reaction is a direct measure of the increase in dissolution of the more active metal and a reflection of the rate of corrosion. This principal applies when the two dissimilar metals are in direct contact with each other, such as for zinc-coated steel (Figure 1c).



(a)



(b)



(c)

Figure 1:
(a) corrosion of two different metals in isolated environments.
(b) flow of galvanic current between two dissimilar metals that are electrically connected.
(c) protection against corrosion of zinc-coated steel where the corrosion rate of the zinc controls the overall composite common rate

Table 1: Galvanic Series of Metals and Alloys in Sea Water

	NOBLE (CATHODIC)
	Gold
	Platinum
	Titanium
	Graphite
	Silver
PASSIVE	Stainless Type 316
	Stainless Type 310
	Stainless Type 304
	Stainless Type 302
	Stainless Type 430
	Stainless Type 410
PASSIVE	80% Ni 15% Cr
	Inconel
	60% Ni 15% Cr
	Nickel
	Monel
	Copper-Nickel
	Bronzes
	Copper
	Brasses
ACTIVE	80% Ni 20% Cr
	Inconel
	60% Ni 15% Cr
	Nickel
	Tin
	Lead
ACTIVE	Stainless Type 316
	Stainless Type 310
	Stainless Type 304
	Stainless Type 302
	Stainless Type 430
	Stainless Type 410
	Cast Iron
	Carbon Steel
	Cadmium
	Aluminium
	Zinc
	Magnesium Alloys
	Magnesium
	ACTIVE (ANODIC)