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Galvanic Corrosion - Solar Panel Mounting Systems

What is galvanic corrosion and why is it important?

Galvanic corrosion is a corrosion process by which two metals can electro-chemically corrode when in contact together with an electrolyte (such as the moisture and salt in sea spray). This corrosion can - if not identified and rectified - lead to extremely dangerous and costly failures in fixtures and fittings - like PhotoVoltaic mounting systems.

The metals used in Solar PV mounting systems (typically aluminium alloys and stainless steel) can be plagued with corrosion issues when used together without some form of prevantative treatment.

We typically anticipate that the useful lifecycle of domestic PV systems is around 25+ years. System designers and installers MUST therefore design a similar life-cycle into the supporting components. This is essential *if* they are to provide a viable investment opportunity to their customers.

What causes galvanic corrosion?

Essentially two differing metals (say aluminium rails and stainless steel brackets) and an electrolyte (sea-spray for example) create in effect a 'battery' in which electrical current forms and a resulting electro-chemical corrosion process occurs...

Put scientifically; a galvanic circuit is created in which the anode (the active metal - aluminium in this case) loses electrons to the cathode (the noble / less active metal - stainless steel) when both metals are exposed to an electrolyte (sodium chloride - sea salt) - which is present in the atmosphere during stormy conditions in sea side locations.

The nobility of the two metals involved is the determining factor of corrosion. The more dissimilar metals are in nobility terms, the greater the potential for corrosion.

As a rule of thumb, solar installers should avoid (or mitigate the effects of) using metals that are vastly dissimilar in the Galvanic Series Table - particulalry in areas where the likelyhood of electrolytic moisture is present; i.e. particularly seaside locations where electrolytic salts are likely to be present in the atmosphere. (The same can also be true in industrial locations where dioxides and othe electrolytic compounds may occur in higher than usual concentrations)

Avoiding galvanic corrosion

Most Solar Pannel system components and braketry (including the module frames themselves) are either raw aluminum (or aluminum alloy) or anodized aluminum (i.e. previously, deliberately 'coroded' providing inherant corrosion resistance). Typically nuts, bolts and fixings are made in stainless steel (to avoid the other type of chemical corrosion: that we all know as rust).

Installers must be careful to select the right materials when specifiying installations. We suggest taking equipment manufacturers advice and /or using anodized components - epsecially in PV systems that are near to the sea or in close proximity to industrial output.

The following options are generally considered best practice for Galvanic Corrosion Prevention:

- Use just one material; to fabricate electrically isolated systems - e.g. exclusively using stainless steel in the mounting system;

- If mixed metal systems *are* to be used, select metals which are as close as possible to each other in the galvanic series, or by select materials that are galvanically compatible (sharing the same galvanic properties).

- Avoid the compounding effect of a 'small anode' and 'large cathode' (e.g. an aluminium washer between large stainless steel components). A small stainless steel washer between larger aluminium components is by the same virtue more accpetable... Particulalry avoid mixed materials in nuts and bolts and other treaded components.

- Insulate wherever practical e.g. by using a gasket, inert washer or similar. It is essential to insulate the entire components if practicable.

- Avoid applying coatings as these may hide problems later or even exacerbate problems by retaining water.

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Avoid mixing materials far apart in the series especially in fixtures and structurally important areas (such as nuts, bolts and washers).

- Install sacrificial anodes - a third highly active metal that is anodic to both metals in the system and which will be delibrrately 'lost' through galvanic corrosion meanwhile saving the other materials from damage.

Most importantly of all:

We recommend having any PV system regulalry inspected by someone who knows what they are looking for!
