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Sacrificial (Galvanic) Cathodic Protection (CP)

Simple, Reliable, and Often the Smartest Solution

Corrosion is not a coating failure problem - it's an electrochemical problem. Steel in contact with soil, seawater, brackish water, or wet concrete will corrode when electrons leave the metal and flow into the environment. The goal of cathodic protection is to stop electron loss. Sacrificial (also called galvanic) cathodic protection is the most direct way to do it: connect a more reactive metal to the structure and let that metal corrode instead.

When applied correctly, galvanic CP is predictable, passive, and low-maintenance - often the ideal solution for smaller or well-coated structures. Understanding when and why galvanic CP works starts with understanding electrochemistry.

Galvanic Protection Uses the Electrochemical Series to Your Advantage

Every metal has a natural electrical potential - a tendency to either hold onto electrons or give them up. Magnesium, zinc, and aluminum alloys have more negative potentials than steel, meaning they are more willing to corrode (give up electrons).

In a galvanic system, we intentionally connect one of these reactive metals to the asset we want to protect. The environment - soil, seawater, or water inside a tank - completes the electrical circuit.

The results are straightforward:

- The sacrificial anode becomes the anode of the electrochemical cell and corrodes.
- The structure becomes the cathode and receives electrons, preventing corrosion.

A good way to summarize this:

We sacrifice an expendable metal so the valuable one doesn't corrode.

There are no electronics, no external power, and no automatic control systems. The chemistry itself drives the protection.

How Galvanic CP Works in Practice

The sacrificial anode and structure are electrically bonded together. When placed in the electrolyte:

1. The anode naturally generates current due to the voltage difference between metals.
2. That current flows through the electrolyte toward the structure.
3. The structure receives electrons and becomes the cathode.
4. The sacrificial anode slowly consumes itself over time.

As long as the anode has material remaining and the electrolyte can conduct current, the structure stays protected.

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Unlike ICCP, galvanic protection cannot increase current on demand. Its output is determined entirely by the anode metal, surface area, and environment. This makes proper design - especially current-demand estimation - essential.

Why Galvanic CP Is Often the Right Choice

Sacrificial CP is chosen for three main reasons: simplicity, reliability, and passive control.

- No power source required - ideal for remote locations.
- Inherently safe - no risk of overprotection or hydrogen damage to coatings.
- Minimal maintenance - no rectifier to inspect or troubleshoot.
- Lower upfront cost for small or moderate current demands.

Because galvanic systems rely on the natural difference in potential between metals, they are most effective when the asset being protected:

- Has a good coating (low current demand),
- Is physically small or isolated,
- Is in an environment with high conductivity

This is why zinc and aluminum dominate in marine applications, while magnesium is used in high-resistivity soils where more driving voltage is needed. Driving voltage (also called driving potential) is the difference in natural electrical potential between the sacrificial anode and the steel structure. The greater the voltage difference, the harder the anode “pushes” protective current onto the steel. In low-resistance environments like seawater, zinc and aluminum alloys provide enough driving potential to generate the required current. In high-resistance environments such as dry or rocky soils, current movement is more difficult, so a metal with a much more negative potential — magnesium — is required to overcome that resistance and deliver adequate protective current.

A simple way to think about it:

- Seawater = easy to push current through → zinc or aluminum works
- Dry soil = hard to push current through → magnesium needed

Magnesium doesn’t protect because it's “better” — it protects because it has a higher available voltage to drive current into difficult environments.

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Limitations of Galvanic Systems

Galvanic CP is not universally applicable. It struggles when:

- The structure is large or poorly coated (current demand is too high),
- Soil or water resistivity is high (current cannot flow effectively),
- Future current demand may increase (expansion, coating degradation, tie-ins).

Once the sacrificial anodes are consumed - protection stops.

Where Sacrificial CP Excels

Galvanic CP is often the smartest and most economical option for:

- Water heaters and internal tank protection
- Buried pipelines with good coatings
- Short isolated pipeline segments
- Marine structures in contact with seawater
- Reinforced concrete in localized applications
- Storage tank bottoms (with proper soil conditions)

If current demand is low enough for sacrificial anodes to meet it - galvanic CP wins.

The Value of Sacrificial CP

Corrosion is constant. Galvanic cathodic protection makes corrosion manageable. There are no electronics, no feedback loops, no parameters to tune. The electrochemistry is built into the material itself. The structure stays protected. The anode corrodes instead. Replace the anode when necessary, not the structure.

About American Carbon Company

American Carbon Company (ACC) manufactures and supplies sacrificial anodes used in galvanic cathodic protection systems across marine, pipeline, and industrial applications.
Our product family includes:

- BADGERCOAST™ Zinc & Aluminum cast galvanic anodes for seawater and brackish environments
- BADGERCONNECT™ Magnesium anodes for high-resistivity soil and internal tank protection
- BADGERCORD™ Zinc Ribbon Anodes for linear assemblies

Whether you are designing a new system or replacing existing materials, ACC is available as a technical sounding board - from alloy selection to assembly configuration to lifecycle planning.

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