Galvanic Corrosion Disasters Arising from Improperly Selected Conductive Silicone Gasket Fillers

EMI/RFI SHIELDING METROLOGY & ELECTROCHEMICAL ENGINEERING | REEMANE SILICONE

Primary Compliance Standards:	MIL-DTL-83528 (EMI Shielding), ASTM G71 (Galvanic Corrosion)	**Target Audience:**	Hardware Architects, Avionics Engineers, Telecommunications Designers
Manufacturing Framework:	Electrochemical Compatibility Analysis / Co-Extrusion Engineering	**Document ID:**	REEMANE-TECH-WP-323Y

1. The Electrochemical Physics of EMI/RFI Shielding Gaskets

In aerospace avionics, military telecommunications, and 5G base station enclosures, electronic hardware must be simultaneously protected from environmental intrusion (water/dust) and Electromagnetic Interference (EMI). To achieve this dual-functionality, Original Equipment Manufacturers utilize conductive silicone gaskets. Because raw silicone is a profound dielectric insulator, chemical engineers heavily load the polymer matrix with microscopic metallic particles—such as silver-plated copper, silver-plated aluminum, or nickel-graphite—transforming the gasket into a highly conductive Faraday cage.

However, when a highly conductive silicone gasket is clamped between two metallic flanges (typically cast aluminum or magnesium), an invisible, highly destructive electrochemical reaction is initiated. If moisture from high humidity, rain, or salt fog breaches the outer edge of the flange, it acts as an electrolyte. The metallic filler inside the silicone acts as the cathode (noble metal), and the aluminum enclosure acts as the anode (active metal). This instantly creates a microscopic, short-circuited battery known as a galvanic cell. Without absolute electrochemical compatibility engineering, the aluminum housing will rapidly corrode, disintegrating into white aluminum oxide powder and catastrophically compromising both the environmental seal and the EMI attenuation.

2. The Anodic Index and Dissimilar Metal Ruin

The severity of galvanic corrosion is dictated by the Anodic Index—a mathematical measurement of the electrochemical potential difference between two dissimilar metals in a conductive environment. The golden rule of galvanic engineering mandates that the potential difference between the gasket filler and the mating flange must not exceed zero point two five volts (0.25V) in standard environments, or zero point one five volts (0.15V) in harsh marine (salt spray) environments.

Novice designers frequently request pure Silver or Silver-Plated Copper filled silicones to achieve maximum EMI shielding effectiveness (e.g., > 120 dB attenuation). However, pure silver is highly cathodic (noble), whereas an untreated aluminum housing is highly anodic. The galvanic potential difference between silver and aluminum exceeds one point zero volts (1.0V). When exposed to a saltwater electrolyte, this massive voltage differential rapidly accelerates the corrosion of the aluminum flange. Within weeks, the housing is physically eaten away, resulting in a disastrous field failure that costs millions in warranty claims.

3. Strategic Filler Selection: Nickel-Graphite and Passivation

To explicitly halt galvanic corrosion while maintaining MIL-DTL-83528 compliance, Reemane Chemical Engineers enforce a strict electrochemical compatibility matrix during the Design for Manufacturability (DFM) phase. If the OEM's enclosure is untreated or mildly chromated aluminum, we mandate the use of Nickel-Graphite or Silver-Plated Aluminum filled silicone elastomers.

By substituting pure silver with Nickel-Graphite, the electrochemical potential of the gasket is significantly lowered, closely mirroring the potential of the aluminum housing. This drops the galvanic voltage difference to below zero point three volts (0.3V), practically neutralizing the "battery effect" even in the presence of an electrolyte. For extreme military marine applications, we utilize Silver-Plated Aluminum fillers, where the aluminum core of the filler identically matches the aluminum of the housing, resulting in zero galvanic potential difference and infinite corrosion resistance.

4. The Ultimate Defense: Dual-Durometer Co-Extrusion

While matching the Anodic Index mitigates corrosion, the ultimate engineering defense is to prevent the galvanic cell from forming entirely by eliminating the electrolyte. If water cannot reach the metal-to-metal interface, corrosion is physically impossible.

For mission-critical outdoor enclosures, Reemane Silicone abandons single-material gaskets in favor of advanced Dual-Durometer Co-Extrusion architectures. We extrude a single, unified gasket comprised of two distinct zones: an inner core of highly conductive EMI silicone, perfectly bonded to an outer jacket of pure, non-conductive weather-sealing silicone. When the enclosure is clamped shut, the outer non-conductive silicone creates a hermetic environmental barrier that totally repels moisture and salt fog. Because the inner

conductive EMI core is perfectly sealed in a dry environment, the galvanic cell is starved of its electrolyte, guaranteeing absolute EMI attenuation and zero enclosure corrosion for the entire lifecycle of the hardware.

Electrochemical Design Metric	Sub-Optimized EMI Shielding	Reemane Anti-Galvanic Architecture
Galvanic Potential Difference	**> 0.50V (Triggers rapid aluminum pitting).**	**< 0.25V (Mathematically neutralizes battery effect).**
Filler vs. Aluminum Housing	**Pure Silver / Silver-Copper (Catastrophic corrosion).**	**Nickel-Graphite / Silver-Aluminum (Electrochemical match).**
Electrolyte Mitigation	**Conductive filler exposed directly to exterior environment.**	**Dual-Extrusion: Non-conductive outer jacket blocks moisture.**
Hardware Lifecycle Integrity	**Flange degrades into white powder within weeks of salt exposure.**	**Guaranteed MIL-DTL-83528 compliance and zero flange damage.**

Eradicate Enclosure Destruction from the Inside Out

Do not allow mismatched anodic indices to corrode your mission-critical telecommunications and aerospace hardware. Partner with Reemane Silicone to deploy electrochemically neutral conductive fillers and advanced moisture-blocking co-extrusion architectures.

Submit your flange metallurgy and shielding requirements for an electrochemical compatibility audit:
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Review our EMI/RFI Shielding and Co-Extrusion capabilities:
www.siliconefactories.com/get-a-quote/