

Electrical Equipment Corrosion Protection

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Electrical Equipment Corrosion Protection: Preventing Failures in Harsh Environments:

Electrical corrosion protection is critical for switchgear, control panels, and enclosures operating in coastal, industrial, or wastewater environments. Without proper protection, corrosion can compromise enclosures, conductive materials and insulation; this may cause faults and lead to costly downtime or pose other electrical hazards. Learn how to prevent corrosion in switchgear and control panels using NEMA-rated enclosures, coatings, and environmental controls.

Corrosion Definition

Corrosion in electrical panels is the chemical or electrochemical deterioration of metal components (conductors, terminals, busbars, enclosures, or fasteners) due to reactions with moisture, contaminants, or chemicals in the environment. Some environments corrode more quickly than others. Corrosion = metal deteriorating due to chemical or electrochemical reactions with its corrosive surroundings and forming into a weaker compound (like rust, oxide, hydroxide, or salt).

Causes in Corrosive Environments

Common environmental conditions that promote corrosion include the following:

Corrosion Cause	Description	Examples
Humidity & condensation	Moisture creates electrolytic paths between metals and contaminants.	Coastal air, unheated or poorly ventilated spaces.
Salt (chlorides)	Salt accelerates oxidation and forms conductive residues on live parts.	Marine or de-icing salt exposure.

Corrosion Cause	Description	Examples
Acidic or alkaline vapors	Industrial gases (SO ₂ , H ₂ S, NH ₃ , chlorine) attack metals and insulation.	Pulp/paper mills, wastewater treatment, electro-chemical plating shops, chemical plants.
Temperature cycling	Expansion/contraction pumps moist air in/out of enclosures.	Outdoor or washdown non-sealed and/or non-rated panels or enclosures. Outdoor or washdown areas where enclosures are not sealed or properly rated.
Galvanic reactions	Dissimilar metals in contact cause electron exchange and localized attack.	Copper–aluminum connections, zinc–steel hardware.

What Happens Inside Panels and Controls

1. Oxidation increases contact resistance, leading to heat buildup and potential fire hazards.
2. Corrosion of busbars or lugs increases voltage drop and power loss.
3. Rust or pitting of enclosure compromises NEMA/IP rating and safety.
4. Conductive corrosion residue increases risks of short circuits or tracking.
5. Degradation of insulation and labeling; identification and reduce safety.

Signs of Corrosion

- Green or white residue (copper or aluminum oxides)
- Rust streaks or pitting on enclosure or hardware
- Increased frequency of breaker tripping or equipment downtime.
- Blistered paint or powdery film

- Measured increase in contact resistance or with PPE on, perform IR scan for “hot spots”
- Unexplained tripping or insulation faults

Testing and Inspection Methods

Routine inspections and targeted testing help identify corrosion before it leads to equipment failure.

- Visual inspection (routine annual maintenance)
- Infrared thermography (detects resistance heating)
- Contact resistance testing
- Surface contamination analysis (chloride/sulfate ion lab tests)
- Environmental monitoring (humidity, airborne corrosive contaminants)

Mitigation & Prevention

Ensure all protective measures align with UL 50E, UL 508A, and NFPA 70 (NEC) enclosure standards.

Method	Explanation
Use corrosion-resistant materials	Stainless steel enclosures, tin- or nickel-plated copper, anodized aluminum.
Environmental sealing	NEMA 4X / 12 / IP66+ enclosures, gaskets, or pressurization.
Anticondensation & heaters	Prevent condensation by keeping internal temperature above dew point (+3°). Use a thermostatically controlled enclosure heater (around 70W typical).
Protective coatings	Conformal coatings, anti-corrosion sprays, or dielectric grease on contacts.

Method	Explanation
Galvanic isolation	Use compatible metals or insulating washers between dissimilar materials.
Close all unused conduit openings	In addition to NEMA 4X/12 gasketed enclosures; close all unused conduit openings and close all wired conduit interiors to effectively block air flow.
Periodic cleaning and testing	Neutralize residues and check continuity.

Example: Coastal Wastewater Facility Panel

This case demonstrates that proactive corrosion control can eliminate downtime and extend panel service life.

- Problem: Salt mist and hydrogen sulfide from treatment tanks corroding breaker terminals.
- Result: Increased contact resistance; circuit breaker nuisance trips, or worse case, fails to trip.
- Fix: Replaced enclosure with NEMA 4X stainless steel, installed small thermostatic heater, applied dielectric grease on terminals, and specify tin-plated copper busbars

Summary

Corrosion in electrical systems is preventable with proper materials, enclosure selection, and environmental control. By applying sound engineering design and regular inspection, equipment life and safety can be dramatically improved, especially in harsh environments.



Corrosion Inhibitors 5 & 11 #4196 & #4197

Emitter for Protection of Control Boxes

Features

- Provides continuous long term corrosion protection
- Nontoxic and safe to handle and apply
- Does not interfere with electrical, optical, or mechanical performance
- No spraying or wiping required
- 105 Protects 5 cubic ft of enclosed space
- 111 protects 11 cubic ft of enclosed space
- May last up to two years
- Approved for the US military and NATO
- Free of nitrites, halogens, and phosphates
- Conforms to MIL I-22110C
- Accepted by FDA for corrosion protection of electrical and electronic equipment within food processing plants
- Effective in polluted and humid environments



Description

CORROSION INHIBITORS are an easy and affordable way to protect enclosed electrical equipment, switchgears and tools. They are self-stick cartridges which release a vapor inside enclosed areas, which forms a very thin layer of protectant on all surfaces within the enclosure. The micro-coating inhibits the interaction of air and moisture – reducing corrosion. Each emitter releases a vapor to form a protective molecular layer. It provides long-term protection against corrosion even in the presence of adverse conditions including salt, moisture, airborne contaminants, H₂S, SO₂, NH₃, and others.

Applications

- Electrical panel
- Medical equipment
- Tool & spare part boxes
- Hand-held battery operated devices
- Scientific and measuring equipment
- Marine, aerospace
- Electrical motors
- Electrical enclosures
- Telecommunication equipment
- Electromechanical controls
- Military instruments
- Junction fuse boxes
- Gun safes

Directions

Select a space within any enclosure where corrosion protection would be useful. Verify the surface to which the device will be affixed is clean and free of debris. Peel off the protective peel strip from the bottom of the device and attach it to the clean surface.

Product Characteristics

Appearance	Green or yellow plastic cup with Tyvek lid
Odor	Light
Density	N/D
Solubility in water	Insoluble
Organic solvents	0.0%
Boiling Range	Undetermined
Melting Range	Undetermined
Flash Point	Not applicable
Self-igniting	Not self-igniting
Danger of explosion	No explosion hazard
Size (Protection range)	11: 2.25" diameter, 1.27" high (11 ft ³ coverage) 5: 2.25" diameter, .75" high (5 ft ³ coverage)
Storage	Store in a cool, dry area out of reach of children. Keep closed when not in use.
Transport information	
Class #	77.5
NMFC	50234-sub2
Proper Shipping Name	Dessicants, NOI

Health	0
Flammability	1
Reactivity	0
Personal Protection	B

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Corrosion Inhibitors 5 & 11 - Pro Chem, Inc.

As an example, here's an effective but little-known way to protect interiors of electrical panels, MCC's and controls from corrosion. Found these corrosion inhibitors products easy to use and very effective. Whether you're protecting electrical equipment in salt-air marine environments; waste water treatment plants, plating shops, ...etc. These are self-stick cartridges which release a vapor inside enclosed areas, that forms a very thin layer of conformal coating protectant on all surfaces within the enclosure; schedule to replace cartridges every 2-years.

About the Author:

Dennis Zimmer is a professional electrical engineer with more than 35 years of experience in MEP, AE, and Controls across commercial, manufacturing, and industrial projects. Dennis has served as a principal engineer, middle manager, and business owner. Over the course of his career, Dennis has held P.E. licenses in 15 states.

He has also been accredited by WA LSI to perform electrical field evaluations for over 7 years and has additional Machine Safety & Risk Assessment certification.

His passion is mentoring engineers in technical mastery, business acumen, and leadership excellence.

Thank you, Dennis

