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Corrosion Resistance Selection Guide

This Guide Will Help You:

- Understand the ratings and approvals required for Corrosion Resistant Enclosures.
- Recognize the typical materials used in corrosive environments.
- Select a material for a given application.
- Make an enclosure selection for a given application.



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Why are Corrosion Resistant Enclosures needed?

To protect critical components from harsh environments while also providing a finish that remains presentable with minimal maintenance.

- Typical environmental conditions requiring corrosive protection include:
- Sun / UV exposure (outdoor applications)
- Chlorine (Water Treatment facilities)
- Saline (Coastal, Marine applications)



Ratings and Approvals

For corrosion resistance, an “X” is added to the end of the standard the NEMA Type protection level. For example, Type 4X is a corrosion resistant version of a Type 4 enclosure. There is no European IEC (IP rating) equivalent mark indicating a product’s corrosive resistance.

How do North American agencies define corrosion resistance for label purposes?

TYPE 4X Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, hose-directed water, and corrosion; and that will be undamaged by the external formation of ice on the enclosure.

Essentially, an enclosure will get an “X” if the box under laboratory conditions passes a six hundred hour salt spray with no worse pitting than that exhibited on a G90 Galvanized sheet steel sample run at the same time.

- Note: There are concerns with assuming any 4X enclosure meets a given application’s need. Salt spray is only one chemical that can cause corrosion; some approved 4X enclosures can be severely damaged by other chemicals.



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Materials

NEMA 4X enclosures can be made from a variety of other materials including:

- Stainless Steel
- Aluminum
- Die-Cast Aluminum
- Fiberglass
- Polycarbonate

Material Considerations

Chemical Resistance

Rate the long-term performance of a material when exposed to various chemicals.

Cost

What is the relative cost of a corrosion-resistant material compared to other options? Balance cost with appropriate chemical resistance to maximize value.

Weight

What is the relative weight of a corrosion-resistant material compared to others?

Impact Resistance

How does a material resist an impact? Also consider operating temperature as some materials perform better in a narrow temperature window.

Customization

Sometimes it makes sense to have enclosure modifications done at the factory depending on the difficulty of field modifications. The value added in customization can often offset the added cost.

Other considerations include enclosure design features, EMC, heat dissipation / absorption, aesthetics, conductivity, and availability.



Stainless Steel Material

- What materials are most common and what is the different between them?
- 304 SS contains about 19% chromium and 9% nickel
- 316L Stainless Steel contains about 17% chromium and 12% nickel
- "L" indicates lower carbon content than standard 316
- Contains 2-3% molybdenum for even greater corrosion resistant properties



Why Use 316L Stainless Steel?

- Molybdenum found in 316L increases the corrosion resistance against many harsh industrial chemicals and solvents, and inhibits pitting caused by chlorides.
- 316L can withstand corrosive attack by potash, sodium and calcium brines, hypochlorite solutions, phosphoric acid, sulfite liquors and sulfurous acids.
- 316L is specified for industrial equipment that handles the corrosive process chemicals used to produce certain products like paper, textiles, bleaches and rubber.
- Type 316 is the main stainless used in marine environments.



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304 Stainless Steel

Chemical Resistance	Excellent resistance to salts, solvents, acids, alkalis
Cost	Less costly than 316L, but generally higher than other options.
Weight	Heaviest option
Impact Resistance	Strong over broad temperature ranges - same as 316L
Customization	Unlimited special sizes and easy cutouts from source; hard material to cut in the field
Hammond Series	EJ, 1414, EN4, ST, 1418, 1422, HN4, 2C, Waterfall



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316L Stainless Steel

Chemical Resistance	Superior resistance to salts, solvents and acids. Excellent resistance to alkalis, particularly suited to sulphuric acid, potash, seawater.
Cost	Highest material cost.
Weight	Heaviest option
Impact Resistance	Strong over broad temperature ranges
Customization	Unlimited special sizes and easy cutouts from source; hard material to cut in the field
Hammond Series	EJ, 1414, EN4, 1418 1422 HN4, Waterfall



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Aluminum

5052 Grade Sheet and die-cast typical for enclosures. Less popular metal option for medium to large enclosures so availability is limited.

Chemical Resistance	Excellent resistance to solvents but not recommended for acids and alkalis
Cost	Lower cost than stainless steels, similar to fiberglass reinforced polyester
Weight	Lightest metal option, similar to fiberglass reinforced polyester
Impact Resistance	Excellent impact resistance, superior to fiberglass
Customization	Easy to cut in the field. Sheet aluminum can be made into special sizes, while cast aluminum cannot.
Hammond Series	1590Z, R100, 1414, 1418



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Fiberglass Reinforced Polyester (FRP)

Chemical Resistance	Generally excellent salt resistance; need to review for other specific chemicals
Cost	Less expensive than metals (gap lessens as box size increases)
Weight	Light, easy to transport
Impact Resistance	Satisfactory for general use, less than metals
Customization	Easy to cut in the field although glass fibers need safety attention; non-standard sizes and colors limited.
Hammond Series	1590ZGRP, R130, PJ, PJU, PJW, PJFS





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Polycarbonate

Chemical Resistance	Excellent acid and salt resistance. Review specific solvent and alkali chemicals before selecting polycarbonate.
Cost	Least expensive
Weight	Lightest alternative
Impact Resistance	Least resistance and has narrower range of temperature acceptability than FRP
Customization	Easy to cut in the field; non-standard sizes and colors limited
Hammond Series	1554, 1555, 1555F, 1557, PCJ





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Which Industries Need Corrosion Protection?

- Oil & Gas
- Water Treatment
- Wastewater
- Food & Beverage
- Pharmaceutical
- Mining
- Marine applications
- Roadside (salt exposed)

