Corrosion Considerations
Objectives

- Rust
- Protection Methods
- Paint Standards
- Chemical Corrosion
- Stainless Steel
- Protective Coatings
- Interior Protection
Metal Corrosion, Rust

- Corrosion presents a major threat to metal enclosures

- Specifying the right enclosure for an application is the first step, considerations include.
  - What will the environment contain: moisture, gases, are corrosives present?
  - Will the enclosure be indoors or outdoors?
  - Maintenance, can the enclosure be maintained?
Mild Steel Enclosure Corrosion

- Mild steel enclosures are a good compromise of strength and cost

- These enclosures will be impacted by corrosion if not appropriately treated to protect the metal

- Two common treatment methods include galvanizing and painting
Protection Methods

- Galvanizing using zinc may protect metal surfaces.

- Galvanization can fail at holes, seams or joints where the coating is pierced; a zinc coating provides cathodic protection to the metal.

- Paint provides protection from rust provided the paint surface is not scratched or damaged.

- The type of paint also makes a difference; powder paint is 3 times more effective in resisting corrosion than liquid alkyd baked enamel.

Example of blistering experienced during a 600 hr. salt spray test
# Test Agency Paint Standards

## Indoor
- Types 1, 12, 13
  - Enameling
  - Galvanizing
  - Plating
  - Equivalent
    - OR
  - 24 Hour Salt Spray
    - No Red Rust

## Outdoor
- Types 3R, 4, 6
  - G90 Galvanizing
  - Zinc Coating
    - 0.0054 min.
  - Painted G60 or A60
  - Painted Zinc Coating
    - 0.0034 min. Zinc
  - UL 1332 Certified Paint
    - OR
  - 600 Hour Salt Spray
    - Results Similar to G90

## Outdoor-Corrosive
- Types 4X, 6P
  - 304 Stainless Steel
  - Polymeric
  - Aluminum
    - OR
  - 200 Hour Salt Spray
    - Results Similar to 304SS
## Chemical Corrosion

<table>
<thead>
<tr>
<th>Solvents (e.g. grease)</th>
<th>Alkalis (e.g. chlorine)</th>
<th>Acids (e.g. sodium)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommended</strong></td>
<td><strong>Polyester</strong></td>
<td><strong>Polycarbonate</strong></td>
</tr>
<tr>
<td>Stainless steel 304 / 316</td>
<td>ABS</td>
<td>Polyester</td>
</tr>
<tr>
<td>Fiberglass (compression molded)</td>
<td>Stainless steel 304</td>
<td>Polyster</td>
</tr>
<tr>
<td>Aluminum</td>
<td></td>
<td>ABS</td>
</tr>
<tr>
<td>Polyester</td>
<td></td>
<td>Stainless steel 304 / 316</td>
</tr>
<tr>
<td><strong>Satisfactory</strong></td>
<td><strong>Stainless steel 316</strong></td>
<td></td>
</tr>
<tr>
<td>Polycarbonate</td>
<td>Fiberglass (compression)</td>
<td></td>
</tr>
<tr>
<td>ABS</td>
<td>Polycarbonate</td>
<td></td>
</tr>
<tr>
<td>Steel, (polyester powder coated)</td>
<td>fiberglass</td>
<td></td>
</tr>
<tr>
<td>Fiberglass (spray-up)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Limited Use</strong></td>
<td><strong>Steel (polyester powder coated)</strong></td>
<td></td>
</tr>
<tr>
<td>Steel (polyester powder coated)</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Stainless Steel Enclosures

Stainless steel enclosures are often specified for corrosive environments. The most typically specified types are 304 and 316L depending on the application requirements.

With recent increases in the cost of steel, other material grades have been researched to determine their ability to stand up to extended salt spray testing.
Non-Standard Stainless Steel

### Stainless Steel Material Test

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Test Specification:</th>
</tr>
</thead>
<tbody>
<tr>
<td>201 SST</td>
<td>- 200 hr. ASTM B-117-03 Salt Spray Test</td>
</tr>
<tr>
<td>304 SST</td>
<td>- NEMA style enclosures</td>
</tr>
<tr>
<td>430 SST</td>
<td>- Assemblies completed by Hoffman</td>
</tr>
</tbody>
</table>
Non-Standard Stainless Steel Test Results

- All enclosures showed signs of red rust
- 201 grade stainless steel is in the same austenitic family as Type 304/316 stainless steel
- 430 grade stainless steel is in the ferritic family and thus is magnetic and not hardenable by heat treatment
- Type 316L was not tested, but would perform better than others
- Other materials exist, however, they do not significantly outperform the industry standard Type 304/316L materials
Tea Staining on Stainless Steel

- Tea staining is a common occurrence for stainless steel enclosures in applications that place them in environments with salt spray.
- Tea staining is mostly a cosmetic defect and does not impact the integrity of the enclosure.
- To prevent tea staining:
  - Regularly wash the enclosure with water to remove salt
  - Paint the enclosure
  - Chemically treat the enclosure surface
Protective Coatings

A number of methods exist to address rust prevention. Three of the more common methods include:

- Protective coverings
- Moisture reduction
- Vapor corrosion inhibitors
Interior Protection

- Rust Inhibitors

- Inhibitors work by emitting an invisible odorless non-toxic vapor that diffuses throughout the surrounding atmosphere until the air is saturated.

- The vapor clings to metal surfaces until the enclosure is opened.
Consider where the enclosure will be placed and the elements in the air

Type 304 & 316 stainless steel material is a viable option for highly corrosive environments

Protective coatings are also options

Hoffman offers online tools and resources to help determine the right protection level
Available Resources

- HoffmanSpecifier’s Guide
- Visit [hoffmanonline.com](http://hoffmanonline.com)
  - Find products by defined criteria
  - Download product drawings
  - Discover new products