Interpon®
POWDER COATINGS
Architectural

Guidance Note 9

Marine and Industrial Environments

AkzoNobel

Overview

The environment affects coatings on metal in two ways.

- UV and moisture cause degradation of the polymers and pigments, leading to chalking, fading and gloss loss of the coating film.
- Moisture, salts and pollutants cause corrosion underneath the coating, leading to unsightly blistering and ultimately delamination of the paint film.

When considering the specification, it is important to think about the environment. You need to choose the correct substrate preparation: this includes a chemical passivation / conversion of the metal, the use of a primer, the chemistry of the top-coat and the frequency of regular cleaning.

1. Corrosion Potential

As a general guide the distance of a building from tidal waters or pollutant source should be considered. More than 5km is normally safe and considered “normal”, while a beach-front position will lead to constant salt spray and high corrosion potential.
Detailed corrosivity maps exist for some countries, but not all. This website has several: http://corrosion-doctors.org/AtmCorros/CorrMaps.htm [1]

Where they exist the problem with simply using a set distance from the source can be seen. For example, in the UK corrosivity map, some areas of the east coast are more corrosive than others even at the same proximity to the sea (see Figure 1).

Figure 1. UK corrosion of Zinc [1]

Aluminum is less prone to corrosion than steel, but without adequate pre-treatment and coating protection, it too corrodes from a building in central London (see Figure 2).

Figure 2. Filiform corrosion on Al (London 2013)

The accepted ISO standard for corrosion protection by paint systems is ISO 12944. This started life as a standard for corrosion protection on steel, but Part 2 on classification of environments has become widely used across many applications (See table 1).

Table 1. Classification of interior/exterior environments as defined in ISO12944-2018

Corrosivity Category	Exterior	Interior
C1: Very Low	-	Heated buildings with clean atmospheres (offices, shops, schools, hotels)
C2: Low	Atmospheres with low level of pollution, mostly rural areas	Unheated buildings where condensation may occur such as depots or sports halls
C3: Medium	Urban and industrial atmospheres, moderate sulphur dioxide pollution, or coastal areas with low salinity	Production rooms with high humidity and some air pollution such as food processing plants, laundries, breweries, or dairies
C4: High	Industrial areas with high humidity and aggressive atmospheres	Chemical plants, swimming pools, coastal ships and boat yards
C5: Very high	Industrial areas with high humidity and aggressive atmospheres	Buildings in areas with almost permanent condensation and with high pollution
CX: Extreme	Offshore areas with high salinity and industrial areas with extreme humidity and aggressive atmosphere and subtropical and tropical atmospheres	Industrial areas with extreme humidity and aggressive atmosphere

These environments are based on experiments that have measured the rate of metal loss for uncoated steel. The classification of environments applies to structural steel exposed to ambient (less than 120°C [248°F] conditions.

2. Design Considerations

Corrosion is worse when parts do not receive regular washing by rainwater. The American Architectural Manufacturers' Association conducted real-time natural weathering tests on parts receiving regular rain washing, and parts that were covered and received no direct rain. The results are shown in Figure 3 below. The covered parts showed extensive edge corrosion and some corrosion from the scribe, while the uncovered – washed – parts showed only some edge corrosion. The implications are that wherever possible parts should be designed to receive rainwater washing. Access for manual cleaning must also be considered. Buildings of up to 6 storeys may be accessible by cherry-picker for exterior maintenance, but beyond this a bespoke cleaning solution will be required (this is also a consideration for any later re-painting of parts.

Figure 3. Corrosion on covered (left) and non-covered (right) parts in AAMA weathering tests

3. Control Measures during coating

A coating applied to bare metal may superficially appear to form a good film and adhere, but if you make a small cut into the film it can be pulled away from the substrate. The metal requires a “pre-treatment” – a chemical conversion that keys into the metal surface and then into the subsequent coating layer. Additionally, the metal needs a totally clean surface for the pre-treatment. An aluminum surface is cleaned by “etching” of the metal with acid or alkali, or both. The etch removes a surface layer of metal, thus removing all potential contaminants. The minimum requirement is to remove 1g/m^2 of the surface. This suffices for C1-C3 environments. Studies have shown that C4 and C5 environments require at least 2g/m^2. This has a cost implication for the coater, so unless this is specified, they may not do it.

Powder coatings normally do not require a primer on aluminum in any circumstance, so long as sufficient etch is carried out. Liquid coatings often do not require primer, but in C4 and C5 environments it is good practice. Corrosion normally begins at a break in the film, or at an edge where the coating thickness is lower. To counteract this, the coating should be applied thicker for C4 / C5 environments, and any edges that are cut during fabrication should be suitably sealed. Guidance Note 7 details a method and products to seal the edges. Below table summarizes this information:

Table 2. Preparation Requirements for Exterior Environments

Item	C1-C3 Environments	C4-C5 Environments
Etching of surface	Minimum 1 g/m^2	Minimum 2 g/m^2
Coating thickness	As recommended on datasheet	At least 20% thicker than standard
Cut edges	No need to seal	Must be sealed with suitable mastic or coating
Primer	Not needed for powder Check with supplier for liquid	Not needed for powder Mandatory for liquid

4. Control Measures – Lifetime Maintenance

Coating surfaces will gradually degrade over time with the action of UV and moisture, and eventually some corrosion may occur. These processes are accelerated if pollutants sit on the surface of the coating and are not removed. This is the reason why coating suppliers recommend regular cleaning of the surface – and warranty conditions normally demand it.

The regularity of the cleaning depends on the coating type, the environment, and the terms defined by the coating supplier. As a rule of thumb, the coating frequency would be four times as much for a seafront location than a C3 clean environment. If any warranty is obtained for the coating, the cleaning schedule will normally be stated in the warranty terms by the coating supplier or the coating applicator

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