Cyclic Corrosion Testing on Surfaces Prepared by Dry Ice Blasting.

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The following test performance results were obtained in a controlled ISO 9001 Quality Approved laboratory environment.

AkzoNobel makes no representation that the exhibited published test results, or any other tests, accurately represent results actually found in field environments and accepts no control or liability for the appropriateness of any product.

Application, environmental and design factors can vary significantly and, due care should always be exercised in the selection, verification of performance and use of the coating(s). AkzoNobel recommends that independent testing and assessment is carried out prior to the application of any product to determine suitability for use.
Agenda

Panel Preparation

Coating Application

Panel testing

Summary
Panel Preparation
Panel Conditioning

- Carbon steel panels were initially blast cleaned to Sa2.5 (ISO8501-1:2007)
- Panels are then exposed to cyclic ageing to produce a uniform corrosion condition across panel
- Ageing cycle ISO 12944-9 for 28 days
- Result is highly corroded substrate with tightly adhering rust scale and high concentration of salts
Panel Preparation

- Panels were blast cleaned with a combination of dry ice (3mm pellets) and garnet (10%) added to dry ice stream
- Result is very clean surface with pits and profile free from visible corrosion products
- Traces of gingering was noted
- Surface profile was measured using Testex X Coarse Replica Tape recording 50-80 microns
Coating Application
Coating Application

2 coating systems were applied to test panels

- **Typical 3 Coat Maintenance System**
  - 1 coat Aluminium Surface Tolerant Epoxy @100 microns
  - 1 coat Epoxy Intermediate @125 microns
  - 1 coat Polyurethane Finish @50 microns

- **High Build Single Coat System**
  - 1 coat high build Modified Epoxy @400 microns
Panel Testing
Ageing Test

ISO 12944-9 ‘Cyclic Salt Spray/UV Exposure ageing cycle

Used to qualify coatings for extreme environments such as offshore

- 3 days UV/condensation
  - (4 hours QUV-A @60°C / 4 hours condensation @50°C)

- 3 days neutral salt spray
  - Exposure to continuous salt fog (5% NaCl solution @35°C)

- 1 day dry @ -20°C
  - Develop internal stress within the coating

- 1 cycle = 1 week

The ISO20340 accelerated corrosion test requires 25 repeated cycles
Anti-Corrosive Testing of Primer / Intermediate / Finish Coating Systems

Salt Fog Chamber

QUV-A Cabinet
Testing

Panels have artificial damage introduced to bare steel

2mm scribe to simulate damage in the field

After exposure the coating is removed around the scribe

Average corrosion creep is measured along length of scribe at 9 points

Adhesion is measured before and after exposure
ISO12944-9:2018 Acceptance Criteria

Cyclic corrosion testing is intended for abrasive blast cleaned steel in new construction. This testing is to replicate the process on maintenance & repair and is indicative only.

- Adhesion
  - ISO4624:2016 Paints and varnishes -- Pull-off test for adhesion
  - >5Mpa

- Corrosion Creep from Scribe
  - ISO12944-6:2018 Paints and varnishes -- Corrosion protection of steel structures by protective paint systems -- Part 6: Laboratory performance test methods
  - <8mm for non zinc primers
**Results: System 1 Surface Tolerant Epoxy**

3 coat system

<table>
<thead>
<tr>
<th>Panel</th>
<th>Initial Adhesion</th>
<th>Final Adhesion</th>
<th>Corrosion Creep /mm</th>
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<tbody>
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<td>1</td>
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<tr>
<td>3</td>
<td>10.2</td>
<td>7.7</td>
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</table>
System 2 – Hydrocarbon Modified Epoxy

Single Coat system

<table>
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<th>Panel</th>
<th>Initial Adhesion</th>
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<th>Corrosion Creep /mm</th>
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</thead>
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</table>
Removal of Aged Coatings

Test panel coated with solvent free epoxy phenolic @ 500 microns dry film thickness

Coating aged for 6 months.

Coating removed along weld area with Dry Ice (3mm pellets) + 10% garnet
Summary

- Removes corrosion from steel surfaces
- Removes aged coatings
- Produces a visually clean surface with good surface roughness/profile suitable for painting with typical surface tolerant protective coatings systems
- When tested to ISO12944 Cyclic Corrosion Testing, panels coated with common surface tolerant coatings were found to perform well after 25 cycles.
- Indicative results as test programme is intended for dry abrasive blasting in new construction
- Surfaces prepared by Dry Ice Blasting with abrasives offer a sound alternative option to conventional surface cleaning methods