Accelerated corrosion tests for marine environments

the need for a Swedish marine test centre
Sweden/Scandinavia has the potential to play a leading role in the development of sustainable maritime and marine industries. We collaborate with industry and society to make this possible.

This is done by conducting advanced research into the maritime and marine solutions of the future, such as **energy extraction from waves** and **microalgae**, **offshore windfarms** and **marine foods**. A circular economy and an ocean in balance may also prove to be the source of tomorrow’s biotechnologies and **biopharmaceuticals**.
Offer to test in marine environments

• Help marine companies going from idea to products on the market

• Offer possibility to test in lab and in field for
  • Corrosion protection
  • Antifouling
New marine research and innovation centre in Kristineberg, Sweden

To complement international test sites and support across the blue growth sector
The facility also holds four ROVs, three research vessels, research diver with state of the art equipment, scientific buoy, labs, conference halls and accommodation.
Sea water systems Kristineberg

Deep sea water (32 m)  Surface sea water (5 m)
Accredited testing at a 3rd party independent lab to evaluate coating durability

- Blistering
- Corrosion protection
- Spread from scribe
- Cracking and embrittlement
- Adhesion loss/flaking
- Aesthetic degradation: gloss, colour
How do we accelerate the life-time

Corrosive gases

Salt spray

Sunlight/UV exposure

Temperature & Humidity

Chemicals

Outdoor exposure – field tests
Surface analysis and characterisation

- Chemical surface composition
- Microstructure
- Surface properties
- Failure analysis
- Adhesion
- FT-IR
- UV-VIS-NIR
- SEM-EDX, ESEM-EDX
- AFM
- XPS
- TOF-SIMS
- Confocal Raman Spectroscopy etc
What the industry/customers ask for

Does our coating/product fulfil the requirements according to Technical document ABCD?

- Exposure according to ISO 1234 for a duration of 240 hours
- Evaluation according to ISO 5678
- Requirement level for approval is Rating-value 7

Can you test our coating/product for us to guarantee technical life-time of X years?

- Environment: Indoor, Industrial, Road/Automotive, Tunnel, Coastal, Off-shore, Ship...
- Requirements on properties: Functional, Mechanical, Electrical, Aesthetic...
Corrosivity categories and typical environments

ISO 9223

### Table C.1 — Description of typical atmospheric environments related to the estimation of corrosivity categories

| Corrosivity category | Corrosivity | Typical environments — Examples
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Indoor</td>
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<tr>
<td>Outdoor</td>
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</tbody>
</table>

### Table C.1 (continued)

| Corrosivity category | Corrosivity | Typical environments — Examples
<table>
<thead>
<tr>
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<td></td>
</tr>
</tbody>
</table>
Corrosivity categories and mass loss

7. Corrosivity determination based on corrosion rate measurement of standard specimens
ISO 12944-2 Paints and varnishes – Corrosion protection of steel structures by protective paint

Part 2: Classification of environments

<table>
<thead>
<tr>
<th>Corrosivity category</th>
<th>Mass loss per unit surface/thickness loss (after first year of exposure)</th>
<th>Examples of typical environments (informative only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-carbon steel</td>
<td>Mass loss, g/m²</td>
<td>Zinc Mass loss, g/m²</td>
</tr>
</tbody>
</table>

Part 6: Laboratory performance test methods

<table>
<thead>
<tr>
<th>Corrosivity category as defined in ISO 12944-2</th>
<th>Durability ranges according to ISO 12944-1</th>
<th>Test regime 1</th>
<th>Test regime 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 2812-2 (water immersion) h</td>
<td>ISO 6270-1 (water condensation) h</td>
<td></td>
<td>Annex B (cyclic ageing test) h</td>
</tr>
<tr>
<td>ISO 9227 (neutral salt spray) h</td>
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<td></td>
</tr>
</tbody>
</table>

Table 2 — Categories for water and soil

<table>
<thead>
<tr>
<th>Category</th>
<th>Environment</th>
<th>Examples of environments and structures</th>
</tr>
</thead>
</table>

RISE – Marine Test Centre
ISO 12944-9:2018 Protective paint systems and laboratory performance test methods for offshore and related structures

These tests can be quite tough but are they good enough to secure reliability in marine environments?

<table>
<thead>
<tr>
<th>Test</th>
<th>Scribe line</th>
<th>Environment of corrosivity category CX (offshore)</th>
<th>Environment of combined corrosivity category CX (offshore) and immersion category Im4 (splash and tidal zones)</th>
<th>Environment of immersion category Im4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclic ageing test</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tests with natural sea water
Salt spray and cyclic Temperature/Humidity

Deep sea water
Surface sea water

+ Cyclic corrosion chamber
Outdoor exposure – Swedish west coast
ISO 11997-1 Cycle A and ISO 14993
RISE is there for you

- Test Marine reliability
- Accelerate innovation

What are your challenges?
  - Materials
  - Coatings
  - Environments