

# Handbook

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To find out more about the benefits this app could offer you please visit [www.coatingsradar.com](http://www.coatingsradar.com)

App available to download





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Innovation



Interactive



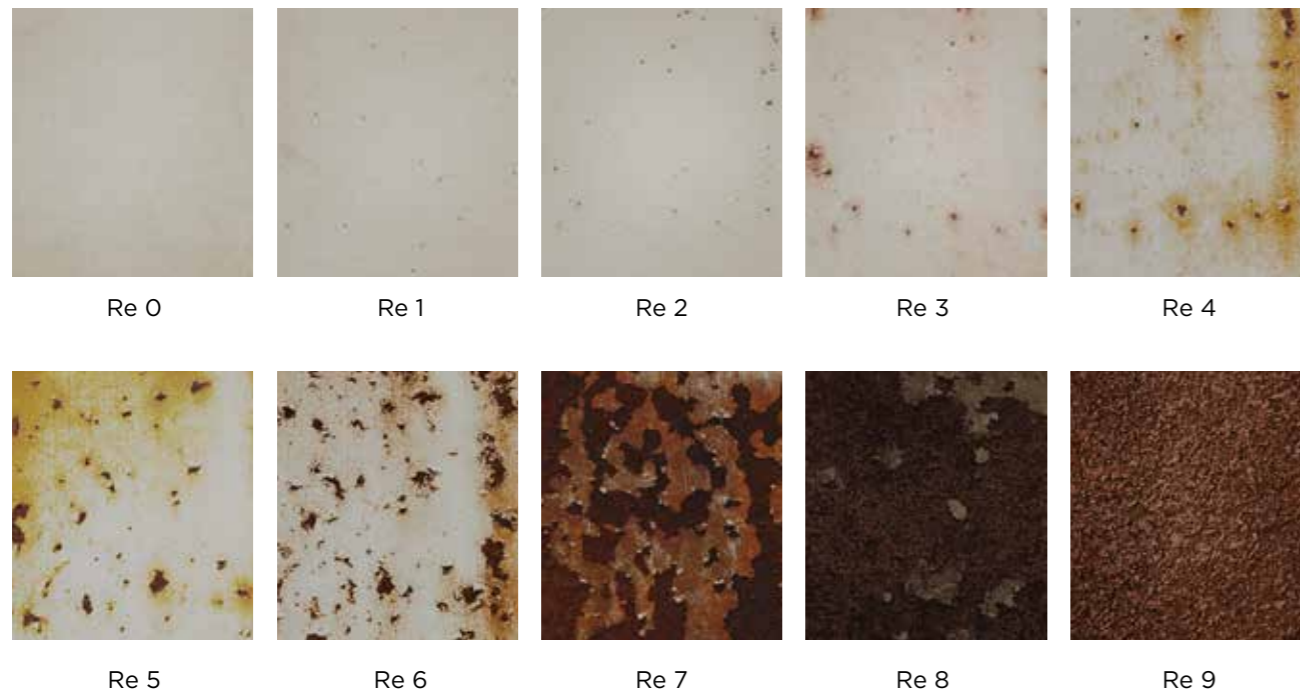
Intelligence



# European Rust Scale and General Corrosion

The Re Scale is a widely used international reference for assessing the level of rusting on a coated surface. It is based on the “European Scale of Degree of Rusting for Anticorrosive Paints,” which was developed in the 1960s and is still relevant today. This document includes black and white photographs of different degrees of rusting on a steel substrate coated with an oil-based air-drying anticorrosive paint.

## Re Scale

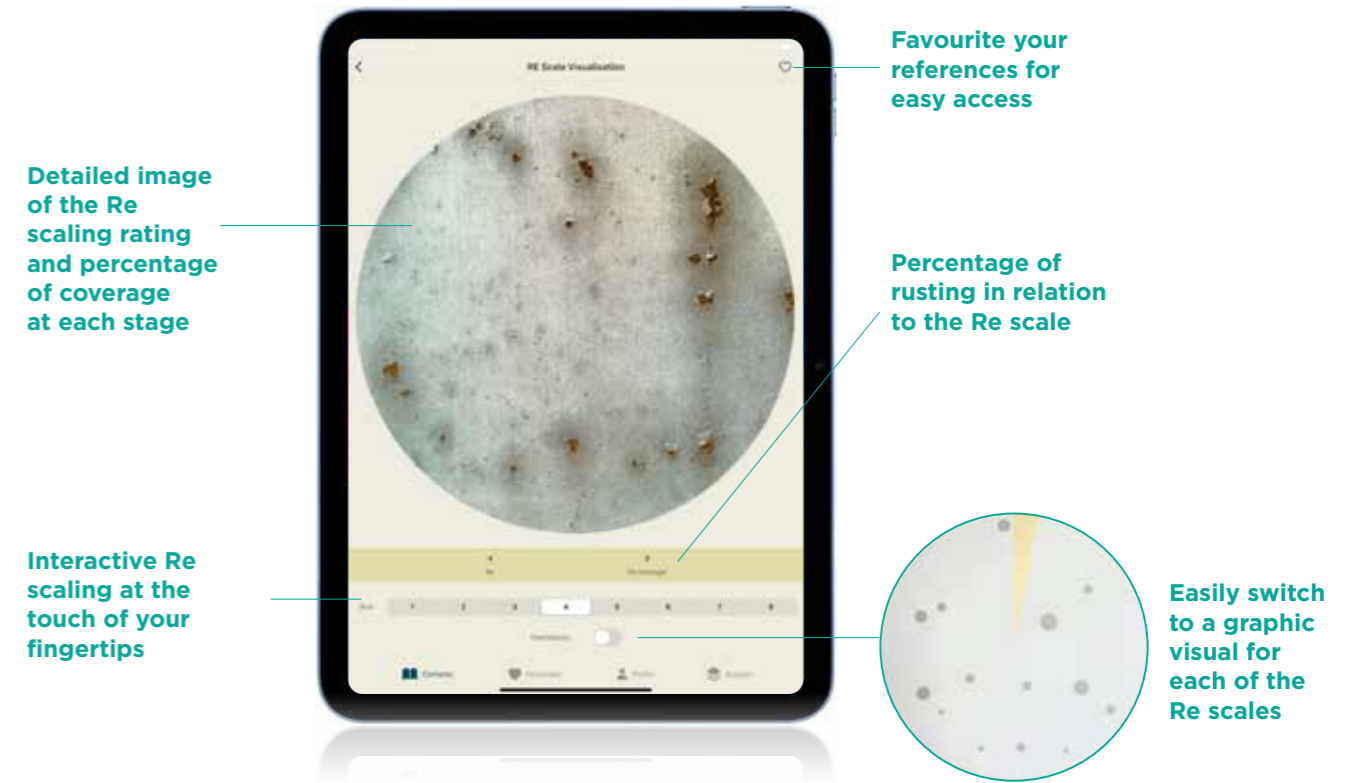


The Re Scale comprises ten photographs, ranging from Grade Re 0 to Grade Re 9. Grade Re 0 indicates no visible corrosion, while Grade Re 9 represents 95% visible corrosion. Coatings Radar provides examples of the Re Scale in various colours to simplify identification on coloured-coated surfaces.

**The Coating Radar app also offers examples of actual structures (marine, offshore, wind, petrochemical) with variable degrees of corrosion as per the Re Scale.**

## Re Scale Visualisation

A re-scale visualisation is included within the Coatings Radar App detailing the re-size and percentage of rust on an interactive slide.



## Rating Schemes

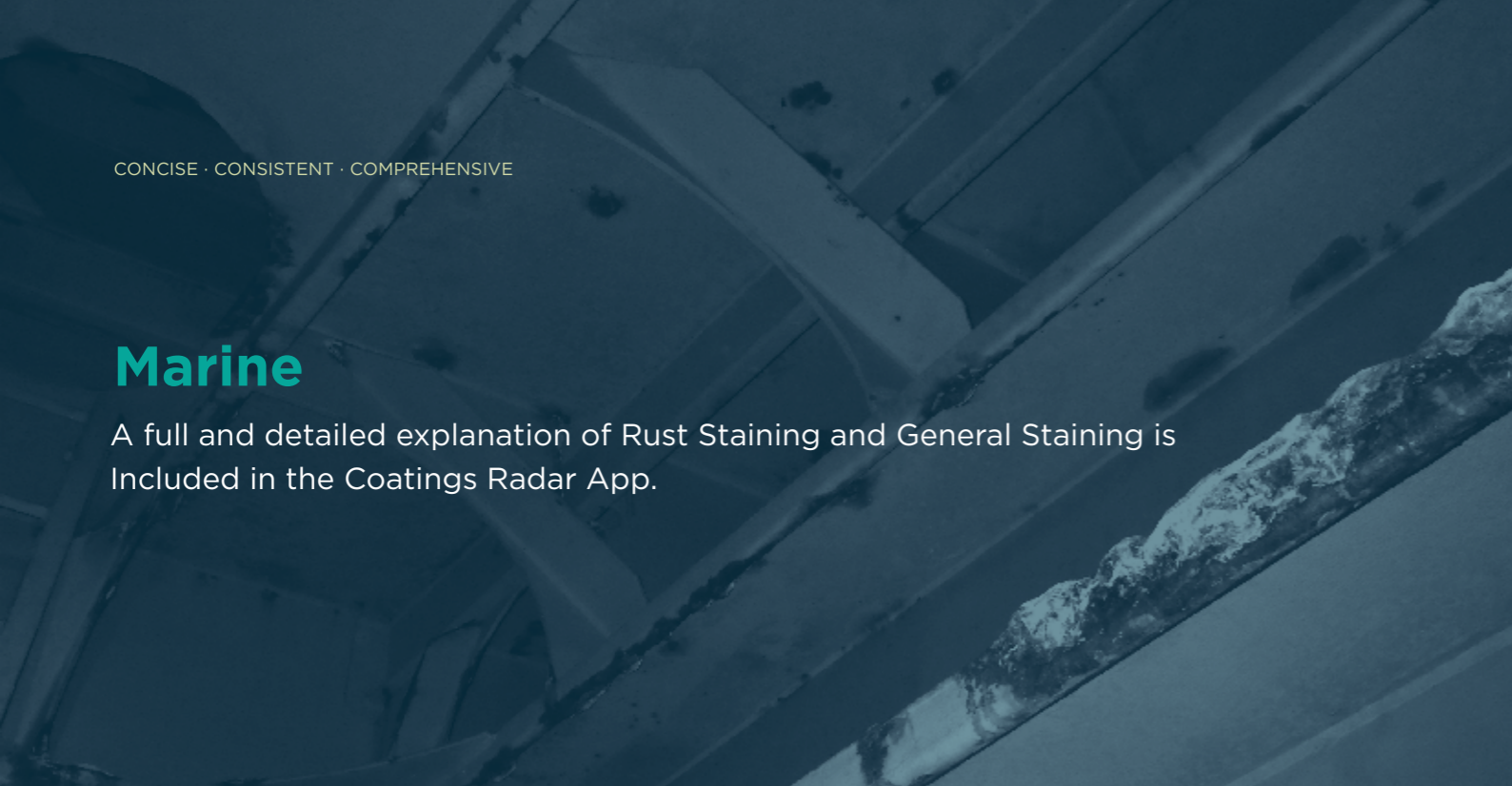
Several tables and charts are included within the Coatings Radar App -

- Re Evaluation - Details of the Re Scale (Re 0-9) and corresponding percentages of rust on a coated surface
- Comparison of ASTM D610, ISO 4628-3 and The European Rust Scale
- Alternative Assessment Diagrams
- Coating Breakdown (Localised)
- Coating Breakdown (Scattered)



## Marine

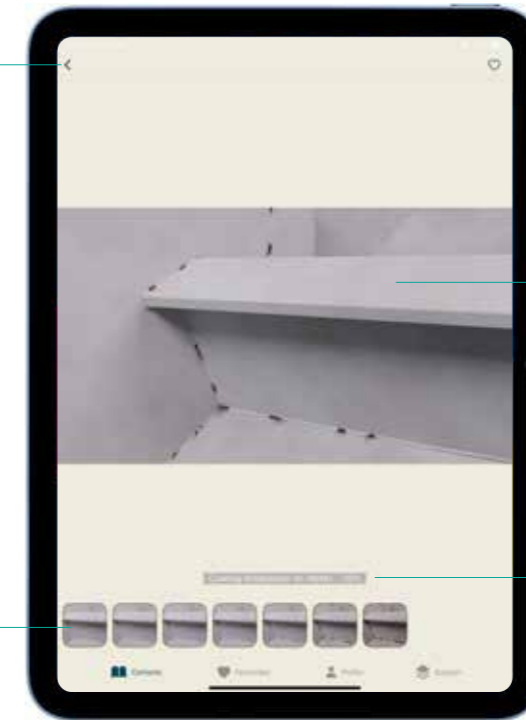
A full and detailed explanation of Rust Staining and General Staining is Included in the Coatings Radar App.



### Welds and Edges

Coatings Radar App includes an interactive section on the percentage calculation of coatings breakdown:

Switch from welds, edges or welds & edges breakdown



Detailed image of the coating breakdown for each percentage

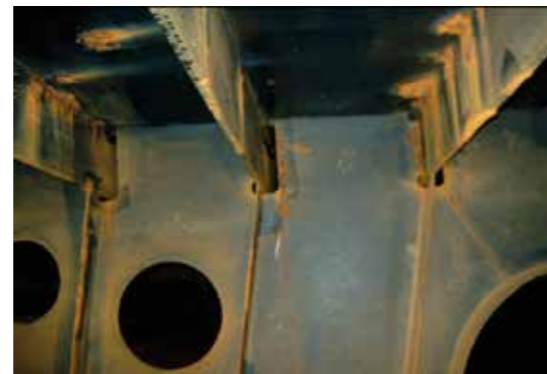
Select your coating breakdown from 1 - 75%

Percentage of breakdown on welds in relation to the image



#### Good Condition

The IACS documents have several photographs of in-service tank coatings in good condition.



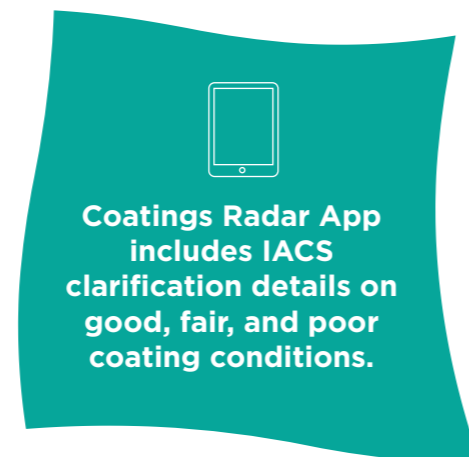
#### Fair Condition

The IACS documents have several photographs of in-service tank coatings in fair condition.



#### Poor Condition

The IACS documents have several photographs of in-service tank coatings in poor condition.



A document review is included in the IACS Recommendation 87 "Guidelines for Coatings Management and Repairs for Ballast Tanks and Combined Cargo/Ballast Tanks on Oil Tankers".

**The Coatings Radar App is ideal for assessing the condition of in-service coatings used in marine environments. It can determine the overall condition of the coatings and the vulnerable locations for coating breakdown, including welds and edges.**

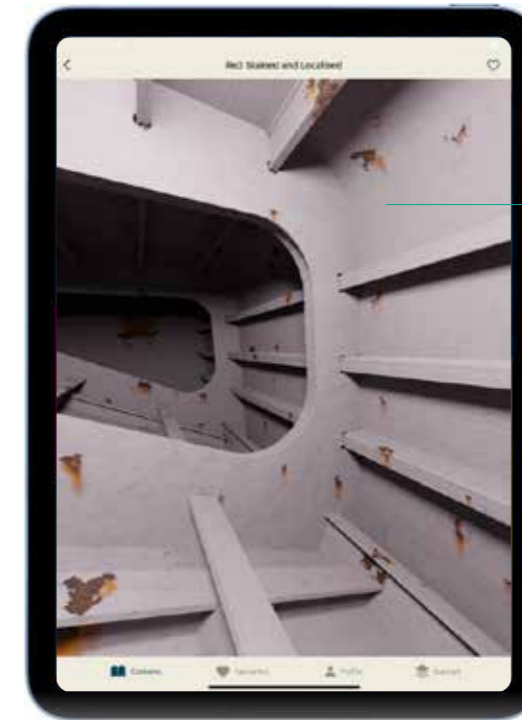


## Rust Staining

A full and detailed explanation of Rust Staining and General Staining is Included in the Coatings Radar App

### Interactive

Coatings Radar App includes 360° stained tanks - Localised and Scattered Gallery for Double Bottom Tanks and Wing Tanks.



360°

Detailed 360° image of stained tanks

### Detailed Images



Month by Month rust staining is detailed in the Coatings Radar App.

### Live Videos



Live video of rust staining to 'in situ' coatings is also contained within the Coatings Radar App.



The Coatings Radar App considers the coating assessment on aged coatings subject to a salt-laden environment with the use of videos, photographs and live videos.



## Paints and Varnishes

ISO 4628 is the evaluation of degradation of coatings – designation of quantity and size of defects, and of intensity of uniform changes in appearance and has ten parts. Coatings Radar details four of the defects for interactive evaluation of coatings.

- Blistering (ISO 4628-2)
- Rusting (ISO 4628-3)
- Cracking (ISO 4628-4)
- Flaking (ISO 4628-5)

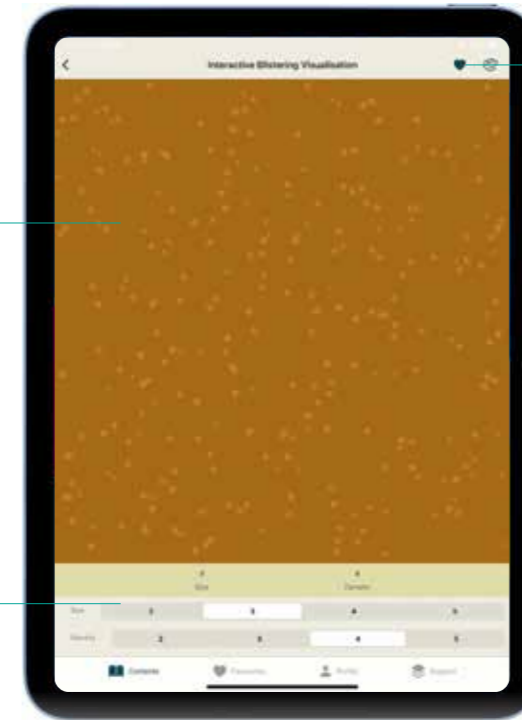
### Blistering Tools

An interactive blistering visualisation is detailed in the app. You can set the blister size, density and paint colour.

Graphic image of selected blistering

Select variations of size and density

Easily change paint colour with a wide selection of different coloured paints

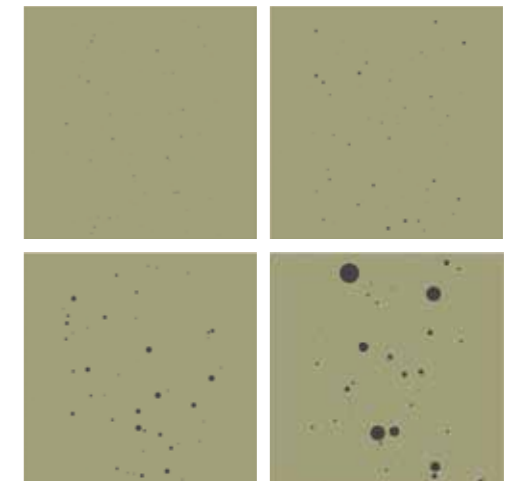


### Correlation Table

A blistering correlation table is included in the Coatings Radar App comparing ISO 4628-2 and ASTM D 714

### Also included:

- An overview of the ISO 4628-2 is also detailed.
- Blistering Sizes 2, 3, 4 and 5 are included and include quantity and density





## Rusting Tools

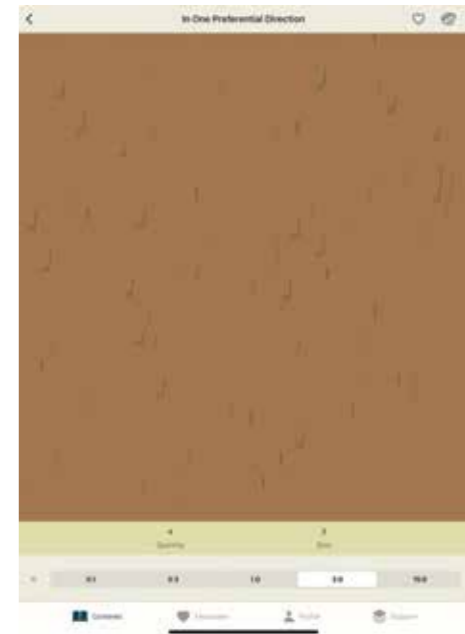
An Interactive rusting visualisation is detailed in the app. You can set the percentage of rust which compares the Re Scale number and paint colour. Localised and scattered rust is detailed.

## Cracking Tools

An interactive cracking visualisation for cracking without and with one preferential direction is detailed in the app. You can set the percentage and size of the cracking for both preferential directions and paint colours.



Various other colour options are available

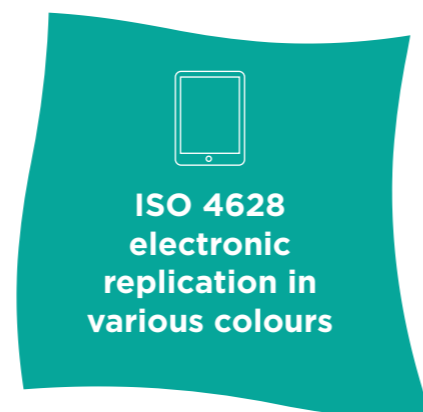


Various other colour options are available

### Degree of Rusted Area

The degree of rusting and rusted area is tabulated as the degree of rust (Ri0 to Ri5) as an area percentage.

- Live videos of Rusting are included in the Coatings Radar App
- An overview of the ISO 4628-3 is also detailed.



The Coatings Radar tabulates the rating scheme for designating the quantity of cracks as per ISO 4628-4, along with the rating and size of cracks. (0-5)

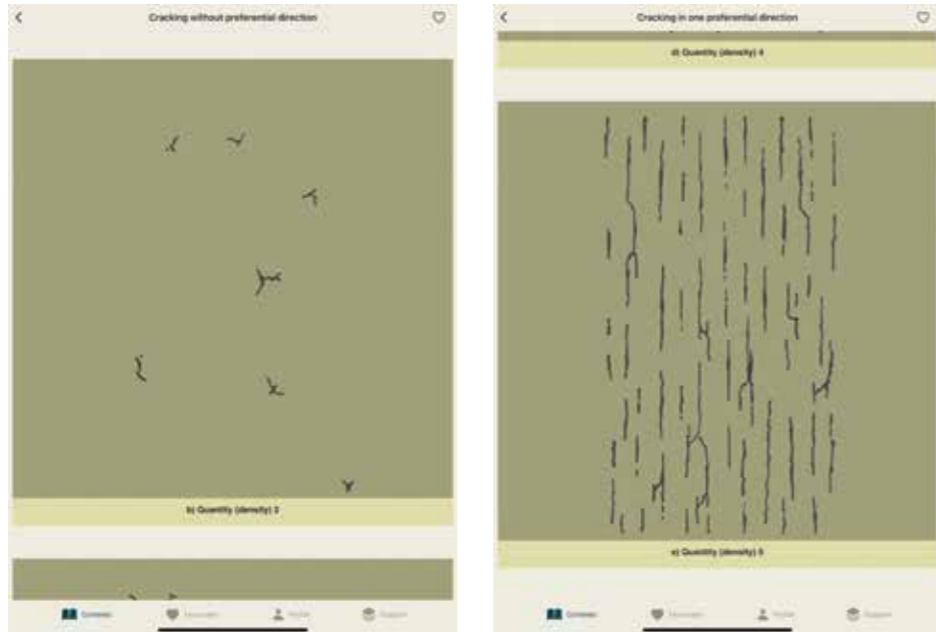
- Live videos of cracking are included in the Coatings Radar App
- An overview of the ISO 4628-4 is also detailed.

**The Coatings Radar App can simulate a coated substrate with various degrees of rust or cracking. It is an interactive tool which allows colour changes and helps the coating surveyor to correctly assess the coating condition.**



## Cracking Tools (cont)

### Cracking sizes



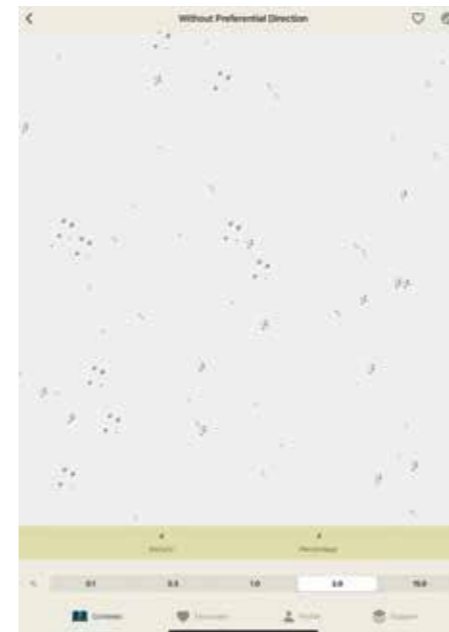
Cracking Sizes 2, 3, 4 and 5 are included and include quantity and density – with and without one preferential direction.



Examples of the different types of cracking are included in the Coatings Radar App. Irregular, Long Line, Short Parallel, Switch, Crow Foot, Mosaic, Shrinkage, Short, Random, Sigmoid

## Flaking Tools

An interactive flaking visualisation for flaking without and with one preferential direction is detailed in the app. You can set the percentage and density of the flaking for both preferential directions and paint colours



Various other colour options are available

### Quantity of flaking

The rating scheme for designating the quantity of flaking to ISO 4628-5 (0 to 5) and the percentage is tabulated in the Coatings Radar App. The size of the flaking and rating is also tabulated for ease of reading.

Examples of flaking without preferential direction and flaking in a preferential direction is included in the Coatings Radar App.



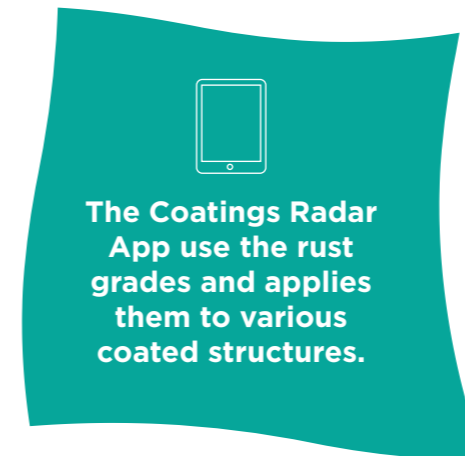
### Also included:

- Live videos of cracking are included in the Coatings Radar App
- An overview of the ISO 4628-5 is also detailed.



## Marine, Offshore and General Corrosion

The Coatings Radar App has an entire initiative section that the user can use to compare new and old structures on the extent of rust of a coated surface using the “European Scale of Degree of Rusting for Anticorrosive Paints,” and ISO 4628-3 Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Assessment of degree of rusting.



### Marine

- Cargo Holds
- Cargo Tanks
- Cargo Oil Tanks
- Double Bottom Tanks
- Wing Tanks

### Oil and Gas

- Oil and Gas Offshore Structures
- Oil and Gas Piperack
- Oil and Gas Pipes

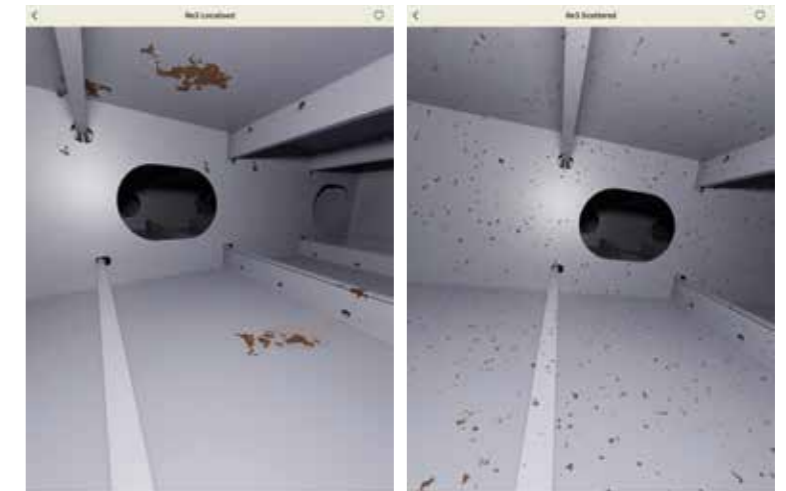
### Wind Energy

- Offshore Wind Farms

Tank coatings can be viewed via a 360° gallery in the Coatings Radar App. The specific rust scale (Re) is activated before selecting localised or scattered rust.

Older tanks can also be selected for tanks that have been subject to salt water, such as double bottom tanks, where you will find rust staining from the specific rust locations.

### Double Bottom Tanks - Re (no staining)



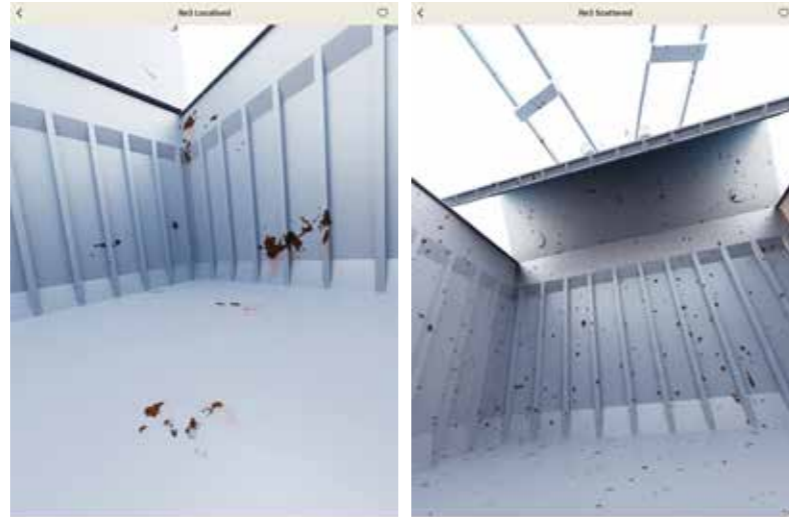
### Double Bottom Tanks - Re (with staining)





### Cargo Holds

- Localised and Scattered corrosion spots.



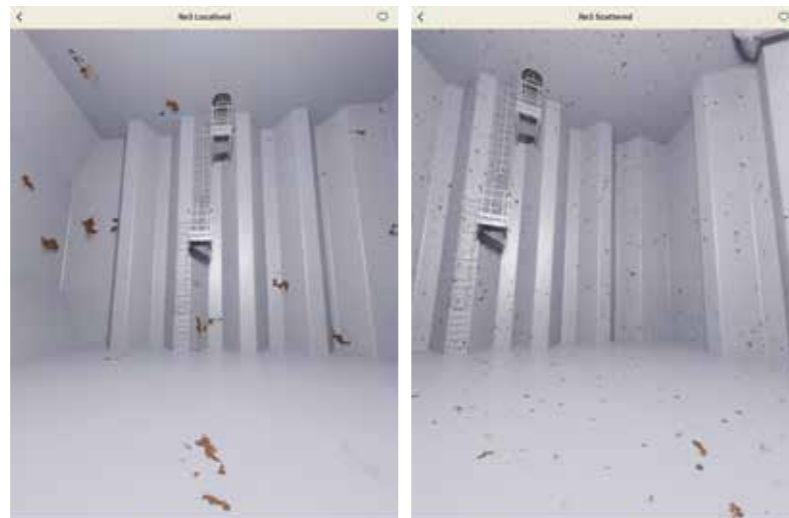
### Wing Tanks

- Localised and Scattered corrosion spots



### Cargo Tanks

- Localised and Scattered corrosion spots.



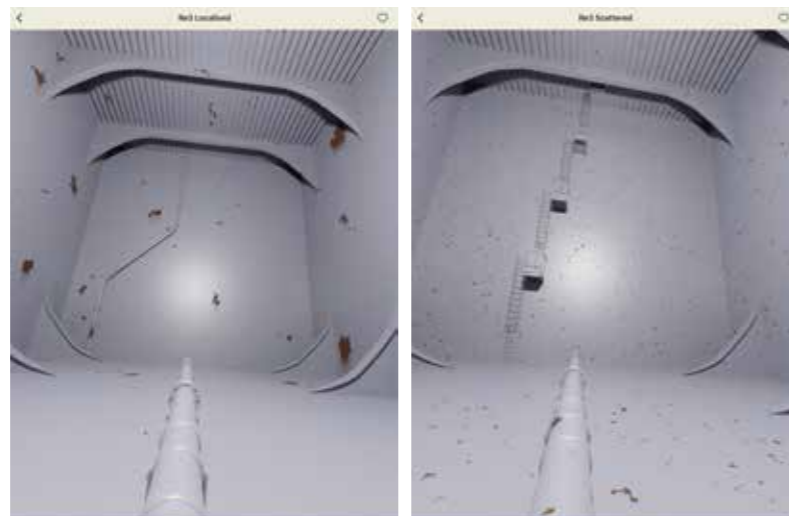
### Oil and Gas

- Corrosion Assessment to Offshore Platform



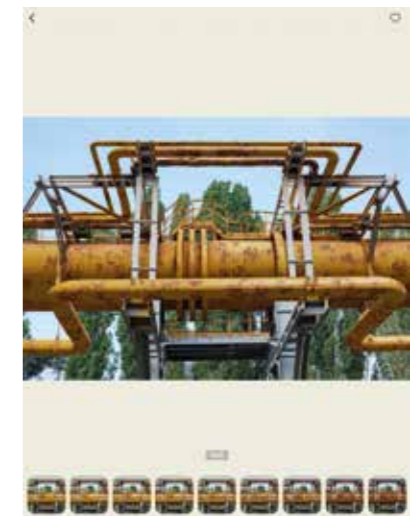
### Cargo Oil Tanks

- Localised and Scattered corrosion spots.



### Oil and Gas Piperack

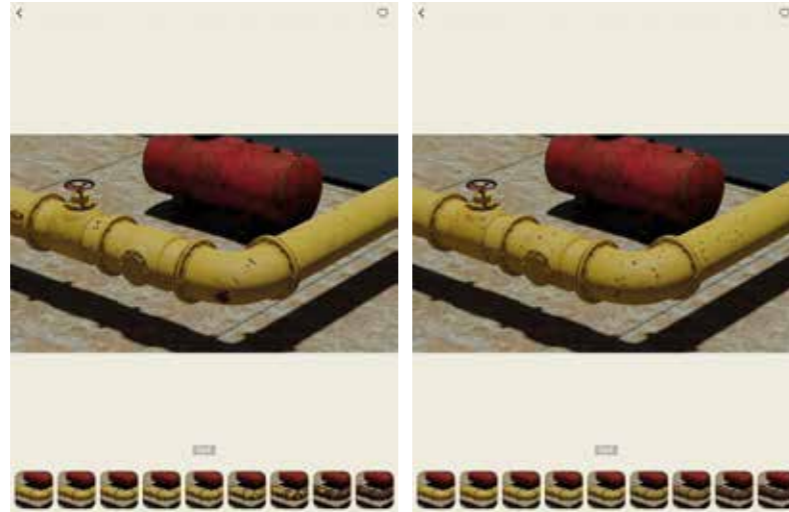
- Corrosion Assessment to Petrochemical Pipeline





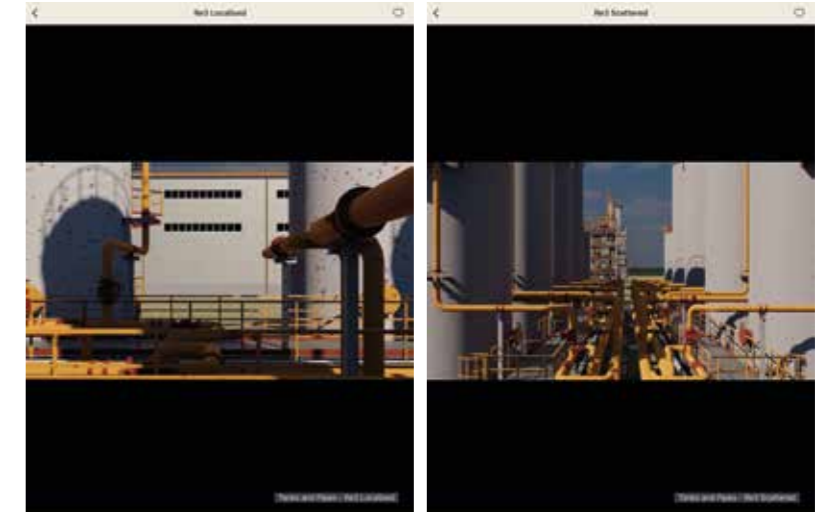
### Oil and Gas Piperack

- Localised and Scattered corrosion spots

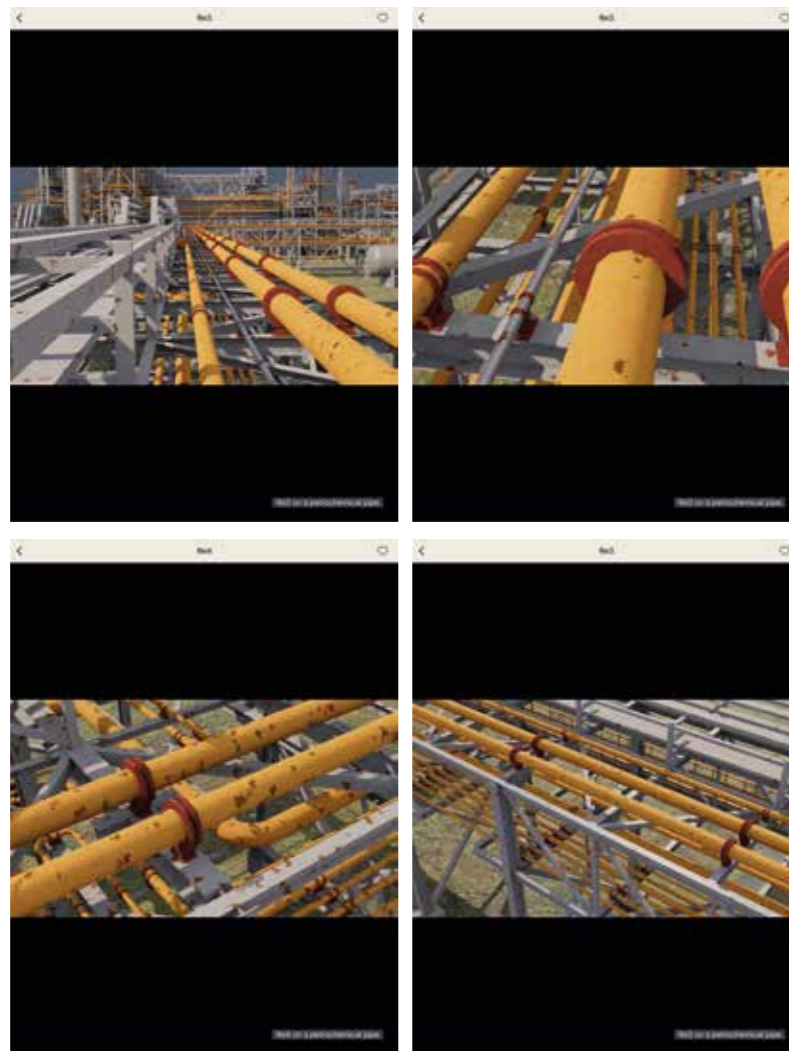


### Tanks and Pipes

- Localised and Scattered corrosion spots.

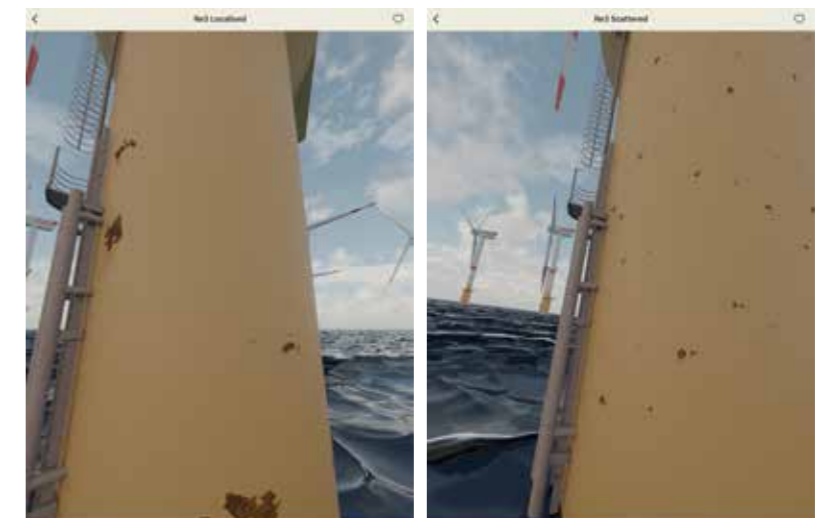


### Piperack Videos (Flyby)



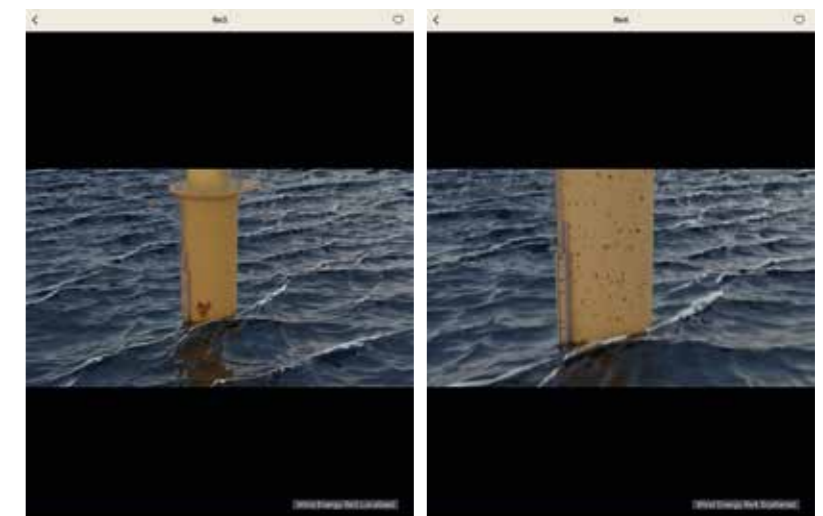
### Wind Energy (Gallery)

- Localised and Scattered corrosion spots.



### Wind Energy (Videos)

- Localised and Scattered corrosion spots.





## Industrial Tests

The Coating Radar offers the users comprehensive information on Coating Adhesion, Coating Surveys, Sampling and Coating Thickness.

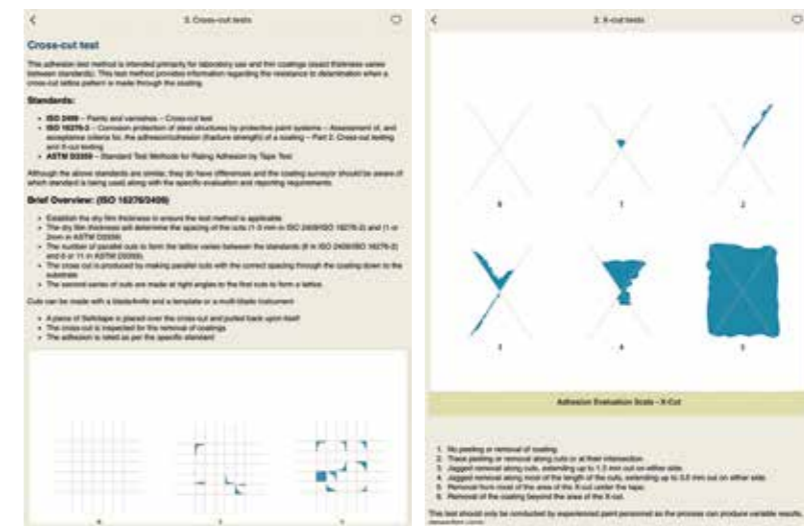
## Adhesion

Adhesion of a coating refers to the bond strength between a coating and another coating or substrate. Adhesion testing will determine the bond strength and establish the likelihood of coating performance and suitability for overcoating.

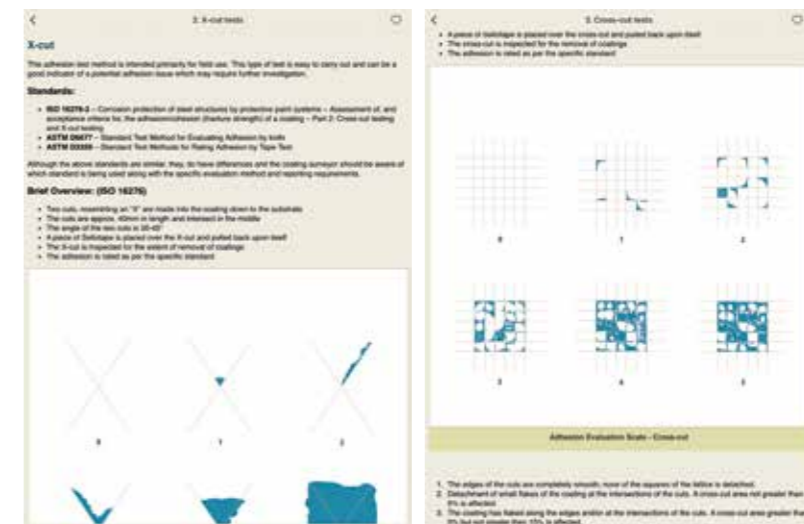
The Coatings Radar App details all the adhesion tests on a coated surface, including X-Cut, Cross-Cut, and Pull-Off Tests.

A full description and introduction to adhesion tests are included.

### X-Cut

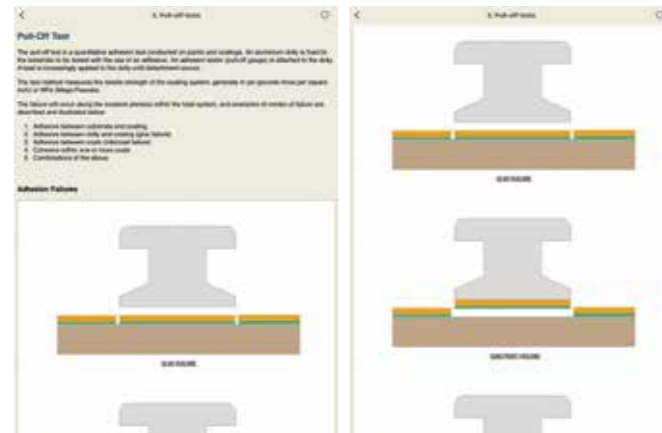


### Cross-Cut





## Pull-Off

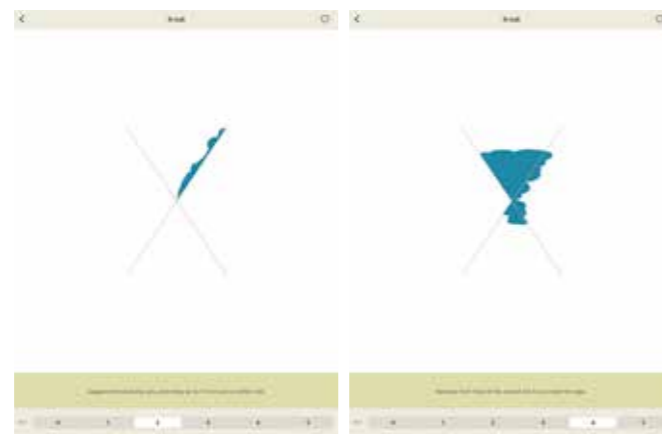


The Pull-Off adhesion modes ( Glue failure, substrate failure and intercoat failure) are contained within the Coatings Radar App as an interactive demonstration.



## Adhesion Visualisations

X-Cut test in accordance with ISO 16276-2 is detailed in the Coatings Radar App. The user inputs the size from the sliding chart to illustrate the X-Cut test.



Pull-Off Cohesive failures are contained within the Coatings Radar App as an interactive demonstration.



Cross-Cut in accordance with ISO 16276-2 and ISO 2409 is detailed in the Coatings Radar App. The user inputs the size from the sliding chart to illustrate the Cross-Cut test.



Pull-Off combinations are included in the Coatings Radar App with Interactive examples of adhesion tests on multi-coat systems.





# Coating Surveys

To ensure a protective coating is providing corrosion protection over the life of its future replacement, it is essential that consistent coating surveys are conducted which will determine the condition of the coating and suitability for maintenance or future work removal.



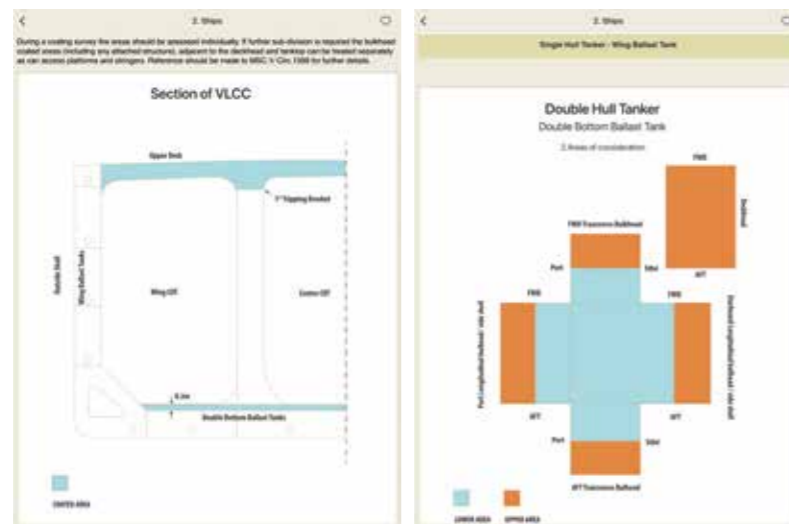
## Petrochemical and Refineries

A description of petrochemical and refinery environments is contained on the Coatings Radar App, including typical techniques for Corrosion under insulation (CUI) and specific information a coating surveyor will need to conduct a coatings survey on a petrochemical plant.

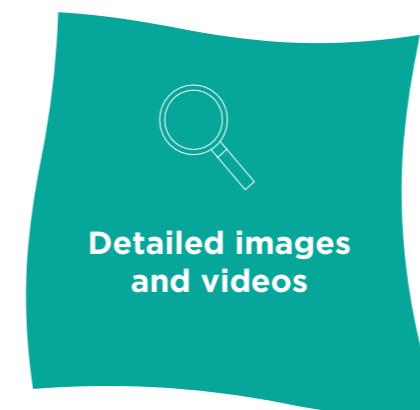
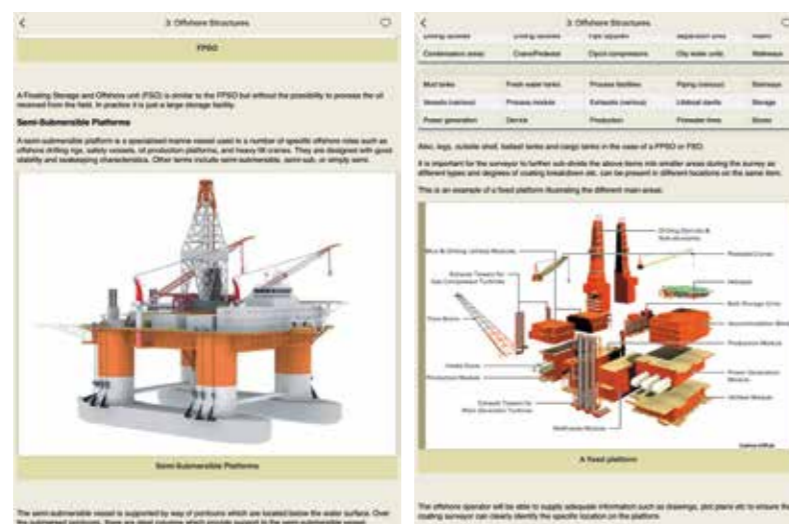
## Bridges (Infrastructure)



## Ships



## Offshore Structures



The Coatings Radar App offers a comprehensive description of various industries including Ships, Offshore Structures, petrochemicals, refineries and bridges to assist the coating surveyor working in different industries.



## Sampling

The collection of paint samples is an integral part of a coating survey or coating failure investigation. The correct sampling technique process must be conducted.

The Coatings Radar App includes a paint sampling introduction, paint flakes, detachment, blistering sampling and a list of suitable equipment requirements for paint sampling.

A full introduction to paint sampling is detailed.

## Coating Thickness

Coatings are designed to perform their intended function when applied within the specified or recommended range by the coating suppliers.

### Paint Flakes

Details of how to collect paint samples



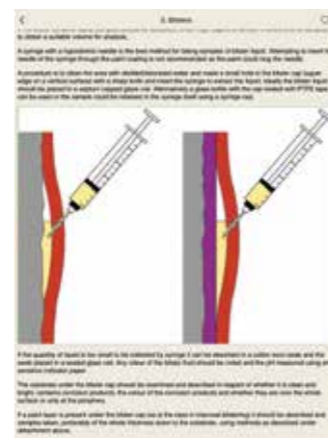
### Detachment



### Delamination



### Blistering



A detailed description of sample containers is included in the Coatings Radar App and includes cargo samples, control samples, labelling and chain of custody

### Equipment

A full list of coating surveyors' equipment is included with an illustration of each item.

This section of the coatings Radar App has a comprehensive review of the dry film thickness:

- Introduction to dry film thickness and implications on coating performance
- Dry Film Thickness Gauges. Types of dry film thickness used



- SSPC - PA2 (initial Overview)

Level	Thickness	Coat Reading	Wet Measurement	Dry Measurement
Level 1	Minimum	100%	As specified	As specified
Level 2	Minimum	100%	As specified	As specified
Level 3	Minimum	100%	As specified	As specified
Level 4	Minimum	100%	As specified	As specified
Level 5	Minimum	100%	As specified	As specified
Level 6	Minimum	100%	As specified	As specified
Level 7	Minimum	100%	As specified	As specified
Level 8	Minimum	100%	As specified	As specified

- Dry Film Thickness Standards
- Details of various standards relating to dry film thickness measurements

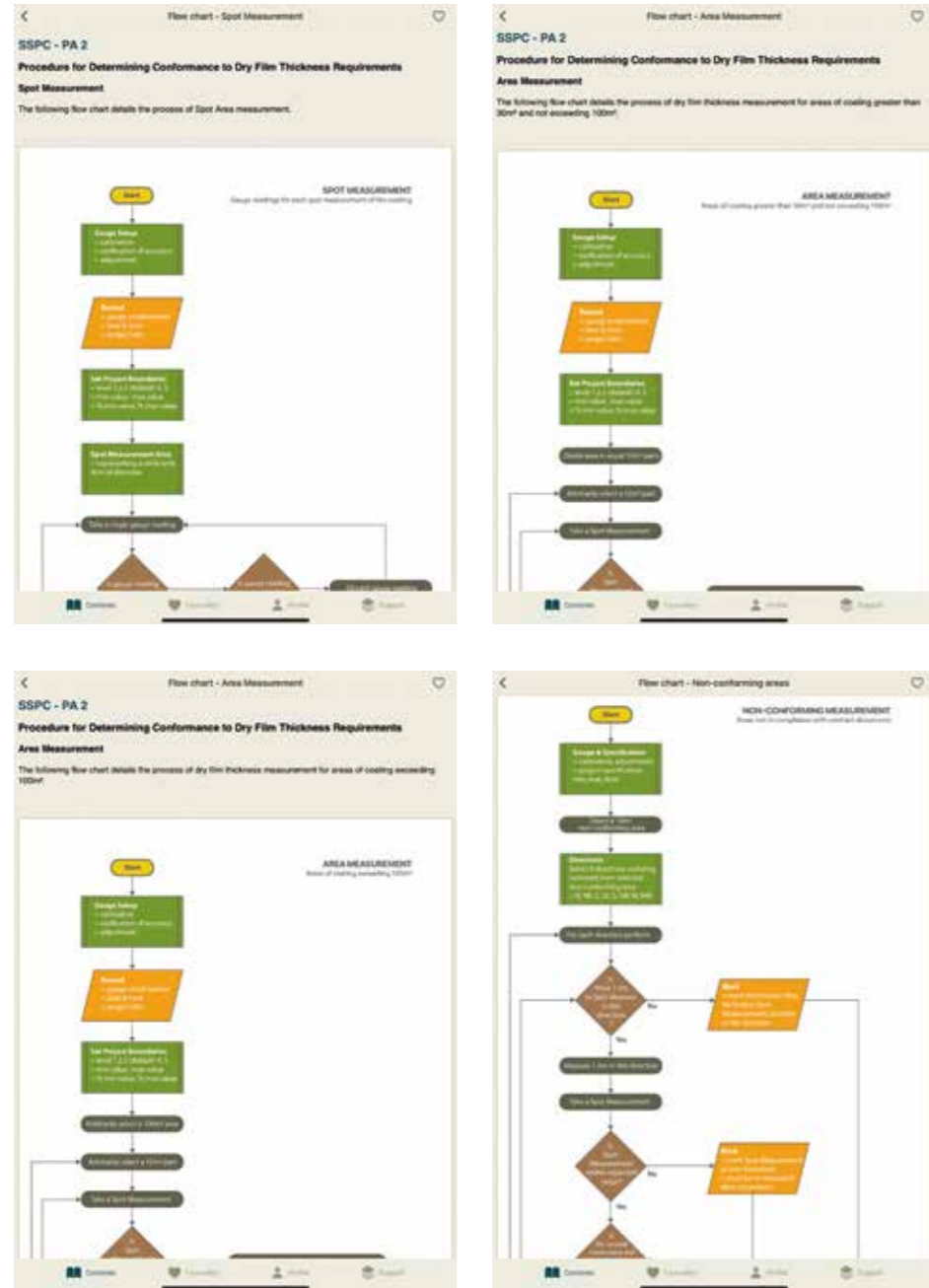
1. ASTM - D7091
2. ISO 19840
3. IMO PSPC
4. ISO 2808



# SSPC - PA2 Interactive Tools

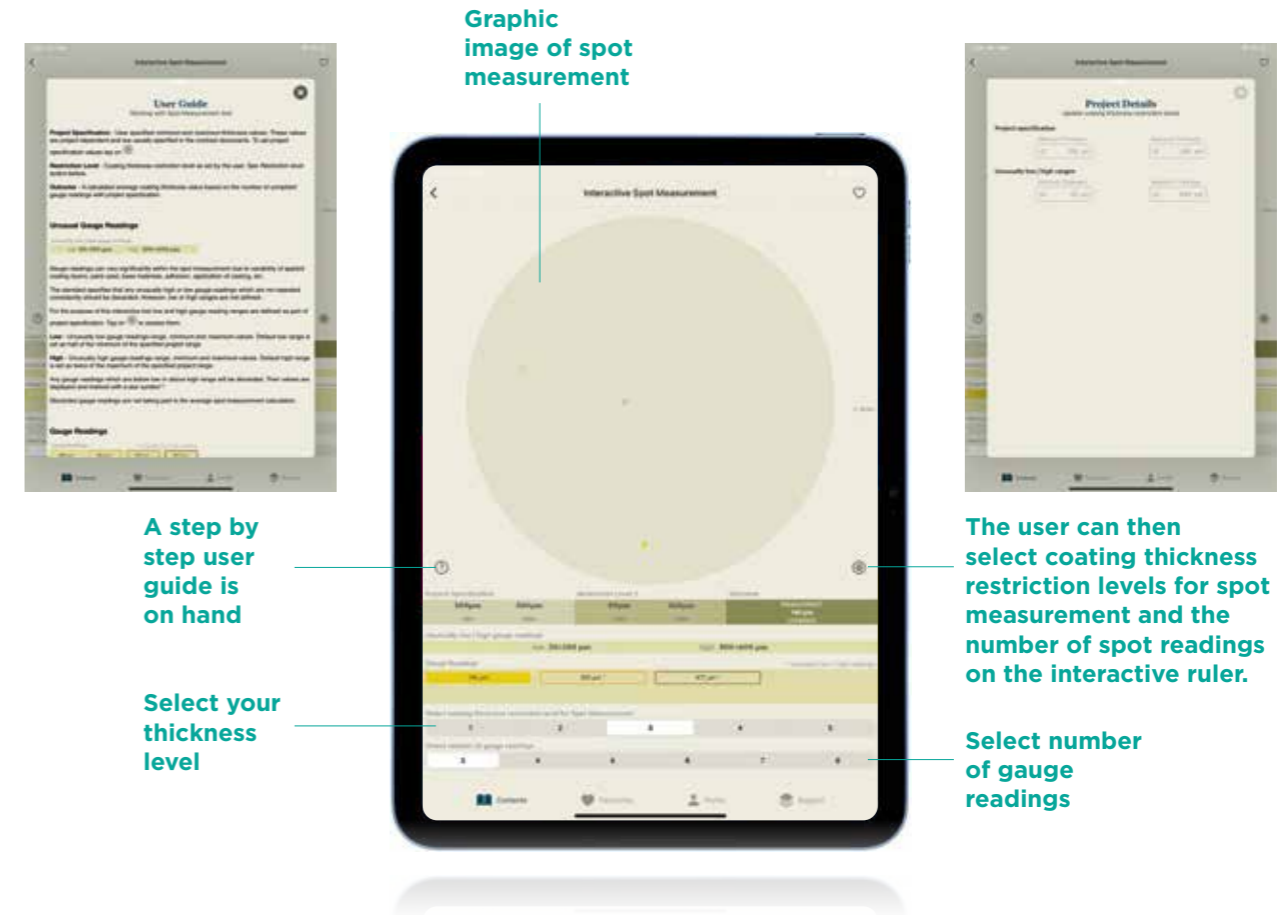
The Coatings Radar App has a comprehensive interactive tool for using the SSPC-PA2

## Flow Chart Spot and Area Measurement



## Interactive Spot Measurement

The Coatings Radar App allows the user to set up the project dry film thickness requirements using the project specifications and unusually low/high ranges and input the spot measurements.



  
Interactive area measurement tool also included

The Coatings Radar App with the interactive tool allows the user to simulate real life project scenarios where the SSPC-PA2 can be used.





## Manuals and Standards

The Coatings Radar App has several materials and Standards documents to assist with conducting a coating survey.



**FREE**  
Manuals and  
standards

### Fitz's Atlas of Coating Surveys

A full electronic version of Fitz's Atlas of Coating Surveys book is included in the Coatings Radar App.



#### Contents

1. Introduction
2. Coating Surveys
3. Estimation of Percentages
4. European Scale of Degree of Rusting of Anticorrosive Paints
5. Common Defects
6. Marine Fouling
7. Dry Film Thickness Surveys
8. Passive Fire Protection
9. Adhesion Testing
10. Holiday Detection
11. Sampling Techniques
12. Field Tests and Laboratory Analysis
13. Photography
14. Documentation and Reporting
15. Health and Safety
16. Standards and Test Methods

### Paint Testing

Paint testing should be conducted with International Standards; this will ensure a consistent method of evaluation and should minimise any misinterpretation of the findings.

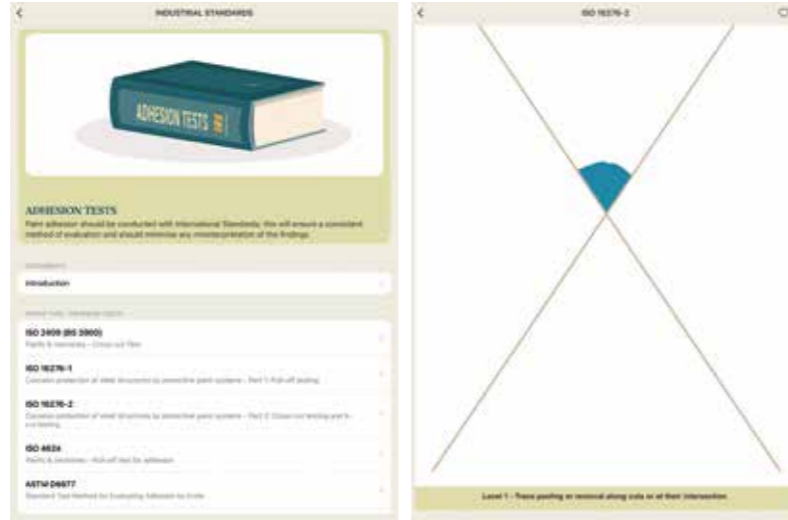
This section details a number of SSPC, ASTM and ISO Standards used for Paint Testing on Coatings Surveys.





### Adhesion Testing

Paint adhesion should be conducted with International Standards; this will ensure a consistent method of evaluation and should minimise any misinterpretation of the findings.



### Surface Calculations

Calculating paint consumption correctly can be extremely important, especially in certain locations, such as shipboard maintenance or offshore structures, where additional deliveries can be a problem.

### Interactive Calculators



### Dry Film Thickness

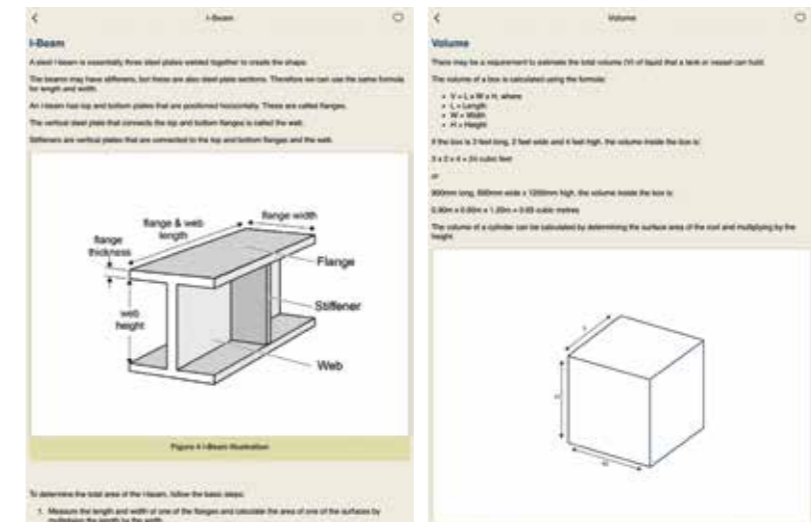
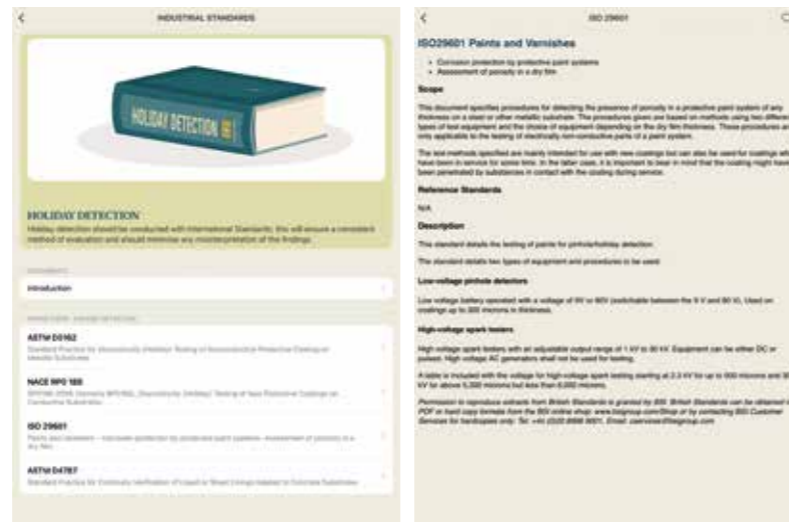
Dry Film Thickness should be conducted with International Standards; this will ensure a consistent method of evaluation and should minimise any misinterpretation of the findings.



### Calculating Areas

### Holiday Detection

Holiday Detection should be conducted with International Standards; this will ensure a consistent method of evaluation and should minimise any misinterpretation of the findings.





### Paint Arithmetic

#### Surface Profile

**The Depth of Surface Profile**  
An absolute flat (smooth) surface is greater in size than a smooth surface. The depth of the surface profile will increase the quantity of paint required to fill the troughs on the surface.

Comparison of a flat steel surface and an absolute flat (smooth) surface. The surface area is increased.

Figure 10 Absolute Flat (Smooth) Steel

**Old and Pitted Steel Surfaces**  
Old and pitted steel surfaces will require additional paint to fill for surface irregularities.

**Absorbent Surfaces**  
Absorbent surfaces such as concrete, wood, etc. will allow the paint to penetrate the surface and increase paint usage. The absorption will decrease after the first coat.

#### Volume Solids (VS)

To obtain Volume Solids use the following formula:  
Dry Film Thickness  $\times$  VS = Volume Solids  
See Film Thickness

Example:  
30% Volume Solids  
Wet Film Thickness = 100  $\times$  30% Dry Film Thickness = 30

The product data sheets will advise the volume solids of coatings (typically 50-100%). Most paints are composed of solids and liquids, the solids being the volume (mass) of particles that the pigment and filler. The solids are the non-volatile part of the paint. The liquid (solvent) is the part of the material which evaporates and plays no part in the distributed paint. The solvent is the volatile portion of the paint.

- Non-Volatile = Solids, resin, etc.
- Volatile = Solvent

If the paint has a volume solids of 70%. This remaining 30% will be the solvent and will evaporate during the paint application and drying.

In theory the 70% solids will be applied to the surface, however, this does not take into account any practical wastage.

### Conversion Tables

#### Inches to Centimetres

1 Inch = 2.54 Centimetres

Inches	Centimetres
1	2.54
2	5.08
3	7.62
4	10.16
5	12.7
6	15.24
7	17.78
8	20.32
9	22.86
10	25.4
11	27.94
12	30.48
13	33.02
14	35.56
15	38.1
16	40.64
17	43.18
18	45.72
19	48.26
20	50.8
21	53.34
22	55.88
23	58.42
24	60.96

#### Weight - Pound / Kilo

1 Kilogram = 2.20 pounds

Lb	Kg
1	0.453
2	0.907
3	1.361
4	1.814
5	2.268
6	2.722
7	3.175
8	3.629
9	4.083
10	4.537
11	4.991
12	5.444
13	5.898
14	6.352
15	6.806
16	7.26
17	7.714
18	8.168
19	8.622
20	9.076
21	9.529
22	9.983
23	10.437
24	10.891

### Conversions

#### Useful Formulas

- Theoretical covering rate (TDR), m<sup>2</sup> per lit = 10 divided by lit % divided by the Dry film thickness in microns
- Practical Covering Rate (PCR) = TDR  $\times$  (100% - absorption) = PCR
- Area of a plate = length  $\times$  width
- $A = L \times W$
- Circumference =  $\pi$   $\times$  diameter
- Perimeter = diameter  $\times$   $\pi$
- Area of circle =  $\pi$   $\times$  r<sup>2</sup>
- Cylinder surface area of the sides = length  $\times$  circumference
- Volume (sides) = length  $\times$  width  $\times$  height
- Volume Cylinder =  $\pi$   $\times$  r<sup>2</sup>  $\times$  h
- $\pi$  = (3.14)  $\times$  (2) = 6.28
- $\pi$   $\times$  (1)  $\times$  (2) = 6.28
- Microns = mil  $\times$  25.4
- Mils = Microns divided by 25.4

#### Converting Temperature

The easiest method of conversion is a conversion chart which is readily available.

Calculation:  
If the temperature in °F is known and needs to be converted to °C, the following formula can be used.

Example:  
Converting 80°F into Centigrade °C = (°F - 32)  $\div$  1.8  
= (80 - 32)  $\div$  1.8  
= 48  $\div$  1.8  
= 26.67°C

If the temperature in °C is known and needs to be converted to °F, the following formula can be used: °F = (1.8  $\times$  °C) + 32 °F

Example:  
Converting 5°C to Fahrenheit °F = (1.8  $\times$  5 °C) + 32 °F  
= (9) + 32  
= 41 °F

### Surface Assessment

It is common to come across different types of corrosion on a coated surface, which must be accurately documented in the coating survey report.

### Surface Area Formulas

#### Spheres

The surface area of a sphere is calculated by multiplying the square of the radius by 4 and by  $\pi$ .

Area = 4  $\times$   $\pi$   $\times$  R<sup>2</sup>

#### Cylindrical Tank

The surface area consists of the cylindrical shell (3.142  $\times$  D  $\times$  H) added to the two flat ends (3.142  $\times$  R<sup>2</sup>)  $\times$  2 for Area = 3.142  $\times$  D  $\times$  H + (3.142  $\times$  R<sup>2</sup>)  $\times$  2

#### INDUSTRIAL STANDARDS

**SURFACE ASSESSMENT**  
It is common to come across different types of corrosion on a coated surface, which must be accurately documented in the Coating Survey report.

Introduction

- Pitting Corrosion
- Crevice Corrosion
- S-Metallic Corrosion
- Undermining (Creep)
- Rust Scale
- Edge Corrosion
- Rust Spalling (Flaking)
- Rust Staining
- Mechanical Damage

#### Pitting Corrosion

Pitting corrosion is a localized form of corrosion in which cavities or "holes" are produced in the material. Pitting is considered to be more dangerous than uniform corrosion damage because it is more difficult to detect, predict and design against.

Corrosion products often cover the pits. In small, narrow pits with narrow overall metal loss can lead to the failure of an entire engineering system. Pitting corrosion, which, for example, is almost a common denominator of all types of localized corrosion attack, may assume different shapes.

Pitting corrosion can produce pits with their depth often uncontrolled or covered with a non-corrosive product of corrosion products. This can be either hemispherical or cup-shaped. **ASTM G46**

**ASTM G46 Standard Guide for Examination and Evaluation of Pitting Corrosion**  
This guide covers the selection of procedures that can be used in the identification and examination of pits and in the evaluation of pitting corrosion to determine the extent of its effect.

Pits may have various shapes and sizes.

**Trough Pits**

“ Everything at  
your fingertips. ”