

GENERAL SPECIFICATION

CORROSION

GS EP COR 451

Corrosion and Coatings Integrity Inventory for Offshore Installations
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1. Scope

This General Specification will allow Subsidiaries to carry out an inventory of the visible coating integrity of offshore structures, installations, and associated equipment.

The aim of this document is to ease coating inspection by checking the intensity and extent of corrosion on a regular basis and enhance traceability of actions made to preserve the Safety, Operability and, if required, Cosmetic integrity of Company offshore installations.

This document can be used for contractual guarantee inspection purposes.

The aim is to give a consistent and rapid view of each installation or equipment considered, focusing on areas of coating breakdown as well as areas attacked by corrosion, therefore helping to forecast and prepare touch up or major remedial works in terms of planning and budget.

This document explains the use of the form "Corrosion and coatings integrity inventory form for offshore structure, installations, and equipment" and associated appendices.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ISO 4628 (All Parts)	Evaluation of paint and varnish defects. Designation of intensity, quantity and size of common types of defect – All Parts
ISO 8501-1	Preparation of Steel Substrates Before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness - Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates After Overall Removal of Previous Coatings

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
Not applicable	

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3. Documents and Equipment required to perform Inspection

3.1 Documents

- Work Permit
- Corrosion and Coating Integrity Inventory Form
- Previous relevant Inspection form (if any)
- [ISO 8501- 1](#) for rust grade assessment
- [ISO 4628 \(All Parts\)](#) and Assessment scale for breakdown (Table 1).

3.2 Equipment (informative)

- Specific Safety Equipment and Instruction stated in Work Permit
- Digital Camera
- DFT Measurement apparatus
- Scraper and Hammer (Brass type)
- UT apparatus for measurement of wall thickness
- Laser Measurement device and Decametre
- Binoculars
- Chalk, Marker, Pen and Notebook.

4. Measurements and Estimates of Surfaces

4.1 General

- All measurements must be made in Metric System.
- All measurements and evaluations must be made **on site**.
- All measurements must be made without compromising the safety of personnel and equipment.

4.2 Inaccessible areas

4.2.1 Evaluation of surfaces for inaccessible areas

If, for any reason, some measurements cannot be made in a safe way, the inspector will make an estimate and will endeavour, back in the office, to correct this estimation using relevant drawings.

4.2.2 Evaluation of degree of rust for inaccessible areas

When measurement is not possible due to lack of access, it is difficult to make an accurate evaluation of the degree of corrosion by differencing the extent of rust stain from the extent of the corrosion itself. Therefore, the use of binocular is mandatory in this situation.

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4.3 Measurement & recording of surface areas

When measurements and estimations are completed, the inspector will:

- Record the total surface of the item (measured + estimated) in the relevant cell
- Calculate % of measured amount with regard to total surface of items

$$(\text{Measured m}^2 / \text{Total m}^2) \times 100 = \% \text{Measured m}^2$$
- Record the % of measured m² of the item in the relevant cell
- The % of estimated amount will be automatically calculated and displayed in m² in the **“Total m² of area”** cell on the area sheet and summarized in the **“Grand Total”** on the front sheet.

4.4 Cleanliness of surface area

The inspector has to estimate the % surface area of the Items affected by "Heavy and hard to clean oil".

When this evaluation has been completed and recorded Item by Item, the amount of "Dust and Light oil" will be automatically displayed in m² on subtotal and Grand Total.

5. Coating Condition Evaluation

5.1 General

All evaluation of coating breakdown must be made with regard to [ISO 4628 \(All Parts\)](#), which relate a degree of rust to a uniformly rusted area (i.e. for Ri3, an area where rust represents about 1% of the said area). It is strongly recommended to make sure that the inspector has understood the principles of [ISO 4628 \(All Parts\)](#) before proceeding with the evaluation.

The inspector must keep in mind that the aim of the evaluation is not to determine the number of m² corroded but to use percentage areas of a given structure or equipment associated with the attached "Assessment scale for breakdown" to determine the surface of the areas affected by a degree of corrosion.

5.2 Visual Evaluation Diagram of surface %

The estimation of the surface % affected by coating breakdown will be facilitated by the use of the following Visual Diagram: Assessment scale for breakdown (Table 1).



5.3 Recording

5.3.1 Evaluation of area $\geq$ to Ri3, Ri4 and Ri5

Inspector must record the % of the area estimated for each degree of rust.

Note: Cumulated % (Ri3+Ri4+Ri5) cannot exceed 100%.

5.3.2 Evaluation of area < to Ri3

It is impossible to record any value in the Ri2 column because this level is considered as normal for offshore installations. When the evaluation for other rust degrees has been completed and recorded, the amount of area = or < to Ri3 is automatically displayed in the pink column as the balance.

Example: The total surface of Item "Structure" at "Elevation XXXX" of a square 4 legs Jacket is 200 m².

- With the help of "Assessment scale for breakdown" the Inspector find the North side at level Ri4, the West side at level Ri5 and other sides at level < Ri3

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- in this situation he will record 25% on relevant item line (“Structure”) in Ri4 column, 25% in Ri5 and nothing in Ri2 as it will be automatically calculated at 50%
- Then the surface breakdown will be automatically displayed respectively as 50 m² for Ri4, 50 m² for Ri5 and 100 m² for Ri2
- Incidentally, if this situation comes from a permanent drip/shower of Sea water or Chemical, he will indicate “See comments” on the relevant Item line and give more explanations on the “Comments” page (Page 11/11).
- Accordingly he will record the following comments: “North side Ri4. West side Ri5 (see comments)”.

6. Wall thickness measurements, Colour Code and Comments

6.1 Wall thickness measurements and colour code

Whenever possible, and especially when severe corrosion has been detected, the inspector shall carry out wall thickness measurements using portable UT equipment. Depending on the actual wall thickness measured, the inspector will record the extent of corrosion according to the following colour coding. This will allow the inspection department to be aware of the problem, and carry out complementary measurements and/or evaluations if necessary.

- **Green:** < 10% of metal loss
- **Orange:** 10% < metal loss < 50%
- **Red:** Metal loss ≥ to 50% and/or Ri5.

6.2 Comments

Comments stated on “**Front**” and “**Measurement**” sheets must be short and concise.

6.2.1 No Comments

To be sure that all items have been reviewed, the Inspector will have to write “No Comments” on the line allocated to the Item.

6.2.2 Comments

When anomalies have been found, the Inspector will have to make comments on the line allocated to the Item.

6.2.3 Severe corrosion Comments

In the case of severe corrosion, the Inspector will have to make comments on this specific line.

6.2.4 Additional comments

If additional comments are needed, this will have to be developed separately on Page 11 under “Additional Comments”.

Example: If Inspector finds a flaking problem affecting 50% of water injection line he will record on the line allocated to piping the following comment: “**50% Flaking on W. Injection line**” or “**See comments on page 11**”, and fill the adjacent margin cell with orange colour.

7. Pictures

- All areas must be photographed with a digital camera
- Pictures must be made on **e-mail** mode and compiled on **Word file**.

Note: e-mail mode give the best compromise between quality and file size. This is important when fast and safe **Internet** electronic transmission of a large amount of pictures is necessary.

8. Actions

The inventory shall lead to actions summarised in the following table:

	Next inspections	Paint refurbishing	Inspection by relevant specialist
Immediate	Not applicable	When Ri5	When Ri5 and/or Red colour
12 months	When Ri4 and Ri4 < 50%	When Ri4 and Ri4 > 50%	Orange colour
24 months	When Ri3 and Ri3 < 50% and/or orange colour	When Ri3 and Ri3 > 50%	Not applicable
48 months	Ri2 and/or green colour	Not applicable	Not applicable

9. Reporting

Technical reporting must be made using terms which are understood the same way worldwide.

9.1 Definition and description of terms

Appendix 3 “Definition and description of terms” gives a list of most common terms and expression used in our profession.

10. Protection of document

Only cells subject to recording such as, dates, unit number, surface, percentage, etc. are active. All other cells are locked and masked.

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Appendix 1

Appendix 1 Guidelines for the use of the “Corrosion and Coating Integrity Inventory Form” (Informative)

Inventory Form

The inventory form is made of 11 sheets:

- The front sheet records, in a synoptic way, the main information about the installation (Name, location, age, dates, grand total measurements, conclusion of inspection, actions and recommendations, etc.)
- The 9 other sheets record: measurements, pictures, and special comments area by area
- Each sheet allows treatment of 24 items per area. The entire form allows for an installation inventory of 9 Elevations Areas and 216 Items
- The last sheet is for extended comments.

Front sheet for Unit Data record

Front sheet (Page 1/11)	
Cells	Specific explanations
Subsidiary	Self explanatory
Site	Self explanatory
Name or number	Self explanatory
Type	e.g. FSO, FPSO, Platform, jacket, etc.
Process unit, structure, or equipment	Self explanatory
Date of inspection	Self explanatory
Date of last inspection	Self explanatory
Name of Inspector	Self explanatory
Date & extent of last refurbishment	Was last paint refurbishment major overhaul or touch up?
Date of next refurbishment	As documented in maintenance programmes
Age	Self explanatory
Forecasted abandon date	Self explanatory
Conclusion	State brief and main comments regarding inspection
Actions carried out/required	Actions carried out or required if severe corrosion found
Documents required	Add any specific document required to perform inspection
Equipment required	Add any specific equipment required to perform inspection
Grand Total	Summary automatically calculated from data given in sheets 2-11

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Appendix 1

Other sheets for measurement record

Other sheets (page 2 to 11)	
Cells	Specific explanations
AREA and/or elevation	Self explanatory
Date of inspection	Self explanatory
Area Items	State the type of items evaluated (Pipes, structure, gratings, stairs, etc.)
Surface m ²	Enter the measured and/or Estimated surface of the item in m ²
% Measured	Enter for the item the % of real measurement of area on site or on drawing
% Estimated	The balance of % of estimated surface will be automatically calculated
Scaffold volume m ³	Estimate the scaffold volume necessary for 100% access to item
Pictures	All areas must be photographed with digital camera on e-mail mode. Pictures must be compiled in .doc file and N° of the picture given here
Heavy oil	Enter estimated % of surface soiled by heavy oil
Dust and/or light oil	The percentage will be automatically calculated from heavy oil soiling
% ≤ Ri2	No value to be entered. This level is considered as normal state for offshore installations. Therefore it is calculated automatically from evaluation results
≥ Ri3	Inspector must record the % of the area estimated for each degree Note: Cumulated % (Ri3+Ri4+Ri5) cannot exceed 100%
≥ Ri4	Inspector must record the % of the area estimated for each degree Note: Cumulated % (Ri3+Ri4+Ri5) cannot exceed 100%
≥ Ri5	Inspector must record the % of the area estimated for each degree Note: Cumulated % (Ri3+Ri4+Ri5) cannot exceed 100%
Comments	Write brief comment in front. If no comment, write "no comment"

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Appendix 1

Other sheets (page 2 to 11)	
Cells	Specific explanations
Colour coding	This section is to be filled in when wall thickness measurements have been carried out, which is mandatory for heavily corroded areas Colour Code mentions the corrosion severity, not the size Green $\leq$ 10% of metal loss Orange = 10% < metal loss < 50% Red = metal loss $\geq$ to 50%
Total m² of area	Automatically calculated from areas given by the inspector

Appendix 2 Pictures(informative)



Example of pictures recorded on e-mail mode (15 Ko per picture)



Location and Comments



Location and Comments



Location and Comments



Location and Comments

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Appendix 3 Pictures Definition and description of terms

Abrasive: The agent used for abrasive blast cleaning; for example, garnet, grit, shot, etc.

Absorption: The process of soaking up, or assimilation of one substance by another.

Adhesion: The bonding strength of a coating to the substrate.

Ageing: Progressive degradation of a coating.

Air Entrapment: The inclusion of air bubbles in liquid paint or a paint film.

Air Spraying: Application method by which paint is atomised by compressed air and sprayed on to the surface.

Airless Spraying: Application method by which paint is subjected to high pressure (up to 350 kg/sq.cm) and atomised by passing through a small diameter nozzle.

Ambient temperature: The room temperature or temperature of surroundings.

Anode: The corroding part of an electrochemical corrosion cell.

Anticorrosion: Generic term to qualify paints used to protect metals from corrosion.

Batch: The amount of paint produced in a single production process and identified by a number assigned by manufacturer.

Blast cleaning: Cleaning with propelled abrasives.

Bleeding: The appearance of a newly painted surface over a previously painted substrate if the two paint coatings are not compatible.

Blistering: Bubbling in coating films normally caused by osmosis or solvent entrapment.

Holding Primer (BHP): Primer applied during construction to reduce the amount of *in situ* secondary surface preparation. Not a pre-construction primer.

Blushing: Development of a milky appearance on a coating surface during drying process caused by humidity and/or from the precipitation of one or more solid components of the paint.

Breakdown of coating: Defects in the coatings like rust penetration, blistering, flaking and cracking.

Brittle failure: Cracking and/or other failure normally encountered with hard, low ductility glassy objects and films.

Brittleness: Degree of resistance to cracking or breaking during bending.

Bubbling: Coating defect, temporary or permanent, in which small bubbles of air or solvent or both are present in the applied film.

Cathode: The non-corroding part of a corrosion cell.

Cathodic Protection: Corrosion control by sacrificial anodes or impressed current.

Chalking: Formation of powder on a coated surface as a result of weathering.

Chipping: Cleaning of steel by removing paint, rust and mill scale, or other material using mechanical tools.

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Clean surface: Surface free of contamination (including non-visible contamination such as soluble salts).

Close-up Inspection: An inspection where details are within the close visual inspection range of the surveyors, i.e. normally within reach of hand.

Coating system: A number of coats separately applied, in a predetermined order, at suitable intervals to allow for drying and curing, resulting in a complete coating.

Cracking of coating: Defect with fracture of the coating in at least one coat, and often down to the substrate.

Cross Hatch Test: A method for testing adhesion of a coating, performed by a parallel series of crosshatch cuts near each other.

Curing Time: Time required after application by a coating to reach its complete properties and mechanical characteristic.

Curtaining: Special form of sagging by which the film appears locally with high thickness and with flakes similar to drape curtains.

Dew point: Temperature at which moisture condenses.

DFT: Dry film thickness. The thickness of the paint film, after drying and curing.

Discoloration: Colour change of a coating after application, normally caused by exposure to sunlight or chemical atmospheres.

Dry spray: sand-like finish due to sprayed paint particles being partially dried before reaching the surface.

Drying time: Time interval between application and final cure.

Dulling or Tarnishing: Loss of gloss of a coating.

Erosion: Gradual and irregular destruction of coating surface caused by mechanical action.

Feather edge: Tapered edge.

Finish: Term used to define indifferently the final coat in a paint system or the general aspect of a painted surface after drying.

Flaking: Detachment of a coating from the surface, in the form of flakes.

Flexibility: The degree at which a coating is able to conform to movement or deformation of its supporting surface without cracking or flaking.

Forced drying: Acceleration of drying by increasing the temperature above ambient temperature accommodated by forced air circulation.

Galvanic corrosion: Corrosion of dissimilar metals in electrical contact.

Galvanising: Anticorrosive system which consists in dipping steel, into melted zinc at a temperature of approximately 450°C.

General corrosion: Evenly distributed corrosion attack on steel surface.

Gloss: Aptitude of a painted surface to reflect the light in certain conditions.

Grit: An abrasive obtained from slag and various other materials.

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Hard rust scale: Severe general corrosion accumulated in layers adhering tightly to the steel surface.

Hardness: Resistance of a dry coating to scratching or to superficial deformation due to pressure.

Holiday: Pinhole; skip; discontinuity; voids.

Humidity: Measure of moisture content; relative humidity is the ratio of the quantity of water vapour in the air to the greatest amount possible at the given temperature. Saturated air is said to have a humidity of 100%.

Hygroscopic: Having a tendency to absorb water.

Immersion: Referring to an environment which is continually submerged in a liquid, often water.

Inter-coat contamination: Presence of foreign matter between successive coats.

Lining: Internal coating or cladding of vessels, tanks, or piping.

Local breakdown of coating: Local defects in the coatings like rust penetration, blistering, flaking and cracking.

Maintenance painting: (1) repair painting; any painting after the initial paint job; (2) all painting except that done solely for aesthetics.

Mechanical cleaning: Power tool cleaning, by means of grinding disc, wire brush or similar.

Mill scale: Oxide layer formed on steel by hot rolling.

Mist coat: Thin tack coat; thin adhesive coat. Common practice to wet an inorganic zinc layer, and allow air escape, before full build when top coating.

Orange peel: Appearance similar to orange peel that can be seen on a film applied by airless spraying due to incomplete levelling.

Osmosis: Transfer of liquid through a paint film or other membrane as the result of a solute/solvent couple.

Osmotic blistering: Formation of blisters containing liquid through osmosis.

Overall Inspection: An inspection intended to report on the overall condition of the installation and determine the extent of additional close-up inspections.

Paint system: The complete number and type of coats of a painting job. In a broader sense, surface preparation, pre-treatments, dry film thickness, and methods of application are included in the definition of a paint system.

Peeling: Disbonding of particles of a coating from substrate in the form of strips, due to loss of adhesion.

Pigments: Insoluble coloured particles dispersed in a coating material in order to define appearance, structure and functionality of the final film.

Pitting: Narrow but deep localised corrosion defect.

Pot-life: Time interval after mixing during which liquid material is usable with no difficulty.

Power Tool Preparation: Surface preparation method carried out by mechanical tools, pneumatic or electric such as abrasive discs, wire brush, sandpaper, etc.

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Preventive maintenance painting: Spot repair painting; touch-up or full coats of paint before rusting starts.

Prime coat: First coat.

Primer: General term used to define the first coat of a paint system applied to provide adhesion and/or corrosion protection.

Recoat time: Time interval required between applications of successive coats.

Roller Application: Hand application of a coat of paint using an absorbing roller on a surface.

Sags: Runs.

Sandpapering: Generic term identifying various methods used to smooth or in some cases to roughen a coating surface with abrasive paper.

Scattered breakdown of coating: Various kinds of evenly distributed defects in the coatings like rust penetration, blistering, flaking and cracking.

Shot blasting: Blast cleaning using steel shot as the abrasive.

Shrinkage: Decrease in volume during drying.

Soft coating: Defined as coatings that does not dry, but remain permanently soft.

Solvent entrapment: The encapsulation of solvent within a cured paint film.

Spot repair: Touch up; Preventative maintenance; repainting of small areas.

Spot rusting: Rusting in spot without visible failure of coating.

Stripe Coating: Painting method used before a general coat on discontinuities (weld, back, edge, corner, etc.) where it is not easy to achieve the final thickness with spray application.

Substrate: Surface to be painted; in this context carbon steel, stainless steel, galvanized steel and all surfaces that can affect the corrosion rate or can corrode.

Suspect Areas: Locations showing Substantial Corrosion and/or are considered by the inspector to be prone to rapid wastage.

Swelling: Increasing volume.

Touch-up: Operation of repair of spot damage coated surface.

Varnish, Lacquer: Non-pigmented coating material.

Weld joints: Beads of weld joining two members.

Weld slag: Amorphous deposit formed during welding.

Weld spatter: Beads of metal left adjoining a weld.

Wet Film Thickness: The thickness of paint film just applied and before evaporation of the volatile part.

Wrinkling: Coating defect due to a non-homogeneous solidification of the paint film with wrinkling of the surface coat.

Zinc rich coating: Products containing > 86% (by weight) metallic zinc in the dry film.

Zinc silicate: Inorganic zinc coating.



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Appendix 4

Appendix 4 Corrosion inspection inventory form for offshore installation (Excel file) Corrosion & coating integrity Inventory Sheet.xls

(Informative)

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Appendix 4

	SUBSIDIARY:	DEPARTMENT :	INSPECTOR(S) :	Page: 1/11
CORROSION AND COATING INTEGRITY INVENTORY FORM FOR OFFSHORE INSTALLATIONS				
Process U, Str, equipment :	Type (FSD, FPSO, Platform, Jacket etc...)	Age:	Abandon Date:	
	PROCESS (GasOLW Injection etc..)	Date of inspection	Date of last inspection	Estimated Date of next refurbishment
		Area(s) inspected	Area(s) Inspected	Area(s) Refurbished
		Area(s) inspected	Area(s) Inspected	Area(s) to be Rel refurbished
ACTIONS MADE WITH REGARD TO SEVERE CORROSION FOUND:				

Documents required to carry inspection:		Equipments required to carry inspection:					
Work Permit, Corrosion Insp. Inventory Form + Associate guide line, Previous relevant inspection data (if any), SSQ 462B / 1 to 6		Specific safety equipment and instructions Binoculars, Digital Camera, DFT Measurement device, Scraper and Hammer (Brass type), portable UT meter Chalk , Marker, Laser measurement device and Decimeter , Pen and Notebook.					
		STATED CONDITION AT INSPECTION					
		Measurement		Corrosion degree break down for the whole UNIT			
		Surface	Access to area %	Pitting	Cleanliness in %	COLOUR CODE	Comments
		MF	Measured Estimated	If	Heavy Oil Light oil	= or < R12 = or > R12	NO COMMENTS COMMENTS:
GRAND TOTAL							

[illegible]

[illegible]

[illegible]

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Appendix 4

[illegible]

[illegible]

[illegible]

 SUBSIDIARY:	DEPARTMENT:	INSPECTOR(S):	PAGE 9/11	Process Unit, Structure, equipment		Date of Inspection		
				STATED CONDITION AT INSPECTION				
				NO COMMENTS	COMMENTS			
AREA + Elevation	Surface	Access to area %	Scuff Volume for 100% access	Picture	Clearness in %	Corrosion degree evaluation (As per ISO 4628-3) Note: Cumulative % (R03+R04+R05) cannot exceed 100%.	Date of next inspection for this level	Date of next refurbishment for this level
	Measured	Estimated	M²	IF	Dust and/or Light Oil	Heavy Oil	Colour Code	Comments
Area Items	0	0	0	0	0	0	0	0
Total M² of area	0	0	0	0	0	0	0	0
Total in M²	0	0	0	0	0	0	0	0

[illegible]

