

TECHNICAL SPECIFICATION

PROTECTIVE COATINGS FOR OFFSHORE FACILITIES

DEP 70.48.11.30-Gen.

December 2007

DESIGN AND ENGINEERING PRACTICE



This document is restricted. Neither the whole nor any part of this document may be disclosed to any third party without the prior written consent of Shell Global Solutions International B.V., The Netherlands. The copyright of this document is vested in this company. All rights reserved. Neither the whole nor any part of this document may be reproduced, stored in any retrieval system or transmitted in any form or by any means (electronic, mechanical, reprographic, recording or otherwise) without the prior written consent of the copyright owner.

PREFACE

DEPs (Design and Engineering Practice) publications reflect the views, at the time of publication, of:

Shell Global Solutions International B.V. (Shell GSI)

and/or

Shell International Exploration and Production B.V. (SIEP)

and/or

other Shell Service Companies.

They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Shell Operating Units. Where appropriate they are based on, or reference is made to, international, regional, national and industry standards.

The objective is to set the recommended standard for good design and engineering practice applied by Shell companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to Shell companies for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual Operating Units to adapt the information set forth in DEPs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use DEPs they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will expect them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the DEPs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

The right to use DEPs is granted by Shell GSI, in most cases under Service Agreements primarily with Shell companies and other companies receiving technical advice and services from Shell GSI or another Shell Service Company. Consequently, three categories of users of DEPs can be distinguished:

- 1) Operating Units having a Service Agreement with Shell GSI or other Shell Service Company. The use of DEPs by these Operating Units is subject in all respects to the terms and conditions of the relevant Service Agreement.
- 2) Other parties who are authorized to use DEPs subject to appropriate contractual arrangements (whether as part of a Service Agreement or otherwise).
- 3) Contractors/subcontractors and Manufacturers/Suppliers under a contract with users referred to under 1) or 2) which requires that tenders for projects, materials supplied or - generally - work performed on behalf of the said users comply with the relevant standards.

Subject to any particular terms and conditions as may be set forth in specific agreements with users, Shell GSI disclaims any liability of whatsoever nature for any damage (including injury or death) suffered by any company or person whomsoever as a result of or in connection with the use, application or implementation of any DEP, combination of DEPs or any part thereof, even if it is wholly or partly caused by negligence on the part of Shell GSI or other Shell Service Company. The benefit of this disclaimer shall inure in all respects to Shell GSI and/or any Shell Service Company, or companies affiliated to these companies, that may issue DEPs or require the use of DEPs.

Without prejudice to any specific terms in respect of confidentiality under relevant contractual arrangements, DEPs shall not, without the prior written consent of Shell GSI, be disclosed by users to any company or person whomsoever and the DEPs shall be used exclusively for the purpose for which they have been provided to the user. They shall be returned after use, including any copies which shall only be made by users with the express prior written consent of Shell GSI. The copyright of DEPs vests in Shell GSI. Users shall arrange for DEPs to be held in safe custody and Shell GSI may at any time require information satisfactory to them in order to ascertain how users implement this requirement.

All administrative queries should be directed to the DEP Administrator in Shell GSI.

TABLE OF CONTENTS

PART I	INTRODUCTION	4
1.1	SCOPE.....	4
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	5
1.3	DEFINITIONS	5
1.4	CROSS-REFERENCES	6
1.5	SUMMARY OF MAIN CHANGES.....	6
1.6	COMMENTS ON THIS DEP	7
PART II	SPECIFICATION	8
1.	GENERAL	8
1.1	WARRANTY.....	8
1.2	PAINTING CONTRACTOR RESPONSIBILITY	9
1.3	SURFACE PREPARATION	11
1.4	COATING APPLICATION.....	16
1.6	QUALITY ASSURANCE AND CONTROL.....	18
2.	COATING MATERIALS AND QUALIFICATION.....	25
2.1	COATING MATERIALS	25
2.2	COATING QUALIFICATION.....	27
3.	NEW CONSTRUCTION AND MODIFICATIONS	35
3.1	GENERAL	35
3.2	COATING SURFACES AND SYSTEM REQUIREMENTS	35
3.3	PASSIVE FIRE PROOFING	40
3.4	FINISHING COLOUR SCHEDULE.....	40
4.	MAINTENANCE	41
4.1	GENERAL	41
4.2	COATING SURFACES AND SYSTEM REQUIREMENTS	42
4.3	PASSIVE FIREPROOFING	44
4.4	FINISHING COLOUR SCHEDULE.....	44
4.5	TYPES OF MAINTENANCE	44
4.6	CONDITION OF EXTERNAL COATING BARRIER	45
5.	VISIBLE CORROSION DEGREES	48
PART III	REFERENCES	49

APPENDICES

APPENDIX A	WAVE TANK/CONDENSATION TESTING OF COATINGS FOR SEAWATER BALLAST AND VOID TANKS	54
APPENDIX B	EXAMPLE OF AN INSPECTION AND TESTING PLAN (ITP) FOR COATING WORK	59
APPENDIX C	FINISHING COLOUR SCHEDULE	62

PART I INTRODUCTION

1.1 SCOPE

1.1.1 General

This DEP specifies requirements and gives recommendations for new construction and maintenance painting of facilities to be exposed to an offshore environment. It includes the requirements with respect to protection against corrosion of both ferrous and non-ferrous metals. Typical examples are fixed-leg production platforms, tension leg platforms (TLP), semi-submersibles, SBMs, offloading and floating production storage vessels (FPSO) and facilities at the coastline such as jetties and quays.

This DEP is a performance-based coating standard and is applicable to painting and coating, for new construction, modifications and maintenance of offshore facilities. All paint and coating systems to be used shall meet the qualification requirements and the minimum coating system requirements as specified in this DEP.

This DEP shall be quoted as part of any contractual document where coating work is involved.

It is the responsibility of the Principal to carry out the review and acceptance of the project and quality plan in order to ensure that the painting work is executed in accordance with this DEP.

To achieve a long term service life of the protective coating system, full attention shall be given to the quality of surface preparation and application of the coating system. Quality assurance, quality control and the professional skill of the painters are essential for this process.

For installations with a design life greater than 25 years, unmanned offshore installations and parts difficult to access for maintenance after installation, special 'life time' coatings such as thermal sprayed aluminium shall be considered in consultation with the Materials and Corrosion discipline.

Topics of a general nature regarding painting and coating such as the supply of labour, equipment, personnel safety gear or the use of sub-contractors have not been included in this DEP. They should be included under the General Terms and Conditions of a contract.

This DEP is a revision of the DEP of the same number dated January 2007; see (1.5) regarding the main changes.

1.1.2 Exclusions

This DEP is not applicable to:

- a) Subsea pipelines;
- b) Risers of offshore pipelines being coated with a special coating as specified in DEP 31.40.30.36-Gen. However, if risers are not fully coated with a special coating, the parts of risers above the special riser coating shall be painted in accordance with this DEP;
- c) Temporary construction items to which only a zinc rich primer should be applied;
- d) Internal coatings of tubing or drill pipes;
- e) Fusion bonded powder coatings;
- f) Equipment and components with a (continuous) service temperature below $-100\text{ }^{\circ}\text{C}$ and above $450\text{ }^{\circ}\text{C}$;
- g) Internal coating of equipment and tanks with the exception of the storage tanks specified in this DEP. However, guidelines are given for the selection of coatings for those tanks and equipment in Part II-2.1.2.

- h) Painting and coating of onshore facilities, special riser coatings and line pipe coatings; these are all covered by other DEPs.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them.

This DEP is intended for use in offshore exploration and production facilities and, where specified, other marine facilities.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regard to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent, representative or consultant authorised to act for, and on behalf of the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions and abbreviations

Abrasive blast cleaning	The impingement of a high-kinetic-energy stream of blast cleaning abrasive onto the surface to be prepared.
Anchor profile	Contour of a blast-cleaned surface on a plane perpendicular to the surface.
Application	Application, drying and/or curing of a coating layer
Atmospheric Zone	That part of an offshore facility structure 6 m above HAT.
Dew point	The temperature of a given air/water-vapour mixture at which, under atmospheric pressure, condensation starts.
DFT	Dry Film Thickness; the thickness of the dried or cured paint or coating film.
FPSO	Floating Production Storage Offshore
HAT	Highest Astronomical Tide level
Hot dip galvanizing	Formation of a coating of zinc and/or zinc-iron alloys produced by dipping prepared steel in molten metallic zinc.

HSE	Health, Safety and Environment
LAT	Lowest Astronomical Tide level
MSDS	Material Safety Data Sheet
NDFT	Nominal (specified) Dry Film Thickness
Offshore facilities	Facilities installed in open sea and the coastal waters.
Wetted and intermittently-wetted parts	Parts in the tidal and splash zone and parts that are intermittently wetted by wave and spray action up to 6 m above HAT
Pore	Pinhole or very small size defect in a coating system, penetrating the entire thickness of the coating.
Pot life	The time interval, after mixing of paint or coating materials, during which the mixture can be applied without difficulty or loss of final coating quality.
SBM	Single Buoy Mooring
Splash zone	Zone from 3 m below LAT up to 2 m above HAT.
Submerged zone	Zone below the splash zone (i.e. permanently submerged)
Thinner	Volatile liquid added to lower the viscosity of the paint to ease application
TSA	Thermally Sprayed Aluminium
VOC	Volatile Organic Compound.
WFT	Wet Film Thickness; the thickness of the uncured or wet paint or coating film.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets.

Other documents referenced by this DEP are listed in (Part III).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated January 2007. The following are the main, non-editorial changes.

Old section	New section	Change
1.2.6	1.2.6	Increased frequency of compressed air checks.
1.3.2	1.3.2	Added temperature limitation when washing austenitic stainless steels.
1.3.3.2	1.3.3.2	Added recommendation of SA 3 for internal coating preparation.
1.6.6	1.6.6	Added reference to ASTM E 337.
2.1.3	2.1.3	Added system code W for submerged service.
2.1.7	2.1.7	Added recommendation to blast clean before galvanising structural elements.
2.1.8	2.1.8	Deleted option of organic coating to maintain or repair a TSA coating.
3.2.1	3.2.1	Changed temperature from 60 °C to 50 °C for certain applications.
3.2.6	3.2.6	Changed temperature from 60 °C to 50 °C for certain applications. Added Note 10.
4.2.1	4.2.1	Changed temperature from 60 °C to 50 °C for certain applications.
4.2.2	4.2.2	Table modified substantially.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the DEP Administrator at web address: standards@shell.com. Shell staff may also post comments on this DEP on the Surface Global Network (SGN) under the Standards folder.

PART II SPECIFICATION

1. GENERAL

1.1 WARRANTY

1.1.1 General

Contractors undertaking painting and/or coating work which is to be carried out in accordance with this DEP shall guarantee the quality of their coating work.

Before any painting or coating work shall commence, the warranty period and associated coating condition shall be agreed with the Principal. A warranty period of five (5) years, at the coating condition specified in (II-1.1.2) below, is required for liquid coating systems.

For thermally sprayed aluminium coatings, a minimum warranty of ten (10) years is required. Such coating systems are considered low maintenance coatings for the lifetime of the facility. See also (II-1.1.2) below.

The coating systems to be used in accordance with this specification shall be suitable for a marine environment (C5-M as specified in ISO 12944-2). The expected service life of the organic liquid-coating systems until the first maintenance painting is 15 years and 30 years for thermally sprayed aluminium coatings.

The use of coating systems as described in this DEP and approved by the Principal shall not affect the warranties to be agreed by the contract parties involved.

If reference areas are proposed and agreed, they shall be in accordance with requirements as specified in ISO 12944-7:1998 Clause 7 and ISO 12944-8:1998 Table 1, No. 1.13.

Surfaces that have deteriorated beyond the specified level of breakdown within the warranty period shall be repaired by the Contractor and he/she shall bear the cost of materials, equipment, labour, onshore transport, onshore lodging and onshore storage necessary for the repair.

Only surfaces that have suffered from mechanical damage or chemical spillage as a result of operational activities fall outside this warranty.

Initial acceptance of any new coating work by the Principal will not relieve the Contractor of his obligations under this section until the final inspection has been carried out and acceptance of the completed work has been agreed in writing.

An end-of-warranty inspection shall be carried out by a party to be agreed between the Contractor and the Principal before expiry of the period of a warranty agreement regarding the coating work.

In case of a dispute on the condition of the coating work that has been inspected, an agreed independent expertise body shall conduct a review inspection at the Contractor's cost. Both the Principal and the Contractor shall accept the findings of the inspection by this independent consultant.

1.1.2 New construction and large scale maintenance

Five years after the acceptance date of the completed coating work (10 years for thermally sprayed coating systems):

1. The degree of rusting shall be in accordance with ISO 4628-3 and shall not be worse than Ri 2 (0.5 % rusting) for new construction and large-scale maintenance. This degree of rusting shall only be allowed in localised areas and not be scattered over the total surface area coated;
2. For thermally sprayed coating systems, the acceptable degree of rusting shall be in accordance with ISO 4628-3 and shall not be worse than Ri 0 (0 % rusting).

3. The quality of adhesion between the coating system and the steel substrate, and of the adhesion between the coating layers, shall not be less than 70 % of the values specified in sub-section (II-1.6.8.5);
4. Visual cracking, mud-cracking or flaking of the coating systems is not allowed. Full attention shall be given to areas such as corners where overlaps are difficult to avoid;
5. Blistering is not allowed;
6. No conspicuous discolouration or excessive loss of gloss shall be observed in the topcoats specified for the atmospheric zone. The topcoat on steel floors is not included but the topside of the helideck shall be included. The requirements on colour retention as described in (II-2.2.7) shall be observed.

1.1.3 Spot repair

For spot repair of coating systems no longer under warranty, the applicable duration of the warranty period shall be two years after completion of the applied repair coating. The other requirements of (II-1.1.2) shall be adhered to.

1.2 PAINTING CONTRACTOR RESPONSIBILITY

1.2.1 General

The Contractor, in addition to his responsibilities under the general conditions of the contract, is responsible for the quality of the work which shall be performed in strict accordance with this DEP and all other relevant documents, such as site regulations, safety rules and requirements, product data sheets, referenced standards and codes.

The Contractor is fully responsible for all Quality Assurance and Control activities.

The Contractor shall schedule a pre-job meeting to ensure that job and quality requirements are fully understood. Attendees shall include a representative of the Principal, the Contractor's job superintendent and coating supervisor and the coating inspector, and should also include the coating Manufacturer's representative.

For all coatings work, the Contractor shall submit appropriate work plans and a quality plan for implementing the requirements of this DEP for review by the Principal.

Copies of this DEP, the work plans and the quality plan shall be made available to the coating Contractor's representative at the site and she/he shall be familiar with their contents.

The obligations of the Contractor are explained in more detail in (II-1.6).

1.2.2 Safety and Environment

The Contractor shall be responsible for all aspects of safety and personal protection related to the painting work to be done. Environmental regulations and rules shall be met.

Safe working is of the greatest importance particularly whilst working in confined spaces such as tanks and vessels.

All personnel shall be provided with approved personnel protection e.g. protective clothing, safety glasses, safety shoes, hard hats, goggles, respirators, earplugs, fresh-air-fed hood and any other necessary safety equipment. All safety equipment shall be maintained to a good working condition.

Adequate warning signs shall be prominently displayed at all access points to areas where abrasive blasting and painting is in progress.

Handling and disposal of hazardous waste resulting from the Contractor's painting activities shall be in accordance with regulations and specific contract requirements. Moreover, the Principal's regulations on chemical management or banned materials shall also be strictly adhered to.

1.2.3 Hazardous coating components

The Contractor shall ensure that all layers of a coating system and all blasting materials comply with any local and/or regional standards or regulations on banned materials such as lead, chromate, crystalline silica, or coal tar. The Principal's regulations on chemical management or banned materials shall be strictly adhered to. Any coating system shall fully comply with any local and/or regional air quality or Volatile Organic Compounds (VOC) levels or emission standards or regulations.

Coatings shall contain a maximum 0.1 % monomeric isocyanate at the time of painting. Before commencing any surface preparation, the existing coating system shall be checked for hazardous components. The Principal's or local regulations shall be consulted with regard to the safe handling and disposal of such coating systems.

1.2.4 Personnel

Only professional skilled blasters and painters shall be used. Blasters and painters working on every painting job should be certified in accordance with a scheme approved by the Principal. A certified foreman should supervise the blasters and painters. Before any work is commenced or a contract is awarded, the certificates should be submitted to the Principal. Certifying bodies shall comply with ISO 17024.

A skilled foreman shall supervise the blasters and painters.

If not certified, the skill of all proposed blasting and painting personnel shall be verified before commencing any painting or coating work. The blasters shall each blast a representative structural steel part (min. 4 m²) using the equipment and blasting material to be used for the actual surface cleaning. The painters shall each coat a representative structural steel part (min. 4 m²) with an agreed coating system. The test area shall be fully coated with all coats of the agreed coating system using the tools and equipment to be used for the actual coating work. The painted test area shall be maintained for the duration of the project as a reference.

The Principal will witness all tests.

1.2.5 Protection of equipment and structural members

The painting Contractor shall protect all equipment, structures and any other areas from mechanical damage, environmental damage, blockage or obstruction, damage caused by over blasting, dripping paint, paint splashes and overspray.

1.2.6 Blasting and spraying equipment

The Contractor shall demonstrate that blasting and spraying equipment to be used is in good condition and well maintained. Blasting and painting equipment shall fully comply with any local and/or regional regulation.

The compressed air shall be free of water and oil. Adequate separators and traps shall be provided, installed in the coolest part of the system. The presence of oil and water shall be determined in accordance with ASTM D 4285 at least two (2) times per twelve (12) hours and following every compressor start-up. In no case shall the temperature of the compressed air be allowed to exceed 110 °C.

Blasting nozzles shall be discarded and replaced when the nozzle diameter has increased through wear by more than 50 % of the original diameter.

Blasting equipment, its operators and the equipment being blasted shall be properly earthed to prevent the occurrence of electrostatic discharges.

Abrasive blast cleaning equipment shall be an intrinsically safe construction and equipped with a remote shut-off valve triggered by the release of a dead man's handle at the blasting nozzle.

Where air-operated equipment is used, the operator's hood or headgear shall be positive pressure fed by clean, cool air supplied through a filter, to prevent blast cleaning residues from being inhaled.

When working in confined spaces, adequate ventilation and spark-proof lighting shall be used. As a minimum, ventilation shall ensure sufficient air changes such that the threshold limit value (TLV) of the various coating materials in use shall not be exceeded.

1.2.7 Access

Access for coating work should be constructed so as to provide easy and sufficient access for surface preparation, painting and inspection of all surfaces. Scaffolding shall be constructed in accordance with local regulations and the requirements of the Principal or as otherwise agreed with the Principal.

1.2.8 Handling and coated parts/components

To minimise the risk of damage, no lifting, transportation, erection or fabrication operations shall be done before the paint has been fully dried and/or cured. Welding shall not be carried out on the external surfaces of internally coated tanks or vessels. Canvas or nylon slings shall be used for lifting, and wooden blocks shall be applied during transportation.

1.2.9 Storage protection

The Contractor shall supply all the necessary protection when prefabricated coated steel or coated steel for climate controlled areas has to be stored in the open air prior to erection, to avoid premature failure of the applied paint layers.

1.2.10 Weather protection

Unless otherwise agreed, the Contractor shall supply all the weather protection, scaffolding and any other equipment necessary to ensure that the work is carried out in accordance with this DEP and the agreed programme. This includes, for example, heating and air-drying equipment.

1.3 SURFACE PREPARATION

1.3.1 General

All edges shall be ground to a minimum radius of 2 mm or as otherwise agreed with the Principal. Flame cut areas and weld spatter shall have been ground flush. If this is not the case, the Principal shall be informed, and corrective action shall be taken prior to the application of the first layer of the coating system.

Cleaning of surfaces shall, as a general rule, be done by dry blast cleaning (hereafter referred to as blast cleaning) as outlined in ISO 8504-2. The surface profile and the anchor pattern shall be in accordance with the requirements in this DEP.

Fabrication should be complete before surface preparation begins. However, surface preparation and application of the base layers (prefabricated-system comprising of the primer and sealercoat) of the specified coating system before assembly will be allowed.

Prefabrication primers are allowed. However, after assembly these primers shall be removed by blasting and the surface shall be blasted to the initial specified surface cleanliness unless otherwise agreed with the Principal.

Alternative surface cleaning is only acceptable after written approval of the Principal.

Alternative surface preparation such as power tool cleaning is not acceptable under any circumstances for areas that will be difficult to access in service. Such areas include those exposed to water, steelwork to be insulated or to be buried and the internal surfaces of equipment and tanks.

Stainless steel surfaces shall not be treated with carbon steel cleaning tools or any tools previously used on carbon steel.

1.3.2 Pre-cleaning

Prior to the blast cleaning and/or prior to any painting operation, the surface shall be free of any contamination and any excessive rust scale shall be removed. Excessive salt contamination of parts that have been stored in and exposed to the open air should be removed prior to blast cleaning. Salt contamination shall be assessed as specified in (II-1.6.7.2).

All boltholes shall be solvent cleaned prior to the commencement of blast cleaning. Solvent cleaning shall be carried out in accordance with SSPC SP1.

When emulsion or detergent type degreasers or Teepol/fresh water solutions are used, this treatment shall be followed by copious rinsing using fresh and clean potable water or pressure water/steam wash. All degreasers shall be proven to be biologically degradable.

Maintenance coating projects should always start with high pressure steam/detergent cleaning to remove dirt, grease and/or salt deposits. Such washing shall also be carried out between coats where the surface has become contaminated following a storm or as a result of an extended overcoating interval. The requirements regarding soluble salts and other surface contaminants in this DEP shall be adhered to at all times.

All welded areas and appurtenances shall be given special attention for removal of welding flux in crevices. Welding spatter, slivers, laminations and underlying mill scale not removed during fabrication and exposed before and during blast cleaning operations shall be removed by the best mechanical means. Edges shall be smoothed or rendered flush.

Where rectification has been necessary on blast-cleaned surfaces, the dressed areas shall be pre-cleaned as initially specified.

For the treatment of stainless steels, attention shall be given to the level of free halides in materials to be used. Particular care shall be taken with dry areas, which are not self-draining, so that water collected is removed and not allowed to evaporate leaving salt deposits on the surface. If un-coated austenitic type of stainless steels has to be hot-water cleaned, the temperature of the water shall be not higher than 60 °C.

Detergents with a pH > 9 shall not be used on aluminium substrates.

1.3.3 Cleaning of surfaces

1.3.3.1 General

To prevent dust and abrasive contamination, blast cleaning shall not be done close to painting operations or wet coated surfaces. Environmental restrictions shall be observed. Rough grit blasting will be allowed during the night providing that the surface is subsequently blasted under good light conditions to the specified standard.

Blast cleaned steel surfaces shall not be touched by bare hands.

If the surface being cleaned lies adjacent to a coated surface, which is not to be repaired, the blast cleaning shall overlap the coated surface by at least 50 mm. The edges of the existing coating system shall be feathered. The remainder of the existing coated surface shall be properly protected with shields or screens to prevent any over blast damage.

No acid washes, cleaning solvents or other chemical treatments shall be used on metal surfaces after they have been blast cleaned. This restriction includes inhibitive washes intended to prevent rusting.

The surface profile and the anchor pattern for carbon steel and low alloy steels to be coated with liquid organic coatings shall be in accordance with the written recommendations of the paint Manufacturer. When not specified by the paint Manufacturer or when otherwise specified in this DEP, the surface profile shall be between 40 µm and 70 µm. The anchor pattern shall have a sharp profile.

If stainless steel, galvanised or non-ferrous metal surfaces are to be painted then blast cleaning shall be carried out by smooth sweep blasting, using a fine non-iron containing abrasive (e.g. aluminium oxide). On galvanised surfaces, the zinc layer shall not be damaged; a smooth uniform surface roughness shall be achieved. No defects such as break through or crisping of the zinc layer shall occur. Surface roughness shall be in the range of 20 µm to 30 µm or shall be agreed with the paint Manufacturer.

If approved by the Principal, abrading with sandpaper or light grinding with a suitable (flexible) disc may be used for surface preparation where sweep blasting is impossible. In addition, when aluminium or galvanised components have to be painted, zinc or aluminium corrosion products (white rust) and/or rust present shall be removed.

For carbon steel, low alloy steels and stainless steels to be coated with Thermally Sprayed Aluminium, the surface profile shall be between 70 µm and 110 µm.

The requirements for materials to be used for surface treatments are specified in (II-1.3.2).

Where rectification has been necessary on blast-cleaned surfaces, the dressed areas shall be re-blasted to the initially specified surface cleanliness.

For quality assurance and control requirements refer to (II-1.6).

1.3.3.2 New construction and modifications

The surfaces of carbon and low alloy steelwork for new construction and modifications to existing installations shall be blast-cleaned to the visual standard of Sa 2½ in accordance with ISO 8501-1 at the time of coating. However, for internal coating of equipment, the more stringent SA 3 should be applied.

In addition to the requirements of this ISO standard, blasted-cleaned carbon steel surfaces shall be tested to be free of the presence of mill scale. Particular attention shall be given to shop blasted steel work (i.e. blast cleaning using wheel blast machines).

The surface preparation for touch-up painting of welds (including field welds) and corroded or chemically polluted or damaged areas shall be by blast cleaning (e.g. vacuum blasting). Abrading is acceptable for the repair of damaged coating and areas other than described above.

1.3.3.3 Maintenance

Maintenance painting should be organized and carried out in accordance with the requirements in this DEP. Surface preparation requirements for maintenance are specified in more detail in (II-4.5).

To carry out proper maintenance, all parts of a facility should be made accessible for maintenance painting operations in consultation with the Principal. This should include the removal of insulation and U-bolts, and the lifting of piping from their supports, as necessary.

1.3.4 Abrasives

1.3.4.1 International standards and characteristics of abrasives

Abrasives for use in blast cleaning steels shall be in accordance with ISO 8504-2 and Table 1. Test methods shall be in accordance with the tests specified in ISO 11127. Each batch of abrasive should be tested to check that the abrasive meets the requirements as specified in the relevant ISO standard.

The conductivity of abrasives to be used for stainless steels shall be a maximum of 150 µS/cm. The Principal shall approve the use of alternative abrasive materials.

Table 1 Abrasives specification

Type	Generic Name	Characteristics	Standard
Metallic	Iron grit	> 1.7 % carbon	ISO 11124-2
	Steel grit	0.8 % to 1.2 % carbon	ISO 11124-3
Natural mineral	Staurolite	Iron/aluminium silicate	ISO 11126-9
	Specular haematite	Crystalline Fe ₂ O ₃	
	Garnet	Calcium iron silicate	ISO 11126-10
Synthetic mineral	Coal slag	Aluminium silicate	ISO 11126-4
	Aluminum oxide	Crystalline corundum	ISO 11126-7

1.3.4.2 Selection of abrasives

There is a wide variation in performance between the products within a given generic class of abrasives. Surface anchor profile is directly proportional to the abrasive particle size (the larger the abrasive particle size, the deeper the profile). Cleaning rate is inversely proportional to the abrasive particle size (the larger the abrasive particle size, the slower the cleaning rate). A balanced mixture of particle sizes will produce the optimum level of cleanliness, cleaning rate and surface profile.

Steel or iron grit is commonly used as recyclable abrasives. In general, when steel shot is used, it shall be used together with steel grit and approved by the Principal.

The abrasives shall be free from oil, grease, moisture, chloride contamination etc.

1.3.5 Grades of surface finish

The recognised surface finish grades are summarised in Table 2.

Table 2 Surface finish grades

Surface finish grade	ISO 8501	SSPC	NACE
White metal	Sa 3	SP-5	1
Near-white metal	Sa 2½	SP-10	2
Sweep blast cleaning	Sa 1	SP-7	4
Solvent cleaning	-	SP-1	-
Power tool cleaning	St 3	SP-3	
Power tool cleaning to bare metal	-	SP-11	-
Water jetting	-	SP-12	5
Wet abrasive blasting	-	TR 2	6G198

1.3.6 Removal of residual salts from pitted areas

Where pitting corrosion has been located, pressure water/steam wash with fresh water shall be performed after the initial abrasive blasting. The surface shall be left for 30 min before re-blasting and priming. Should "rust-back" or black-spotting occur, the pressure wash shall be repeated to remove the residual salts residing in the micro pits.

1.3.7 Alternative Methods of Surface Cleaning

1.3.7.1 General

Alternative surface cleaning is only acceptable after written approval of the Principal but the restrictions specified in (II-1.3.1) shall be adhered to.

Alternative primers such as surface tolerant primers may be required for alternative methods of surface cleaning. These shall be in accordance with the paint Manufacturer's recommendations. Alternative primers need the approval of the Principal.

1.3.7.2 Wet abrasive blasting

Wet abrasive blast cleaning techniques may be used to avoid dust or in cases where fire and/or explosion risks are present. The cleaned surface should be washed off immediately after blast cleaning using fresh water. Corrosion inhibitors should not be used or only after written approval of the Principal. Corrosion inhibitor such as mass fraction 0.3 % sodium nitrite with mass fraction 1.2 % ammonium phosphate may be used to prevent flush rust, but Chromate inhibitors shall not be used. Corrosion inhibitor shall not be discarded into the sea. The paint Manufacturer shall approve the use of any inhibitor and the method for removing inhibitor residues before painting.

The cleaned surface shall be dry at the time of painting. Particular care shall be taken to dry areas which are not self-draining, so that water collected is removed.

1.3.7.3 Water Jetting

High-pressure and ultrahigh-pressure water jetting may be used where abrasive blasting is not permitted because of the risk of damage to process equipment. Water jetting is restricted to maintenance painting. It is a hazardous operation and requires the use of well-trained, experienced operators.

Where black spots occur in pits or other surface defects, the surface shall be cleaned again at higher pressure to remove the residual salts.

Corrosion inhibitors should not be used or only after written approval of the Principal. Corrosion inhibitor such as mass fraction 0.3 % sodium nitrite with mass fraction 1.2 % ammonium phosphate may be used to prevent rust flash, but Chromate inhibitors shall not be used. Corrosion inhibitor shall not be discarded into the sea. The paint Manufacturer shall approve the use of any inhibitor and the method for removing inhibitor residues before painting.

The cleaned surface shall be thoroughly dry at the time of painting. Particular care shall be taken to dry areas which are not self-draining, so that water collected is removed.

1.3.7.4 Centrifugal Abrasive Blasting

A portable blasting machine using recyclable steel abrasives may be used to prepare steel decks and tank floors.

1.3.7.5 Vacuum Blasting

Vacuum blasting may be used for spot repair of damaged or corroded areas. It may be used in the locations where open abrasive blasting is not permitted or desirable.

1.3.7.6 Power-tool Cleaning

Power-tool cleaning should be confined to minor areas.

Unless otherwise specified it shall be carried out in accordance with the requirements of ISO 8504-3. Power-tool cleaning (grinding) to bare metal shall be done in accordance with SSPC SP11.

If power-tool cleaning is not feasible, the surface cleanliness shall, as a minimum, meet the visual standard PSt 3 in accordance with ISO 8501-2 at the time of coating. Care shall be taken to ensure that power-tool cleaning does not polish the steel surface. Hand-tool cleaning is permitted prior to power-tool cleaning.

If the surface being prepared lies adjacent to a coated surface, the power tool cleaning shall overlap the coated surface by at least 25 mm and the coated surface shall be feathered.

1.4 COATING APPLICATION

1.4.1 General

In general the requirements for the coating systems in this DEP cover their application to surfaces prepared by dry blast cleaning.

The Manufacturer's product data sheets and specifications for mixing, application and curing shall be considered an integral part of this DEP. The Contractor shall be responsible for obtaining the product and safety data sheets of each material from the Manufacturer.

All coating systems shall be applied in accordance with this DEP and the paint Manufacturer's instructions and data sheets. Any conflicting requirements shall be brought to the attention of the Principal.

Zinc rich primers shall be applied over abrasive blast cleaned carbon and low alloy steel surfaces only.

Paints containing metallic zinc shall never be applied, over-sprayed or dripped onto stainless steel components.

To ensure that only correctly blasted surfaces are coated, a minimum of 100 mm around the edges of prepared areas shall be left uncoated, unless adjoining a coated surface. If they adjoin a coated surface, the connection to the existing paint film shall be made as described in this section.

In cases where the Principal has delivered an object to the Contractor in order to be painted, the Principal will inform the Contractor about the layers of coating which have already been applied. The Contractor shall complete the required system in accordance with this DEP. No coating shall be applied within 50 mm to areas that need to be welded later.

For quality assurance and control refer to (II-1.6).

1.4.2 Mixing and thinning

All paint spraying equipment including mixers shall be thoroughly cleaned before the mixing of new materials. All coating materials shall be mixed and thoroughly stirred in accordance with the instructions of the paint Manufacturer. Sufficient agitation to maintain good mixing shall be applied until the product is used. If air is entrapped in the product during mixing/stirring, sufficient time should be allowed for the air bubbles to escape before application.

Only thinners specified by the paint Manufacturer shall be used.

1.4.3 Compatibility with existing coating systems

Before any painting work is commenced, the compatibility with existing coating systems or layers shall be checked. The paint Manufacturer shall be consulted. If there is any doubt about compatibility, the patch test in accordance with ASTM D 5064 shall be conducted to evaluate the interfacial adhesion. For new construction, modifications and areas under renovation, coating layers should be over-coated only with products made by the same Manufacturer

1.4.4 Overcoating

Coatings shall be dried and cured in accordance with the paint Manufacturer's recommendations, prior to over-coating. Before over-coating, over-runs, drips and smears shall be removed and any coating damage or imperfection shall be repaired. If the DFT does not meet the requirements of this DEP, corrective action shall be taken.

If a zinc primer is specified in coating systems, it shall be over-coated as soon as possible but only after sufficient cure if the primer is an inorganic zinc primer. The paint Manufacturer's maximum over-coating times shall not be exceeded.

Zinc salts (white rust) that have formed during the intervening period shall be removed in accordance with the paint Manufacturer's instructions prior to over-coating.

1.4.5 Spray application

Spraying is the preferred method of application. Lines and spray equipment shall be thoroughly cleaned with the paint Manufacturer's recommended cleaner before the addition of new coating materials. The painting Contractor, as recommended by the paint Manufacturer, shall supply a complete range of tips with varying spray angles and sizes. The spray pressure shall be uniform and the spray pattern smooth.

1.4.6 Brush application

Provided that the paint Manufacturer confirms that the coating material is suitable, brush application may be used under the following circumstances:

- a) Maintenance operations;
- b) In those cases where the Principal considers that spray application may affect other plant, equipment, property or personnel in or near the work site;
- c) For "spot repair", stripe coating or other irregular surfaces and small bore parts not suitable for spray application;
- d) Where indicated by environmental considerations.

Coatings applied by brush shall be smooth and even.

1.4.7 Roller application

Roller application shall only be allowed on steel floors and panels inside climate-controlled areas. Rollers shall be of good quality to ensure uniformity of the applied coating.

1.4.8 Stripe coat

Before spray application of each coat, irregular surfaces such as sharp edges, welds, small brackets, interstices etc. shall be stripe-coated, usually by brush, to ensure the specified film thickness is provided. Stripe coating of primer coats may be carried out following spray application of the full primer coat. This will minimise the time between grit blasting and application of the primer coat. With the exception of the primer, the colour of the stripe coat shall be different from the previous and subsequent coats.

1.4.9 Carbon/stainless steel joints

Where carbon steel pipes are welded to stainless steel pipes, the joint shall be coated with the coating system specified for the stainless steel with a minimum overlap of 5 cm onto the carbon steel. However, the NDFT requirements for the connected carbon steel pipe shall be applicable.

1.4.10 Repair of coating defects

Damaged areas, defects in the coating system such as over-runs, drips and smears that have to be removed or areas with inadequate dry film coating thickness shall be re-cleaned. The re-cleaning shall carry over on to the secure surrounding coating for not less than 250 mm all round and the edges shall be feathered (over a width of at least 70 mm).

After the surface cleaning the specified coating system or the required layers of the specified coating shall be re-applied. Any additional coats shall blend in with the final coating on adjoining areas. Paint Manufacturers shall be consulted if the existing coating requires abrading before over-coating to obtain good bonding.

1.4.11 Inadequate coating thickness

For low and rejected coating DFT the coating system shall be repaired in accordance with this DEP. Where the DFT exceeds the specified maximum requirements, the coating shall be removed and the surface shall be re-blasted and recoated with the initially specified coating system.

1.4.12 Protection of coated contact points

At contact points such as where piping rests directly on a support, either a saddle type or simple beam, there is a potential for severe corrosion. Therefore coated surfaces which will be in contact with other surfaces shall be protected with non-metallic inserts or shims such as Teflon straps or reformed self-adhesive shims, usually made from fibre reinforced plastic.

Shims should have a limited contact area and high impact strength, and retain their properties over sustained load and offshore exposure conditions. A corrosion resistant u-bolt coated with a protective non-metallic material should complete the pipe clamps.

Where clamps are not used, shims made from creep resistant plastic materials such as acrylonitrile butadiene styrene (ABS) are available. These can be adhesive bonded to the underside of the pipe.

The selected system for protection shall be agreed with the Principal. Such protection shall be applied when coatings are fully cured.

1.4.13 Internal coating of tanks, vessels and equipment

Before commencing any internal coating, all welds shall be ground to a smooth rounded contour with a minimum 3 mm radius. Unless otherwise specified by the Principal, internal coating shall be continuous across the full flange face, up to the bolting line.

1.5 PIPING MEDIA IDENTIFICATION AND DIRECTION OF FLOW ARROWS

After the final coats have been applied and cured, piping media identification and flow direction may be required on piping systems. The type and model shall be agreed between the Principal and the Contractor. However, identification tapes shall not contain ingredients such as free chloride that could harm any substrate e.g. stainless steels or nickel-chromium alloys. The Principal shall specify the colour of the topcoat and 'banding' to be applied to piping.

1.6 QUALITY ASSURANCE AND CONTROL

1.6.1 General

The painting Contractor shall ensure that updated product technical data sheets are obtained from the Manufacturer before commencing any painting and that coating materials are within their shelf life.

The Principal or its Representative shall have the right to inspect, check or review, at all times, any or all of the activities, equipment, inspection equipment or product designated for the work. All parts of the work shall be accessible for this purpose.

On behalf of the Principal, regular quality checks will be carried out by a qualified and independent third party inspector, which in no way relieves the Contractor of any responsibility with respect to the quality of the coating work.

The Principal's Representative assigned to the painting work shall be given at least four hours' notice of any change in the schedule of the painting activities.

Whenever any section is to be assembled that will prevent subsequent inspection of an area, the Principal's Representative shall be notified in time, so that inspection and repair activities can be carried out before proceeding with the assembly.

1.6.2 Rejected work and equipment

The Principal shall have the right to reject any work, tools, materials, testing equipment, personnel protection, staging and scaffolding where these do not conform to the requirements of the contract or this DEP.

Any rejected surface preparation or coating application shall be properly marked and documented. Any rejected equipment, surface preparation and/or applied coating shall be replaced or corrected to a level in accordance with this DEP.

1.6.3 Quality plan

Before commencing any work, a written project-specific quality plan shall be submitted to the Principal for approval. This plan shall include:

- a) A sequence for the various activities in relation to the total work to be done;
- b) Detailed scope of the work to be done including, per item or area, the required surface preparation and coating system to be applied;
- c) A listing of the paints and materials to be used including batch numbers;
- d) Full details of the blast and paint equipment including, where appropriate: dehydration, temperature, any other environmental control measures, methods of access, etc.;
- e) Details of the personnel involved in the work together with a clear definition of their responsibilities and lines of communication;
- f) Detailed procedures and plans for testing and inspection including the methods and equipment to be used and the frequency of their application and acceptance criteria. An example of an inspection and testing plan (ITP) is given as attached in Appendix B.
- g) Details documenting the essential steps in achieving quality;
- h) Dew point determination table;
- i) Calibration methods of the inspection equipment;
- j) Qualification of personnel.

Following review and approval by the Principal, the project quality plan may be updated and revised during the work, as and when required. All revisions shall be submitted to the Principal for approval prior to being included in the quality plan.

1.6.4 Reporting

The Contractor shall submit inspection reports not less than once per week. These reports shall include details of weather conditions, air humidity, temperature, particulars of application, e.g. blast cleaning, wet and dry film thickness, and any anomalies. If required by the Principal, the reports shall also detail the progress of work versus the approved programme.

All parts and areas that have been inspected and accepted or rejected shall be clearly identified and documented.

1.6.5 Inspection personnel and equipment

Inspection personnel shall be individually certified by a recognized organisation (NACE International or equivalent) approved by the Principal.

The Contractor shall provide and use all inspection equipment necessary to ensure that the specified conditions and quality requirements are achieved.

Equipment to measure at least the following shall be used:

- | | | |
|----------------------------------|------------------|---------|
| a) Relative humidity | minimum accuracy | 2 % |
| b) Air-and substrate temperature | minimum accuracy | 0.2 °C |
| c) Dew point | minimum accuracy | 0.2 °C. |

1.6.6 Dew point, air humidity and substrate temperature

No coating work shall be carried out when the temperature of the surfaces is less than 3 °C above dew point or the relative humidity of the air is greater than 85 % or the air or substrate temperature is below 5 °C. For maintenance painting offshore a maximum relative humidity of 90 % is acceptable but coating work should proceed within 2 hours of surface preparation. Dew point determination shall be done in accordance with ISO 8502-4 and humidity measurement shall be made in accordance with ASTM E 337. Coatings shall not be applied to surfaces exceeding a substrate temperature of 40 °C. Higher substrate temperatures shall only be accepted if the paint Manufacturer has confirmed in writing that this application will not affect the performance of the coating work.

For maintenance painting on in-service equipment, the Principal shall be consulted for appropriate coatings that are qualified for application on hot equipment and piping.

1.6.7 Cleaned surfaces

1.6.7.1 General

Cleaned surfaces shall comply with the requirements as specified in this DEP.

Cleaned surfaces shall be examined for traces of oil, grease or other contamination and tested for the presence of soluble salts. If present, contaminants shall be removed by solvent washing or for salts, by water washing or steam cleaning, and the affected areas re-blasted. The illuminance for examination shall be at least 500 lx.

No acid washes, cleaning solutions, solvents or other chemical treatments shall be used on metal surfaces after they have been dry blast cleaned. This restriction includes inhibitive washes intended to prevent rusting.

1.6.7.2 Residual salt contamination

The maximum total allowable soluble salts level on the surface is listed in Table 3. The salt level shall be assessed in accordance with ISO 8502-6 and ISO 8502-9. If agreed with the Principal, other suitable methods to measure the chloride ion content or the total salt level may be used.

Table 3 Maximum total soluble salts

Coating category	New Construction	Maintenance
Internal surfaces of vessels and tanks	25 mg/m ²	25 mg/m ²
External carbon steel surfaces	25 mg/m ²	50 mg/m ²
Stainless steels	20 mg/m ²	20 mg/m ²

Testing of the level of salts shall be carried out on each component and at least once per 100 m². The tests shall be carried out a minimum of three times per day during the progress of the work. Special attention shall be given to areas where water has been trapped and dried out.

1.6.7.3 Surface dust

The dust level on the blast-cleaned surface at the time of coating shall not exceed quantity-rating 2 in accordance with ISO 8502-3. Checks on dust levels shall be made at least once on each component and once per 100 m² of prepared surface and a minimum of three checks per day during the progress of the work.

1.6.7.4 Presence of millscale

Sa 2½ blast-cleaned carbon steel surfaces to be used for new construction or modifications shall be tested to ensure they are free of mill scale. The cleaned surfaces shall be examined using magnifying instruments or chemical tests, such as a copper sulphate as outlined in ASTM A 380.

The copper sulphate test will generate no colouring of the surface if mill scale is present, whereas surfaces will discolour to brown (copper colour) if the surface is free of mill scale.

Checks on the presence of mill scale shall be made on each component and at least once per 100 m² of prepared surface and a minimum of three checks per day during the progress of the work.

1.6.7.5 Surface profile

At the beginning of each project, blast cleaned steel panels shall be prepared in compliance with the surface preparation requirements. The surface profile shall be measured by direct microscopic assessment of replicas taken from the surface or by other direct methods provided the Principal has approved them.

For field measurements of surface profile, replica tape, a portable micrometer or other methods may be used provided the Principal has approved them.

Checks on surface profile shall be made on each component and at least once per 100 m² of prepared surface and a minimum of three times per blaster per day during the progress of the work.

Instruments to be used shall be calibrated against the reference steel panels or a known surface. The anchor profile shall be measured in accordance with the applicable part(s) of ISO 8503.

1.6.8 Coating application

1.6.8.1 General coating appearance

The completed coating shall be free from defects such as runs, sags, pinholes, voids, bubbles, orange peel, grit, dust inclusions or other deleterious anomalies and be of good visual appearance. The topcoat shall completely cover the colour of the underlying layers.

If anti-skid systems are applied, the anti-skid material shall be uniformly dispersed on the surface of the coating.

1.6.8.2 Wet film thickness (WFT)

Spot checks shall be carried out during the course of the painting operation to ensure that film thickness is being maintained. These shall be performed according to the procedure described in ISO 2808, Method No. 1A – comb gauge.

Defects found shall be marked, repaired and retested in accordance with this DEP. The Contractor shall provide the necessary equipment for calibrating the holiday detector.

1.6.8.5 Adhesion

The quality of adhesion between the coating system and the steel substrate, and of the adhesion between the coating layers, shall be measured using either:

- a) A self-aligning adhesion tester in accordance with ASTM D 4541. The minimum pull-off force for coating systems with a NDFT greater than 150 µm shall be:
 - 5 MPa for zinc primed coating systems;
 - 7 MPa for non-zinc primed coatings systems;
 - 10 MPa for internal tank coatings and linings.

or

- b) A crosscut test in accordance with ISO 2409, Class 0 for coating systems with a maximum total NDFT of 150 µm.

Testing shall be done on fully cured systems only, i.e. not less than 14 days after the application of the final layer. The adhesion requirements for TSA are specified in DEP 30.48.40.31-Gen.

Adhesion testing shall be carried out on each component and at least once per 100 m² of coated surface. Spots damaged by the adhesion tests shall be repaired in accordance with this DEP.

1.6.8.6 Antiskid system for helidecks and walk ways

Unless otherwise specified by the Principal, the surface friction coefficient of anti skid coating systems applied to helidecks shall be $\mu = 0.8$. The test method to be used shall be approved by the Principal.

1.6.8.7 Inorganic zinc primers

A solvent rub test using MEK in accordance with ASTM D 4752 shall be carried out to ensure inorganic zinc primers are fully cured before overcoating.

1.6.9 Final inspection

As part of the Quality Assurance, a final inspection shall be conducted prior to the final acceptance of the paintwork. This final inspection shall include a visual check of the appearance and overblast of the coating work, and checks on DFTs of the total applied coating system and work completed.

The Contractor and the Principal shall both be represented and they shall sign an agreed acceptance form as part of the warranty agreement.

As part of the acceptance procedure, the Contractor shall prepare a report that includes:

General

- Names of the Contractor and the responsible personnel.
- Scope of work
- Dates when work was carried out
- Good quality copies of the work and quality plan
- Deviations from this DEP and the quality plan

Inspection equipment

- Type and calibration of instruments used.

Surface preparation

- Condition of surface before preparation
- Checks on the requirements as specified for cleaned surfaces (II-1.3 and II-1.6)

Coating application

- Information on coating systems being applied (i.e. product names, DFTs)
- Checks on requirements as specified for coating application (II-1.4 and II-1.6)
- Check on dry film thicknesses of the total coating system applied.

Inspection reports

- A good quality copy of the inspection reports of the Contractor
- Inspection reports from an independent third party.

2. COATING MATERIALS AND QUALIFICATION

2.1 COATING MATERIALS

All paints and coating materials shall be fully qualified in accordance with this section and the coating system requirements specified in (II-3 and II-4).

Approval shall be obtained in writing and shall remain valid for a period of 5 years, unless the chemical formulation or the brand name is later changed.

However, the final selection of coating products may depend on local conditions such as weather conditions, ambient temperature, humidity, pot-life and recoating window.

Paint Manufacturers shall supply coating materials on a worldwide basis together with the technical service related to these materials.

Part of the final selection shall be an application test to be carried out by an agreed paint Contractor.

All coating materials shall be supplied to the work site in their original unopened containers bearing the paint Manufacturer's label and instructions. The label shall at least show the information as outlined in ISO 20340:2003 Clause 5.3.

Coating materials shall be properly stored in accordance with the paint Manufacturer's requirements. In general, no material shall have been in stock for more than 12 months. Coating materials exceeding these requirements shall not be used unless subject to re-inspection and written approval by the paint Manufacturer. Coating materials which have gelled or otherwise deteriorated during storage shall not be used unless subject to re-inspection, testing and written approval by the paint Manufacturer.

Different brands or types of paints shall not be inter-mixed.

Each layer of the paint system shall have a visible difference in colour. However, a compatible coloured undercoat may be used to achieve coverage of the topcoats containing organic pigments. For certain coloured top coats such as yellow, it may be necessary to apply a thicker or an additional topcoat to achieve complete cover of the undercoat.

2.1.1 Coating systems

In general, a multi-layer coating system is specified to reduce the probability of thin film spots and holidays.

The same systems as those specified for new construction may be used for maintenance renovation (II-4.5), if the steel surface has not suffered from pitting corrosion and the surface is blasted to the initially specified visual standard in accordance with ISO 8501-1.

In all other cases the applicable maintenance coating system as described in (II-4) shall be used. However, for steel surfaces which are pitted or for spot repair, an alternative (surface tolerant) primer may be used as part of the maintenance coating system, but only when approved by the Principal.

A light-coloured topcoat should be used for internal surfaces to facilitate visual inspection.

2.1.2 Internal coating of equipment and tanks

Unless specified in this DEP, the selection of internal coatings for equipment, vessels and tanks will be defined in consultation with the Principal on a case-by-case basis. Because of the potentially wide range of service conditions that such coatings might be exposed to, it is impractical to specify acceptance and rejection criteria. Such criteria must be agreed between the Principal, the coating system Supplier and the Contractor.

The Principal's linings and coatings specialists should be consulted in this regard.

For the selection of a suitable internal coating, it is essential to know the operating conditions and that the coating system under consideration will be resistant to the medium under those conditions.

For a coating system to be accepted by the Principal, the paint Manufacturer shall qualify the system to prove its suitability for the proposed service. Six months or more may be required for qualification testing. It is important that sufficient time is available to do this work.

In addition, for potable water, certification of suitability for this service shall be submitted before any coating work is commenced. Similarly the suitability of the proposed coating shall be tested if it is intended for service in de-mineralised water.

Tanks and vessels to be coated and lined internally shall be designed so that effective holiday testing of the completed coating can be carried out. Where holiday testing is not feasible because of the internal structure of the vessel or tank, a coating system applied in a minimum of two coats shall be used.

2.1.3 Identification of coating systems

Each coating system as described in (II-3 and II-4) shall be marked with a system code. The system code consists of numbers and letters. The first letter indicates F for offshore facilities. The second letter indicates the substrate material: C for carbon steel, S for stainless steel, O for any other substrate, L for cold service, T for internal tank coatings and W for submerged service. The numbers used after the second letter pertain to the type of service (II-3.2). The third letter indicates type of work: N for new construction and M for maintenance.

2.1.4 Hazardous components

Paints and coatings shall comply with the requirements on hazardous components as specified in (II-1.2.3) of this DEP. If changes in formulation or alternative coating systems are required to meet such standards or regulations, the Contractor shall immediately notify the Principal and submit details of the proposed alternative system.

2.1.5 Quality assurance

The paint Manufacturers shall operate an ISO 9001 quality management system.

2.1.6 Routine batch testing

Routine batch testing shall be carried out as outlined in ISO 20340:2003 Clause 5.5.3. Before commencing any painting or coating work, the frequency shall be agreed with the Principal. A certificate of conformity is required for all batches of paint used.

2.1.7 Hot-dip galvanising

Hot-dip galvanising is the preferred method for the protection of pre-fabricated structural steelwork such as gratings, ladders, stair-treads, handrails etc. However, for locations close to the sea, offshore locations and locations where painting is required for safety or environmental reasons, galvanised components such as ladders and hand railings shall be protected with a paint system as specified in this DEP applied on top of the galvanised layer, a so-called duplex system. Painting of galvanised grating is not required.

Galvanising of supports, piping, hand railings, gratings and other items as specified in the contract drawings shall be carried out in accordance with ISO 1461. Plate work, e.g. for coolers, may also be Sendzimir galvanized with a minimum zinc thickness of 25 µm on both sides. Items such as structural elements, piping and hand rails should be blast cleaned before they are hot-dip galvanised.

Small areas of galvanised coating damaged by cutting, welding, drilling or any preparation during fabrication, erection, transportation or installation, shall be repaired as described in ISO 1461.

The following point should receive attention:

- a) Fasteners such as bolts (including anchor bolts), nuts and washers to be used for the assembly of galvanised parts shall be galvanised in accordance with ISO 10684. It is essential that the threading of the bolts and nuts be cleared of excessive zinc after galvanising to ensure trouble free use.

Whenever the hot-dip galvanising of components that are to be subsequently coated is ordered, this should always be stated in the order. Usually this results in a better finish and handling of the galvanised items.

2.1.8 Thermal sprayed aluminium (TSA)

Where Thermal Sprayed Aluminium has been specified by the Principal, the aluminium coating and surface cleaning shall meet the requirements specified in DEP 30.48.40.31-Gen. However, the surface profile shall be as specified in (II-1.3.3). The quality of the aluminium shall be at least equivalent to type Al 99.5 % of pure metallic aluminium in accordance with ISO 209-1. However, for hot (>60 °C) insulated equipment, the 1100 grade (99 % Al) is recommended. The sealer coat shall be agreed with the Principal. The required types of sealer coats are defined in DEP 30.48.40.31-Gen. Thermal sprayers shall follow the approval test as outlined in ISO 14918.

For large-scale application of TSA, the Materials and Corrosion discipline of the Principal shall be consulted.

For repair of damaged thermally sprayed aluminium surfaces, the damaged area shall be blast cleaned to PSa 2½ followed by local application of a new coat of TSA.

Overspray from primers on TSA surfaces shall be removed, or 'brushed off' when overlapping the thermally sprayed aluminium at the interface of TSA and organic coating system.

If TSA coatings have to be top coated with an organic coating system for safety markings, the total dry film thickness of the coating system (including sealer) shall be maximum 80 µm. The finishing coat shall have long term colour retention properties.

2.2 COATING QUALIFICATION

2.2.1 General

Testing is the preferred method for the selection of coating systems to meet the requirements as specified in this DEP. To achieve uniformity and reproducibility in testing, all relevant data during the preparation and testing of the test panels shall be recorded. Any deviation shall be highlighted in the test report.

Coating systems shall only be used if they can be demonstrated to satisfy the technical criteria defined in this section. The Principal will only consider a Manufacturer's submissions for external surfaces if the Manufacturer can supply the complete range of approved coating systems. Maintenance coating systems shall be compatible with the relevant coating systems to be used for new construction.

In the event of conflict or discrepancies with referenced standards, the requirements of this DEP shall prevail.

A recognized third party laboratory, to be agreed with the Principal, shall carry out the technical assessment. A Manufacturer's in-house test results shall only be accepted if these have been witnessed and certified by a recognized third party, approved by the Principal.

The Manufacturer shall provide a track record for the coating systems with a minimum duration of three years in a relevant environment.

The Principal may specify additional testing to ensure coating products are suitable for the intended service. Additional testing may not be required for coating systems for stainless steel if the proposed system has been derived from systems tested on carbon steel panels.

2.2.2 Required product information

For each product submitted for technical assessment the information required in ISO 20340:2003 Clause 5.4 shall be provided as a minimum. This is in addition to that given in the MSDS.

2.2.3 Required coating system information

A coating system submitted for qualification assessment shall be described as required in ISO 20340:2003 Clause 6.1.

In addition, paint Manufacturers shall confirm in writing that their paint products do not contain amounts of ingredients such as free chloride that could harm stainless steels or nickel-chromium alloys.

2.2.4 Fingerprint

Each paint or coating of proposed system for qualification shall be subjected to an identification test. A fingerprint test shall be carried out as required in ISO 20340:2003 Clause 5.5 and Annex B (both main and optional parameters).

2.2.5 Formulation of coating materials

Coating systems for the external protection of new carbon and low alloy steelwork in the atmospheric zone with a design temperature of between -35°C and 120°C and in the wetted and intermittently-wetted zone with a design temperature of $< 60^{\circ}\text{C}$ shall be based on a zinc rich primer. For closed steel floors an organic zinc rich primer shall be used. Zinc rich primers are not typically used on FPSOs and other permanently immersed surfaces. The minimum zinc dust pigment content of the non-volatile portion of the primer shall be 80 % by mass (m/m). The zinc dust pigment shall comply with the requirements specified in ISO 3549. However, the lead content shall be maximum 0.01 % for zinc primers to be used in the US or to be applied to facilities to be installed in the US.

2.2.6 Antiskid systems

The antiskid material used in antiskid systems shall be of a non-iron containing and non-sparking or low sparking material. The sparking intensity of this material shall be below that of carbon steel.

Antiskid systems shall be tested for ageing resistance with and without antiskid material. The panels with the anti-skid material do not require a scribe. There shall be no disbonding or cracks with and without antiskid material. No disbonding or cracks between the antiskid material and the coating system shall be observed after panels with antiskid coating have been subjected to the ageing resistance test.

2.2.7 Long term performance

Prior to acceptance of coating systems by the Principal, the Manufacturer shall give assurance in writing that after exposure of 5 years of the topcoats to atmospheric conditions, no conspicuous discolouration shall be observed. The level of discolouration (Delta-E) shall be agreed with the Principal.

NOTE: Coating systems for closed steel floors and tidal and splash zone might be excluded, but coatings for the topside of helidecks are included.

2.2.8 Paint Manufacturer's documentation

In some cases, the paint Manufacturer's test reports and project/track reports may be submitted for the Principal's review and approval as part of the testing required in Table 5.

The reports shall contain test results and proven suitability of the proposed coatings for the intended services.

2.2.9 Test requirements and acceptance criteria

Unless otherwise specified in this DEP, at least two (2) out of three (3) panels shall pass the acceptance criteria. The performance tests are described in (II-2.2.11).

2.2.9.1 Performance tests and acceptance criteria shall be in accordance with Table 5.

Table 5 Performance tests and acceptance criteria

Performance tests (1)	Test requirement	Acceptance criteria
Ageing resistance ISO 20340 (4200 h)	II-2.2.11.2	< 3 mm for zinc primed and < 7 mm for non-zinc primed coating systems.
Sea water immersion in accordance with ISO 20340 (4200 h)	II-2.2.11.2	No blisters, rusting, flaking or cracking.
Cathodic disbonding in accordance with ISO 20340 (6 months)	II-2.2.11.2	Diameter of cathodic disbondment shall be < 20 mm.
Impact resistance	II-2.2.11.3	> 2 J No evidence of cracking
Thick film cracking	II-2.2.11.4	No cracking
Overcoatability and drying properties	II-2.2.11.5	As in II-2.2.12.4
Application	II-2.2.11.6	No defects according to II-2.2.12.5
Resistance to hot services < 120 °C	II-2.2.11.7	No flaking, cracking or disbonding and discolouration.
Heat resistance > 120 °C up to 450 °C	Paint Manuf. according to II-2.2.8	No flaking, cracking or disbonding.
Adhesion	II-2.2.11.1	Both virgin and after testing according to II-2.2.11
Wave/condensation	II-2.2.11.8	According to class B1 of Appendix A, Table A.2
Hot/wet cycling in accordance with NACE TM0104	II-2.2.11.9	Rust creepage: < 3.5 mm
Optional testing (2)		
Ageing resistance in accordance with: NACE TM0404 (Section 7) and NACE TM0304 (Section 7)	II-2.2.12	< 1.5 mm for zinc primed and < 3.5 mm for non- zinc primed coating systems.
NOTES: 1. The paint Manufacturer shall provide evidence that its proposed coating systems shall have minimum edge retention of 50 %. A test method is described in NACE TM0304 and NACE TM0404. The applicable coating systems shall be subject to the approval of the Principal. 2. If approved by the Principal, ISO 20340 ageing testing may be replaced by ageing resistance testing in accordance with NACE TM0404 for new construction coatings and NACE TM0304 for maintenance coatings.		

2.2.9.2 Testing requirements for offshore coating systems

For details on coating systems, see (II-3) for new construction and (II-4) for maintenance. Qualification testing shall be in accordance with Table 6.

Table 6 Qualification testing

Coating System (6)	QUALIFICATION TESTING												
	Application test	Fingerprint	Ageing resistance test	Cathodic Disbonding	Sea water immersion	Impact resistance	Thickfilm cracking (2)	Overcoatability and drying	Hot services <120 °C	Adhesion	Wave tank / condensation	Hot/wet cycling (FPSO only)	Manufacturer's Documentation (4)
FC1-N/M (5)	x	x	x	x	x	x	x	x		x			
FC2-N/M	x	x	x			x	x	x	x	x			
FC3-N/M	x	x								x			x
FC4-N/M	x	x								x			x
FC5-N/M (5)	x	x		x	x	x	x			x			
FC6-N/M	x	x	x			x		x		x			
FC7-N/M (3)	x	x	x			x		x		x			
FC8-N/M	x	x											x
FT1-N/M	x	x					x			x	x		
FT2-N/M	x	x					x			x	x	x	
FT3-N/M	x	x					x			x			x
FT4-N/M (7)													
FT5-N/M (7)													
FS1-N/M (1)(5)	x	x	x	x	x	x	x	x		x			
FS2-N/M (1)	x	x	x			x	x	x	x	x			
FS3-N/M (1)	x	x								x			x
FS4-N/M (1)	x	x								x			x
FS5-N/M (1)(5)	x	x		x	x	x	x			x			
FO1-N/M (1)(3)	x	x	x			x		x		x			
FO2-N/M (1)	x	x	x			x	x	x	x	x			
FL1-N/M	x	x								x			x
FW1-N (8)	x	x		x	x	x	x	x		x			
FW2-N (8)	x	x		x	x					x			

(1) Testing may be omitted if the proposed system has been derived from the systems tested on carbon steel panels. However, an adhesion test and a cathodic disbonding test (when applicable) are required.

(2) Applicable to high solid (minimum 70 % by mass) and solvent-free coatings only.

(3) Anti-skid coating systems to be tested to ageing resistance with and without antiskid material

(4) Paint Manufacturer's documentation in accordance with (II-2.2.8).

(5) Cathodic disbonding, method A.

(6) The requirements of (2.2.5) shall apply.

(7) Shell test protocol for internal coatings in storage tanks in accordance with DEP 30.48.00.31-Gen.

(8) Immersion testing in seawater at a temperature of 65 °C for system FW-1 and 105 °C for system FW2-N.

x = required test

2.2.10 Preparation and condition of test panels

Unless otherwise agreed or specified, the preparation and conditioning of the test panels shall be in accordance with ISO 20340:2003 Clause 8.1, with the following additions, deletions and amendments.

8.1.1 Type and number of panels

Delete the last (3rd) sentence and **add** the following:

Unless otherwise specified, a minimum of four (4) panels shall be prepared. One panel is needed only for the initial adhesion testing and will not be subjected to a subsequent ageing test. The panel size may be reduced to 90 mm x 150 mm x 5 mm with the 0.05 mm wide scribe line omitted.

Add the following paragraphs:

To benchmark coating systems subjected to a qualification test, an additional four panels shall be tested. These panels shall be coated with a reference coating system agreed by the Principal, which has proven field performance of at least 8 years in an offshore environment.

The FC2-N/M coating systems to be qualified for the atmospheric zone shall be tested in Shell yellow or otherwise agreed with the Principal.

8.1.3 Application and curing

Amend the 1st line as follows: The test panels shall be coated in strict accordance with the Manufacturer's most recent written instructions.

8.1.5 Overcoating time

Delete the 2nd paragraph and **add** the following new paragraph:

There shall be no deviation from the overcoating time specified by the Manufacturer.

8.1.6 Conditioning/curing

Delete the 3rd paragraph and **add** the following new paragraph:

The curing time of the coated panels shall be agreed with the Principal and be in accordance with the paint Manufacturer's most recent instructions. The curing time shall be stated in the test report.

Amend the 4th paragraph as follows:

Unless specified, the *test* conditions shall be agreed with the Principal. The agreed conditions shall be stated in the test report.

8.1.7 Porosity detection

Delete the text and **add** the following new paragraph:

Carry out holiday testing in accordance with 1.6.8.4. Pinholes are not acceptable.

8.1.8 Scribe lines

Amend the 1st line of the 2nd paragraph as follows:

Unless otherwise specified in (II-2), make the scribe line(s) on the test panels as follows. The 2 mm wide scribe line is mandatory and the 0.05 mm wide scribe line may be omitted.

2.2.11 Performance testing

2.2.11.1 Assessment: methods and requirements

Unless otherwise specified in this DEP, assessment of the test panels shall be in accordance with ISO 20340:2003 Clause 8.3, with the following additions, deletions and amendments.

8.3.1 General

Amend the 1st sentence of the text as follows:

Assess the panels *subjected to ageing resistance and immersion tests* in accordance with ISO 12944-6.

ISO 20340:2003, Table 5 – Assessment of test panels – Methods and requirements

Delete the 1st row of the Table and **add** the following two rows:

Assessment method	Requirement before testing- (virgin sample)	Requirement after testing
ISO 4624 (pull-off test) Applicable to DFT > 150 µm	Min. 5 MPa for zinc primed coating systems; Minimum 7 Mpa for non zinc primed coatings for external services; Minimum 10 Mpa for internal tank coatings.	Min. 5 MPa or 70 % of the initial value. Minimum 5 MPa for non zinc primed coatings for external services; Minimum 7 MPa for internal tank coatings.
ISO 2409 (crosscut) Applicable to DFT < 150 µm and high temperatures	Class 0	Min. Class 2 or 70 % of the initial value.

Add the following to the column requirements after qualification testing of the 7th Row (heading row excluded) of the table: M < 7 mm for the 2-mm-wide scribe line for non-zinc containing (maintenance) coating systems.

Amend the NOTE to the Table as follows by adding three new notes:

- (1) *Any defect occurring within 10 mm of the edges of the test panel shall not be taken into account.*
- (2) *Unless otherwise specified in this DEP, the (re)-conditioning of panels after exposure testing and prior to pull-off or crosscut adhesion tests shall be for a minimum of 3 weeks in a standard atmosphere of 23 °C ± 2 °C and a relative humidity of 50 % ± 5 %.*
- (3) *No disbonding or cracks between the antiskid material and the coating system shall be observed after panels with antiskid coating have been subjected to the ageing resistance test.*

2.2.11.2 Testing as required in accordance with ISO 20340

The performance testing to be carried out in accordance with ISO 20340:2003 Clause 8.2 is as follows:

- 1) Ageing resistance:
 - Procedure A: Standard procedure with low temperature exposure (thermal shock) shall be used.
- 2) Cathodic disbonding: ISO 15711, method A.
- 3) Immersion testing in accordance with ISO 2812-2 but using the test solution as defined in ISO 15711.

2.2.11.3 Impact (deformation) resistance

A pass/fail test in accordance with ISO 6272-1 shall be performed. The size, preparation and coating of the panels shall be in accordance with (II-2.2.10). The minimum acceptable test value without evidence of cracking is 2 J. Test panels shall be examined with minimum 10× magnification.

2.2.11.4 Thick film cracking

Proven cracking resistance shall be required for solvent free coating systems and all coating systems that include any high solids (minimum 70 % by mass) component. A T-bar shall be constructed by welding together in a letter T the long sides of two (2) panels. The sizes of the steel panels shall be minimum 150 mm x 200 mm x 5 mm (horizontal panel) and 150 mm x 100 mm x 5 mm (vertical panel).

The weld areas and the adjacent flat sides of the T-bar shall be blast cleaned and the surface cleanliness shall be SA 2½ at the time of coating.

The coating system shall be applied onto both concave sides of the T-bar steel in at least three (3) times the specified NDFT (including stripe coating where relevant).

The coated T-bars shall be conditioned, overcoated and cured in accordance with (II-2.2.10).

After the curing, at least two coated T-bars shall be exposed to the following test protocol:

This testing method is to be used for testing of coatings for external and internal immersion surfaces. The total test duration for atmospheric conditions shall be 74 cycles (148 days) as described as follows:

One cycle (2 days):

- 1 h : heating up from +20 °C up to +60 °C
- 6 h : exposure at +60 °C
- 1 h : ambient cooling from +60 °C down to +20 °C
- 16 h : conditioning at +20 °C
- 1 h : cooling from +20 °C down to –20 °C
- 6 h : exposure at –20 °C
- 1 h : warming up from –20 °C up to +20 °C
- 16 h : conditioning at +20 °C

If the cycle is broken, e.g. at weekends, specimens shall remain conditioned at 20 °C until the cycle is re-started. The test cycle may only be interrupted for a maximum of 7 days.

The two exposed samples shall be examined with a magnifying glass of minimum 10× magnification and both shall show no evidence of cracking.

2.2.11.5 Overcoatability and drying properties

Prior to acceptance of coating systems by the Principal, the Manufacturer shall give assurance in writing that the overcoatability and curing shall meet the requirements as below:

1. For new construction with a service temperature of between –35 °C and 120 °C, atmospheric zone, there shall be no restrictions on the overcoatability of the topcoat of the coating system;
2. The top layer of any prefab system for new construction shall be overcoatable for a minimum of 6 months after application;
3. The drying and curing properties of the (first) primer layer to be used for maintenance painting operations offshore shall be such that no excessive waiting time will arise. Touch dry time should be maximum 2 h at ambient temperature.

NOTE: Overcoatability means that coating systems or layers shall adhere well when applied on pre-cleaned existing coating system after the periods as mentioned in items 1 and 2.

2.2.11.6 Application test

Application testing shall be carried out in accordance with ISO 20340:2003 Clause 7. The coating products shall show proper applicability. During the application, any problems with the mixing and application of the coating shall be noted. Surface defects such as popping,

pinholes, orange peel, sweating etc. shall be noted. Such defects may give grounds for failure. Good application properties are crucial for good quality coating work.

In addition, a brush application test shall be carried out using an acceptable portion of horizontally mounted DN 80 pipe, it shall be demonstrated that the intermediate and topcoat layers applied by brush are smooth and even.

2.2.11.7 Resistance to hot service (< 120 °C)

No disbonding, flaking, cracking or conspicuous discolouration shall be observed on the three panels with the coating systems for the atmospheric zone, service temperature of between – 35 °C and 120 °C, after they have been subjected to a hot service (oven) test at 120 °C for 4200 h. The size, the preparation and coating of the panels shall be in accordance with (II-2.2.10).

2.2.11.8 Wave tank/condensation testing of coatings for seawater ballast tanks and void tanks

The testing of protective coatings for the internals of ballast tanks (seawater) and void tanks shall be done in accordance with the test protocol as attached in Appendix A.

This evaluation consists in general of a condensation test according to ISO 6270-1 and ISO 6270-2 and a wave tank test with natural seawater (artificial seawater as defined in ISO 15711 may be used instead). The wave test includes cold wall effect and resistance to cathodic disbonding.

The top panel and side panels of the wave tank test have a horizontal scribe down to bare metal. Unless otherwise agreed, the scribe line shall be 2 mm wide and 50 mm long. If otherwise agreed, it shall be stated in the test report.

Proposed coating systems are applied to blast cleaned panels and the test duration for both test methods shall be 180 days.

2.2.11.9 Hot/wet cycling

This hot/wet cycling test is for FPSO tanks only and shall be done in accordance with NACE TM0104. The requirement for salted and damp panels may be omitted. The rust creepage for clean surface shall be less than 3.5 mm after 12 weeks cycling salt fog test. The test report shall be in accordance with (II-2.2.14).

2.2.12 Optional testing

At the sole discretion of the Principal, ISO 20340 ageing testing may be replaced by ageing resistance testing in accordance with NACE TM0404 for new construction coatings or NACE TM0304 for maintenance coatings.

2.2.13 Alternative assessment

At the sole discretion of the Principal, an alternative method for the qualification of coating systems may be considered. This is restricted to coating systems for carbon steel surfaces, which have long-term (minimum 8 years and preferably more than 10 years) proven performance in the field. For this means of qualification to be considered by the Principal, the paint Manufacturer shall:

- Prepare and submit a detailed dossier as outlined in ISO 20340:2003 clause 5.4 for the coating system(s) including a comprehensive performance track record for each system;
- Fingerprint testing data as required by ISO 20340:2003 Clause 5.5;
- Be prepared to allow inspection of the formulation by the Principal in order to verify that the paint formulation supplied in the case history project is identical to the current formulation.

2.2.14 Test report

The test reports shall contain the information as required in ISO 20340:2003, Clause 9. In addition, all other relevant information such as application data, observations of application properties, type of spray equipment and tips used, deviations and agreements, test temperatures and curing time shall be stated in the report as well.

3. NEW CONSTRUCTION AND MODIFICATIONS

3.1 GENERAL

Minimum coating requirements for new construction and modifications are specified in this section for each field of service.

Surface preparation shall be in accordance with (II-1.3).

Coating systems for new construction and modifications shall only be used if they have been qualified and accepted. The qualification criteria and the definition of the system codes are described in (II-2).

For spot repair of areas exposing the steel surfaces, an alternative primer may be used but only after the approval of the Principal.

3.2 COATING SURFACES AND SYSTEM REQUIREMENTS

3.2.1 Carbon steels and low alloy steels – External

Examples of acceptable coating systems are given in Table 7.

Table 7 External coating systems for carbon steel and low alloy steels

Carbon steel (EXTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Wetted and intermittently-wetted zone, design temp. < 50 °C (1)(2)(6)	FC1-N	3	500	Zinc rich primer 2 coats of high solid epoxy
Atmospheric zone –35 °C up to + 120 °C (3)(6)(7)	FC2-N	3	300	Zinc rich primer, Epoxy midcoat, Polyurethane topcoat
Atmospheric zone (3) >120 °C up to 200 °C	FC3-N	2	200	2 coats of epoxy phenolic
Atmospheric zone (3) >200 °C up to 450 °C	FC4-N	2	110	Zinc silicate primer Heat resistance aluminium paint
Buried parts, design temp. <60 °C (2) (9)	FC5-N	3	500	Epoxy primer 2 coats of epoxy
Decks and floor / light and normal duty	FC6-N	3	350	Zinc rich primer High solid epoxy Epoxy or Polyurethane topcoat
Steel floors /heavy duty and helidecks Antiskid (4)	FC7-N	3	450	Zinc rich primer High solid epoxy Antiskid material Epoxy or Polyurethane topcoat
Hull of floating vessels (FPSO) (8)	FC8-N	2	325	Epoxy primer 2 coats of epoxy
		2	250	2 coats of anti fouling paint (submerged zone only)

3.2.2 Carbon steels - Internal

The same coating systems may be used for the internal coating of stainless steel tanks, if required. In this case, the coatings shall not contain components that could harm the stainless steel.

Examples of acceptable coating systems are given in Table 8.

Table 8 Internal coating systems for carbon steels

Carbon steel (INTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Seawater ballast and void tanks Internal , storage temp. $<50\text{ }^{\circ}\text{C}$	FT1-N	2	350	2 coats of epoxy
FPSO seawater ballast and void tanks, storage temp. $<50\text{ }^{\circ}\text{C}$	FT2-N	2	350	2 coats of epoxy
Potable water	FT3-N	2	300	Refer to (II-2.1.2)
Methanol storage, storage temp. max. $40\text{ }^{\circ}\text{C}$ (10)	FT4-N	1	75	Inorganic zinc silicate
		3	300	3 coats of epoxy phenolic
Diesel storage, storage temp. max. $40\text{ }^{\circ}\text{C}$ (10)	FT5-N	2	300	2 coats of epoxy

3.2.3 Stainless steels - External

Unless otherwise specified, all stainless steels shall be coated.

Examples of acceptable coating systems are given in Table 9.

Table 9 External coating systems for stainless steels

Stainless steel (EXTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Wetted and intermittently-wetted zone, design temp. $<50\text{ }^{\circ}\text{C}$ (1)(2)	FS1-N	3	500	Epoxy primer, 2 coats of epoxy
Atmospheric zone (3) $-35\text{ }^{\circ}\text{C}$ up to $+120\text{ }^{\circ}\text{C}$	FS2-N	2	200	Epoxy primer Polyurethane top coat
Atmospheric zone (3) $>120\text{ }^{\circ}\text{C}$ up to $200\text{ }^{\circ}\text{C}$	FS3-N	2	200	2 coats of epoxy phenolic
Atmospheric zone (3) $>200\text{ }^{\circ}\text{C}$ up to $450\text{ }^{\circ}\text{C}$	FS4-N	2	50	2 coats of heat-resistant aluminium paint
Buried parts, design temp. $<60\text{ }^{\circ}\text{C}$ (2)(9)	FS5-N	3	500	Epoxy primer, 2 coats of epoxy

3.2.4 Other surfaces – External

Examples of acceptable coating systems are given in Table 10.

Table 10 External coating systems for other surfaces

Other Surfaces (EXTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Topside aluminium helidecks – Antiskid (4)	FO1-N	3	350	Epoxy primer High solid epoxy Antiskid material Epoxy or Polyurethane topcoat
Galvanised surfaces in the atmospheric zone –35 °C up to 120 °C	FO2-N	2	200	Epoxy primer Polyurethane topcoat

3.2.5 Cold services

Applicable to all surfaces. The coating material shall not contain components that could harm the substrate.

Examples of acceptable coating systems are given in Table 11.

Table 11 External coating systems for cold services

All Surfaces (EXTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Atmospheric zone and operating temperature –35 °C down to –100 °C (3)	FL1-N	2	200	2 coats of (phenolic) epoxy

3.2.6 Submerged surfaces

Applicable to all surfaces in the submerged zone. The coating material shall not contain components that could harm the substrate.

Examples of acceptable coating systems are given in Table 12.

Table 12 External coating systems for surfaces in the submerged zone

All surfaces (EXTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Design temp. <50 °C (2)	FW1-N	2	350	2 coats of immersion grade epoxy
Design temp. from 50 °C up to 100 °C (2)	FW2-N	2	250	2 coats of immersion grade epoxy phenolic

Notes to Tables 7 through 12:

- (1) Includes tidal, splash and spray zone areas up to 6 m above HAT. J-tubes and riser clamps for this service are included. Top end of risers [if not coated with the special riser coating - refer to (I-1.2)] shall be coated accordingly.
- (2) Coating system is suitable for use in combination with cathodic protection to a minimum potential of -1150 mV Ag/AgCl.
- (3) Applies to both insulated and non-insulated systems.
- (4) Markings of helidecks:
For landing or safety marking of helidecks an aliphatic polyurethane topcoat or equivalent shall be used in the specified finishing colour. The requirements on colour retention (II-2.2.7) shall be adhered to.
- (5) These are examples only and not intended to be coating system requirements.
- (6) Completed components such as carbon steel ladders, handrails, fences and stairways to be used in the atmospheric zone shall be hot dip galvanised in accordance with (II-2.1.7) and be top coated with paint system FO2-N. Galvanised components to be used in the splash zone shall be top coated with system FS1-N. Painting of galvanised grating is not required.
- (7) Unless otherwise agreed, tip of flare boom shall be coated with system FC4-N or TSA.
- (8) The use and type of antifouling paint shall be agreed with the Principal. A dry film thickness of at least 500 µm should be applied at least to the boottop area of the hull (i.e. the area between the light-load and heavy-load external water lines) and to apply an additional aliphatic polyurethane topcoat to the part of the hull that is above water.
- (9) Buried parts and piping, and up to at least 30 cm above ground level.
- (10) Systems FT4-N and FT5-N need to be applied only if specified in the materials selection report, stated on construction drawings or specified by the materials and corrosion discipline. If internal coating is required, methanol storage tanks shall be fully coated whereas diesel storage may be coated only on the bottom and the lower 50 cm of the shell.

3.2.7 Enclosed and partly enclosed areas

The equipment, piping, vessels, structural steel and the inside walls of these areas shall be treated fully in accordance with this DEP. The topcoat shall be applied in the desired colour on parts remaining visible.

3.2.8 Climate controlled areas

For equipment, vessels, tanks and interiors in climate controlled areas; the Manufacturer's coating specifications will be acceptable subject to approval of the Principal. The specified finishing colour scheme shall be adhered to.

3.2.9 Windshields

Windshields shall be made from Sendzimir galvanised plate, which shall be provided with a factory applied coating system on both sides with a minimum thickness of 150 µm. Any cracking of the coating caused by the bending pre-coated plates shall not be acceptable. The plates shall be guaranteed for at least 5 years.

The Manufacturer's specification for coating the plates and their subsequent maintenance shall be subject to approval by the Principal. In addition, the Manufacturer shall provide a guarantee in writing that, at a future date, these windshields can be maintained in accordance with this DEP without adhesion problems occurring.

3.2.10 Subsea structures

When sub sea production systems, and structures such as protection frames installed for the protection of sub sea wellheads or sub sea pipeline tie-ins, require colour marking, the coating system to be applied should comprise of:

1) Poly amide cured epoxy primer	150 µm
2) Epoxy based topcoat	150 µm
Total DFT	300 µm

Unless otherwise agreed with the Principal, the colour schedule shall be in accordance with NORSOK U-CR-008.

The detailed requirements for other sub sea facilities will be defined in consultation with the Principal on an individual basis. Details shall be indicated on the contract drawings.

3.2.11 Onshore isolation joints and flanges

Onshore isolation joints and flanges should be painted in a contrasting colour for easy identification. The colour should be consistent in one area. Black is widely used. Paints containing conductive components e.g. zinc or aluminium shall not be used. The coating should be epoxy based.

3.3 PASSIVE FIRE PROOFING

All steel to be fireproofed, plus a continuous band of steel of minimum width 300 mm away from it, shall be primed and over-coated with a system which has been agreed between the Vendor of the fireproof material and the Manufacturer as being compatible with the fireproofing system and materials. Approval for the use of a specific type of fireproofing shall be obtained in writing from the Materials and Corrosion discipline of the Principal.

For underdecks or areas that are regularly exposed to wet/damp conditions, an epoxy based intumescent fireproofing coating should be considered.

3.4 FINISHING COLOUR SCHEDULE

Unless otherwise specified, the finishing colours to be applied shall be in accordance with Appendix C.

4. MAINTENANCE

4.1 GENERAL

Minimum coating requirements for maintenance are specified in this section for each field of service. In (II-4.5) three recognized types of maintenance are described: spot repair, refurbishment and renovation. Refurbishment and renovation, albeit recognized as large-scale maintenance, are referred to as 'Maintenance' in the following tables.

The same coating systems as those specified for new construction may be used for renovation if the surface has been blasted to the initial specified standard and the steel surface has not been roughened as a result of pitting corrosion.

In all other cases the applicable maintenance coating system as described in this (II-4) shall be used. However, if approved by the Principal, an alternative primer may be used for steel surfaces that have been roughened, for spot repair or when alternative surface cleaning is agreed. Coating systems for maintenance shall only be used if they have been qualified and accepted. The qualification criteria and the definition of the system codes are described in (II-2). For surfaces in the submerged zone, the same coating systems as specified for new construction shall be used (see II-3.2.6).

Surface preparation shall be in accordance with (II-1.3).

4.2 COATING SURFACES AND SYSTEM REQUIREMENTS

4.2.1 Carbon steel and low alloy steels

Examples of acceptable coating systems are given in Table 13.

Table 13 External coating systems for carbon steel and low alloy steels

Carbon steel (EXTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Wetted and intermittently-wetted zone, operating temp. <50 °C (1)(2)	FC1-M	2	500	2 coats of High solid epoxy
Atmospheric zone -35 °C up to +120 °C (3)(6)	FC2-M	3	300	Epoxy primer, Epoxy midcoat, Polyurethane topcoat
Atmospheric zone >120 up to 200 °C (3)	FC3-M	2	200	2 coats of epoxy phenolic
Atmospheric zone >200 °C up to 450 °C (3)	FC4-M	2	110	Zinc silicate primer Heat-resistant aluminium paint
Buried parts, operating temp. <60 °C (2)(9)	FC5-M	3	500	Epoxy primer 2 coats of epoxy
Decks and floor / light and normal duty	FC6-M	3	350	Epoxy primer High solid epoxy Epoxy top or Polyurethane topcoat
Steel floors /heavy duty and helidecks. Antiskid (4)	FC7-M	3	450	Epoxy primer High solid epoxy Antiskid material Epoxy top or Polyurethane topcoat
Hull of floating vessels (FPSO) (8)	FC8-M	2	325	Epoxy primer 2 coats of epoxy
		2	250	2 coats of anti fouling paint (submerged zone only)

4.2.2 Carbon steels – Internal

Examples of acceptable coating systems are given in Table 14.

Table 14 External coating systems for carbon steel and low alloy steels

Carbon steel (INTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Seawater ballast and void tanks Internal, storage temp.<50 °C	FT1-M	2	350	2 coats of epoxy
FPSO seawater ballast and void tanks, storage temp. <50 °C	FT2-M	2	350	2 coats of epoxy
Potable water	FT3-M	2	300	Refer to (II-2.1.2)
Methanol storage, storage temp. max. 40 °C (10)	FT4-M	1	75	Inorganic zinc silicate
		3	300	3 coats of epoxy phenolic
Diesel storage, storage temp. max. 40 °C (10)	FT5-M	2	300	2 coats of epoxy

4.2.3 Stainless steels

Unless otherwise specified, all stainless steels shall be coated.

Examples of acceptable coating systems are given in Table 15.

Table 15 External coating systems for stainless steels

Stainless steel (EXTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Wetted and intermittently-wetted zone, operating temp. $<50\text{ }^{\circ}\text{C}$ (1)(2)	FS1-M	2	500	2 coats of High solid epoxy
Atmospheric zone (3) $-35\text{ }^{\circ}\text{C}$ up to $+120\text{ }^{\circ}\text{C}$	FS2-M	3	200	Epoxy primer Polyurethane top coat
Atmospheric zone (3) $> 120\text{ }^{\circ}\text{C}$ up to $200\text{ }^{\circ}\text{C}$	FS3-M	2	200	2 coats of epoxy phenolic
Atmospheric zone (3) $200\text{ }^{\circ}\text{C}$ up to $450\text{ }^{\circ}\text{C}$	FS4-M	2	50	2 coats of heat-resistant aluminium paint
Buried parts, operating temp. $<60\text{ }^{\circ}\text{C}$ (2)(9)	FS5-M		500	Epoxy primer 2 coats of epoxy

4.2.4 Other surfaces

Examples of acceptable coating systems are given in Table 16.

Table 16 External coating systems for other surfaces

Other Surfaces (EXTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Topside aluminium (4) helidecks – Antiskid	FO1-M	3	350	Epoxy primer High solid epoxy Antiskid material Epoxy top or Polyurethane topcoat
Galvanised surfaces in the atmospheric zone $-35\text{ }^{\circ}\text{C}$ up to $120\text{ }^{\circ}\text{C}$	FO2-M	2	200	Epoxy primer Polyurethane topcoat

4.2.5 Cold services

Applicable to all surfaces. The coating material shall not contain components that could harm the substrate.

Examples of acceptable coating systems are given in Table 17.

Table 17 External coating systems for cold services

All Surfaces (EXTERNAL)	System code	Minimum number of coating layers	Total minimum NDFT μm	Examples of coating systems (5)
Atmospheric zone and operating temperature $-35\text{ }^{\circ}\text{C}$ down to $-100\text{ }^{\circ}\text{C}$ (3)	FL1-M	2	200	2 coats of (phenolic) epoxy

Notes to Tables 13 through 17:

- (1) Includes tidal, splash and sprayzone areas up to 6 m with respect to HAT. Top end of risers (if not coated with the special riser coating, refer to Part I-1.2) shall be coated accordingly,
- (2) Coating system is suitable for use in combination with cathodic protection to a minimum potential of -1150 mV Ag/AgCl ,
- (3) Applies to both insulated and non-insulated systems,
- (4) Markings of helidecks:
For landing or safety marking of helidecks an aliphatic polyurethane topcoat or equivalent shall be used in the specified finishing colour. The requirements on colour retention (II-2.2.7) shall be adhered to,

- (5) These are examples only and not intended to be coating system requirements,
- (6) For surface tolerant coating systems the temperature shall be maximum +100 °C,
- (7) Unless otherwise agreed, tip of flare boom shall be coated with system FC4-N or TSA,
- (8) The same coating system as that used for new construction should be applied. The use and type of antifouling paint shall be agreed with the Principal.
- (9) For maintenance of buried parts and piping around ground level up to at least 30 cm above and below ground level.
- (10) Systems FT4-N and FT5-N need to be applied only if specified in the materials selection report, stated on construction drawings or specified by the materials and corrosion discipline. If internal coating is required, methanol storage tanks shall be fully coated whereas diesel storage may be coated only on the bottom and the lower 50 cm of the shell.

4.2.6 Enclosed and partly enclosed areas

The equipment, piping, vessels, structural steel and the inside walls of these areas shall be treated fully in accordance with this DEP.

4.2.7 Climate controlled areas

For maintenance painting of equipment, vessels, tanks and interiors in climate controlled areas; the paint Manufacturer's coating specification will be acceptable subject to approval by the Principal. The specified finishing colour scheme shall be adhered to.

4.2.8 Windshields

Manufacturer's specification as required in (II-3.2.9).

4.2.9 Onshore isolation joints and flanges

Onshore isolation joints and flanges should be painted in a contrasting colour for easy identification. The colour should be consistent in one area. Black is widely used. Paints containing conductive components e.g. zinc or aluminium shall not be used. The coating should be epoxy based.

4.3 PASSIVE FIREPROOFING

When maintenance is required for steel that has to be re-fireproofed, the coating system shall be agreed between the Vendor of the fireproof material and the paint Manufacturer as being compatible with the fireproof material. Approval for the use of a specific type of fireproofing shall be obtained in writing from the Materials and Corrosion discipline of the Principal.

4.4 FINISHING COLOUR SCHEDULE

Unless otherwise specified, the finishing colours to be applied shall be in accordance with (Appendix C).

4.5 TYPES OF MAINTENANCE

For the maintenance painting of external surfaces, the following types of maintenance are recognized within this DEP. The surface cleaning as specified in (II-1.3) shall be used for stainless steel, galvanised or non-ferrous metal surfaces. Maintenance painting shall be carried out in accordance with the requirements in this DEP.

- **Spot repair:**

After pre-cleaning, small defects in the existing coating system shall be (spot) blast-cleaned. Carbon steel and low-alloy steels shall be spot blasted to the visual standard PSa 2½ in accordance with ISO 8501-2 at the time of coating. The cleaned defects shall be touched-up to the specified coating thickness.

The requirements of re-cleaning of surface and re-application of coating layers as specified in (II-1.4.10) shall be adhered to.

Spot repair should be considered if the coated area has localized (spot) rusting only and the remaining paint film is sound and adequate. The rusting pattern should be less than rust grade 5-S (3 %) spot rusting and/or less than rust grade 7-G (0.3 %) general rusting in accordance with ASTM D 610.

- **Refurbishment:**

After the complete initially coated surfaces have been pre-cleaned, defects in the existing coating system shall be (spot) blast-cleaned. Carbon steel and low-alloy steels shall be spot blasted to the visual standard P_{Sa} 2½ in accordance with ISO 8501-2 at the time of coating. If the remaining part of the existing coating system needs to be sweep-blasted, fine abrasive shall be used to avoid damage to the coating system.

The cleaned defects shall be touched-up with the base layers of the specified coating system. Thereafter a full coat of the initial top layer(s) shall be applied.

The requirements of re-cleaning the surface and re-application of coating layers as specified in (II-1.4.10) shall be adhered to.

Refurbishment should be considered if the whole coated area shows more rusting than described under spot repair but less than rust grade 4-S (10 %)-spot rusting and/or less than rust grade 5-G (3 %)-general rusting in accordance with ASTM D 610.

Refurbishment should not be selected if the rusting pattern is of the pinpointed type as described in ASTM D 610. Any degree of pinpoint rusting shall require renovation; see below.

- **Renovation:**

After the complete initially coated surfaces have been pre-cleaned, all surfaces shall be blast cleaned. Carbon steel and low-alloy steels shall be blasted to the visual standard S_a 2½ in accordance with ISO 8501-1 at the time of coating. Remains of marks of the original coating system are allowed if they adhere well to the surface and are compatible with the new coating system. After the surface preparation a complete new coating system shall be applied.

Renovation should be considered if the rusting pattern as described in ASTM D 610 is pin-pointed over the whole coated area or if the rust grades are higher than those described under refurbishment.

4.6 CONDITION OF EXTERNAL COATING BARRIER

4.6.1 General

Protective coating barriers are subject to degradation and have a limited service life. Breakthrough of corrosion (surface rusting) will be the main visible indication of the breakdown of the coating system. From this stage degradation processes can accelerate and surface rusting will spread over the surface initially coated. The speed of degradation is difficult to predict since many factors have an influence on this process. The percentage of visible surface rusting of coated surfaces is commonly taken to monitor coating condition and define the moment of intervention. However, it is essential to focus on the local corrosion processes as well. Since visual condition monitoring of insulated parts is not possible, it should be agreed how the coating condition of these parts will be established.

4.6.2 Condition monitoring

Asset owners should have a system in place to monitor the condition of the coating barrier at least every 3 years. Certified and experienced coating surveyors should carry out the condition monitoring of the external coating barrier. Surveyors shall be certified in accordance with (II-1.6.5) and shall have proven experience in this field (preferably 5 years). Parts of the facility that are not accessible for visual inspection of the coating condition shall be reported to the Principal.

The facility should be divided into areas or blocks such as wellhead area, process area, under decks etc. The blocks or areas should be sub-divided into components such as piping, equipment, main-structure, sub-structures, etc.

During condition monitoring it is crucial to focus on the local corrosion processes. Local specific corrosion is often severe and unpredictable, and material losses can be excessive and may affect safety and technical integrity of the facilities. If severe local corrosion is observed, this shall be reported to the responsible Technical Authority of the Principal.

Points of attention for coating work condition monitoring surveys are:

- High pressure installation components and vital equipment;
- Welds and built-up butts;
- Bearing points of pipes on supports;
- Clamps and U-bolts for piping;
- Flange connections;
- Valves and threads of the cushions (actuators) of valves;
- Welds where fatigue can occur should be treated with an effective paint system;
- Pipe penetrations through decks and walls;
- Risers especially at the transitions between the splash zone protection and the normal coating system;
- Transitions between insulated and non-insulated installation components;
- Piping inside skirts of vessels
- Connection points of hand railings;
- The upper flanges of beams under gratings especially of walkways;
- Connection welds of the supports of walkways to the main beams;
- Any areas/parts that cannot be maintained shall be determined, analysed and followed up;
- Galvanised gratings

Since maintenance of insulation and passive fireproofing is often recognized to be included in maintenance of paintwork, this should be included in the coating monitoring surveys. Monitoring of the condition of gratings should be included as well.

4.6.3 Acceptance criteria for coating barrier

To maintain an acceptable level of barrier against external corrosion, minimum acceptance criteria (intervention levels) shall be defined. These minimum acceptance criteria should be based on percentages of visible surface rusting of coated surfaces. Intervention levels should be defined for both critical and non-critical components of a facility. The Principal shall define the critical and non-critical components of a facility. Typical intervention levels are given in Table 17.

Guidance on degrees of visible surface rusting is given in (II-5).

Coating systems applied to stainless steel for the purpose of protection against corrosion (e.g. chloride stress corrosion cracking) shall have no imperfections such as damaged areas, cracking, flaking and disbonding.

Table 17 Typical intervention levels

Component	% Surface rusting
Non-safety critical elements	5
Safety-critical elements	3

- NOTES:
1. The visible surface rusting must have a local character and must not be scattered/pinpointed over the whole surface of a component. If surface rusting is scattered/pin-pointed all over the surface, the paint system has lost its protective qualities.
 2. It is crucial that in addition to the intervention levels for coating work, the severity of the rusting shall also be reported. The following guideline may be used:

Light (L)	Visible surface rusting without build-up/flaking of corrosion products;
Medium (M)	Visible surface rusting with slight (local) build-up/flaking of corrosion products;
Severe (S)	Visible surface rusting with clear visible (local) build-up/flaking of corrosion products and/or material losses.

3. Blistering cracking, disbonding, conspicuous discolouration or excessive loss of gloss of the coating system shall also be reported;
4. For the sake of safety (anti-slip) and the visibility of markings, a more stringent intervention value may be required for steel floors with an anti-skid system e.g. topside helidecks. Similar arguments apply to safety markings;
5. For the above-water part of jackets that have a corrosion allowance, a less stringent intervention value may be used;
6. Welds where fatigue can occur, such as the shim plate areas of the legs, should have an intact paint system;
7. For facilities less than 36 months old, and for facilities whose appearance is considered important by the Principal, an intervention level of maximum 3 % should be used for all components.

4.6.4 Evaluation of condition monitoring

The Principal will review the condition monitoring reports. Facility components found to be inaccessible for coating condition inspection should be reported to the responsible Technical Authorities and Management. The barrier coating should be maintained within two (2) years after the condition of the barrier is found to be not in accordance with the minimum acceptance criteria. If repair work has not been carried out in time or if severe (local) corrosion has been observed during condition monitoring, the responsible disciplines should be consulted on further actions to ensure safety and technical integrity.

The condition of all the components of an area/block, including insulation and passive fireproofing, should be reviewed when drafting scopes of work for maintenance.

Consideration should be given to whether it is justified to repair the coating barrier of a single component only, or whether the whole area/block should be maintained. Specialist knowledge, including insight into costs and techniques, may be required to make the choice between repair and large-scale maintenance.

Specific consideration should be given to and thorough analysis made of areas and/or parts that cannot be inspected or maintained. Appropriate actions, such as risk analyses etc., to ensure long-term integrity should be instigated.

5. VISIBLE CORROSION DEGREES

The pictures below can be used for the visual determination of the percentage of surface rusting. These pictures are based on standards such as the European Scale of Degree of Rusting and ASTM D 610.



0.05 %



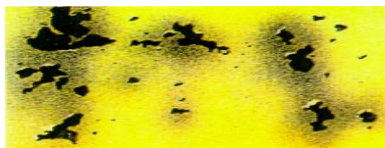
0.5 %



1 %



3 %



8 %



15 % to 20 %



40 % to 50 %



75 % to 85 %



95 %

PART III REFERENCES

In this DEP, reference is made to the following publications:

- NOTES:
1. Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.
 2. The DEP's and most referenced external standards are available to Shell users on the SWW (Shell Wide Web) at <http://sww05.europe.shell.com/standards/>.

SHELL STANDARDS

Painting and coating of new equipment	DEP 30.48.00.31-Gen.
Thermal sprayed aluminium coatings	DEP 30.48.40.31-Gen.
Elastomer coatings and Monel sheathing for offshore riser protection	DEP 31.40.30.36-Gen.

AMERICAN STANDARDS

Standard practice for cleaning, descaling, and passivation of stainless steel parts, equipment, and systems.	ASTM A 380
Standard test method for evaluating degree of rusting on painted steel surfaces	ASTM D 610
Standard test method for coating flexibility of prepainted sheet	ASTM D 4145
Standard test method for indicating oil or water in compressed air	ASDTM D 4285
Standard test method for pull-off strength of coatings using portable adhesion testers	ASTM D 4541
Standard test method for measuring MEK resistance of ethyl silicate (inorganic) zinc-rich primers by solvent rub	ASTM D 4752
Standard practice for conducting a patch test to assess coating compatibility	ASTM D 5064
Standard method for measuring humidity with a psychrometer (the measurement of wet- and dry-bulb temperatures)	ASTM E 337
<i>Issued by:</i> <i>American Society for Testing and Materials</i> <i>100 Bar Harbour Drive</i> <i>West Conshohocken,</i> <i>Pa. 19428-2959</i> <i>USA</i>	
Joint surface preparation standard white metal blast cleaning	NACE No. 1
Joint surface preparation standard near-white metal blast cleaning	NACE No 2/ SSPC-SP 10
Brush-off blast cleaning	NACE No. 4
Surface preparation and cleaning of metals by waterjetting prior to recoating	NACE No. 5
Wet abrasive blast cleaning	NACE 6G198
Discontinuity (holiday) testing of new protective coatings on conductive substrates	NACE RP0188

Offshore platform ballast water tank coating system evaluation NACE TM0104

Offshore platform atmospheric and splash zone maintenance coating system evaluation NACE TM0304

Offshore platform atmospheric and splash zone new construction coating system evaluation NACE TM0404

Issued by:
NACE
1440 South Creek Drive
Houston, TX 77084-4906
USA

Measurement of dry coating thickness with magnetic gages SSPC-PA 2

Solvent cleaning SSPC-SP 1

Power tool cleaning SSPC-SP 3

White metal blast cleaning SSPC-SP 5

Brush-off blast cleaning SSPC-SP 7

Near-white blast cleaning SSPC-SP 10

Power tool cleaning to bare metal SSPC-SP 11

Surface preparation and cleaning of metals by waterjetting prior to recoating SSPC-SP 12

Wet abrasive blast cleaning SSPC-SP TR 2

Issued by:
The Society for Protective Coatings
40 24th Street, 6th Floor
Pittsburgh
PA 15222-4643
USA

INTERNATIONAL STANDARDS

Wrought aluminium and aluminium alloys-Chemical composition and forms of products – Part 1: Chemical composition. ISO 209-1

Hot-dip galvanized coatings on fabricated iron and steel articles-Specifications and test methods. ISO 1461

Paints and varnishes – Standard panels for testing ISO 1514

Paints and varnishes – Cross cut test. ISO 2409

Paints and varnishes – Determination of film thickness ISO 2808

Paints and varnishes – Determination of resistance to liquids –Part 2: Water immersion method ISO 2812-2

Zinc dust pigments for paints – Specifications and test methods ISO 3549

Paints and varnishes – Pull-off test for adhesion ISO 4624

Paints and varnishes – Evaluation of degradation of coatings Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 1: General introduction and designation system ISO 4628-1

Paints and varnishes – Evaluation of degradation of coatings Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 2: Assessment of degree of blistering	ISO 4628-2
Paints and varnishes – Evaluation of degradation of coatings Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Assessment of degree of rusting	ISO 4628-3
Paints and Varnishes – Determination of resistance to humidity – Part 1: Continuous condensation	ISO 6270-1
Paints and Varnishes – Determination of resistance to humidity – Part 2: Procedure for exposing test specimens in condensation-water atmospheres	ISO 6270-2
Paints and varnishes – Rapid-deformation (impact resistance) tests – Part 1: Falling-weight test, large-area indenter	ISO 6272-1
Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness	ISO 8501
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	ISO 8501-1
Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 2: Preparation grades of previously coated steel substrates after localized removal of previous coatings	ISO 8501-2
Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 1: Field test for soluble iron corrosion products	ISO 8502-1
Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 3: Assessment of Dust on Steel Surfaces Prepared for Painting (Pressure-Sensitive Tape Method)	ISO 8502-3
Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 4: Guidance on the Estimation of the Probability of Condensation Prior to Paint Application	ISO 8502-4
Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 6: Extraction of soluble contaminants for analysis The Bresle method	ISO 8502-6
Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 9: Field Method for the conductometric determination of water-soluble salts	ISO 8502-9

Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast cleaned steel substrates	ISO 8503
Preparation of steel substrates before application of paints and related products – Surface preparation methods – Part 2: Abrasive blast-cleaning	ISO 8504-2
Preparation of steel substrates before application of paints and related products – Surface preparation methods – Part 3: Hand- and power-tool cleaning	ISO 8504-3
Quality management systems - Requirements	ISO 9001
Fasteners – Hot dip galvanized coatings	ISO 10684
Preparation of steel substrates before application of paints and related products – Specifications for metallic blast-cleaning abrasives – Part 2: Chilled-iron grit	ISO 11124-2
Preparation of steel substrates before application of paints and related products – Specifications for metallic blast-cleaning abrasives – Part 3: High-carbon cast steel shot and grit	ISO 11124-3
Preparation of steel substrates before application of paints and related products – Specifications for non-metallic blast-cleaning abrasives	ISO 11126
Preparation of steel substrates before application of paints and related products – Specifications for non-metallic blast-cleaning abrasives – Part 4: Coal Furnace Slag	ISO 11126-4
Preparation of steel substrates before application of paints and related products – Specifications for non-metallic blast-cleaning abrasives – Part 7: Fused Aluminium Oxide	ISO 11126-7
Preparation of steel substrates before application of paints and related products – Specifications for non-metallic blast-cleaning abrasives – Part 9: Staurolite	ISO 11126-9
Preparation of steel substrates before application of paints and related products – Specifications for non-metallic blast-cleaning abrasives– Part 10: Almandite Garnet	ISO 11126-10
Preparation of steel substrates before application of paints and related products – Test methods for non-metallic blast-cleaning abrasives	ISO 11127
Paints and Varnishes – Corrosion protection of steel structures by protective paint systems – Part 2: Classification of environments	ISO 12944-2
Paints and Varnishes – Corrosion protection of steel structures by protective paint systems – Part 6: Laboratory performance test methods	ISO 12944-6
Paints and Varnishes – Corrosion protection of steel structures by protective paint systems – Part 7: Execution and supervision of paint work	ISO 12944-7:1998

Paints and Varnishes – Corrosion protection of steel structures by protective paint systems – Part 8: Development of specifications for new work and maintenance ISO 12944-8:1998

Thermal Spraying – Approval testing of thermal sprayers ISO 14918

Paints and varnishes – Determination of resistance to cathodic disbonding of coatings exposed to sea water ISO 15711

Conformity assessment – General requirements for bodies operating certification of persons ISO 17024

Paints and Varnishes – Corrosion protection of steel structures by protective paint systems – Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces ISO 19840

Paints and varnishes – Performance requirements for protective paint systems for offshore and related structures ISO 20340:2003

*Issued by:
International Organisation for Standardisation
Case Postale 56
CH-1211 Geneva 20
Switzerland*

Copies can also be obtained from national standards organisations.

NORWEGIAN STANDARDS

Sub-sea colour and marking NORSOK U-CR-008

*Issued by:
Standards Norway
Strandveien 18
N-1326 Lysaker
Norway*

APPENDIX A WAVE TANK/CONDENSATION TESTING OF COATINGS FOR SEAWATER BALLAST AND VOID TANKS

A.0 GENERAL

The testing procedure shall be in accordance with sub-section (II-2.2.1).

Testing reports from certifying bodies may be submitted for the Principal's approval as part of the testing required in Table 6.

A.1 PREPARATION OF TEST PANELS

A.1.1 Test panels

Unless otherwise agreed the test panels shall be made from steel complying with ISO 1514 and the size shall be 90 mm x 150 mm x 5 mm, but shall fit the wave tank and the condensation chamber. The panels shall be blast-cleaned to the visual standard of Sa 2½ in accordance with ISO 8501-1 at the time of coating. The surface profile shall be agreed with the paint Manufacturer and assessed in accordance with ISO 8503-1.

For the wave tank testing, three sets of four blast-cleaned panels shall be made. For the other tests at least one set of three panels shall be made. For all tests, at least one additional blast-cleaned and coated panel shall be made, but not be exposed, and shall be kept as a reference panel.

A.1.2 Zinc-shop primed test panels

The panels shall be blast-cleaned to the visual standard of Sa 2½ in accordance with ISO 8501-1 at the time of coating. A zinc-shop primer with low zinc content shall be applied to a dry film thickness of 15 µm to 20 µm. The shop-primed test panels shall then be weathered in a marine atmosphere for 14 days. Before the coating to be tested is applied, the shop-primed surface shall be washed with tap water and then dried. Blast-cleaned panels shall be used as reference panels.

A.1.3 Organic (non-zinc) shop primed test panels

The panels shall be blast-cleaned to the visual standard of Sa 2½ in accordance with ISO 8501-1 at the time of coating. An organic non-zinc-containing shop primer shall be applied to a dry film thickness of 20 µm. Before the coating to be tested is applied, the shop-primed test panels shall be cured according to the paint Manufacturer's specification. Blast-cleaned panels shall be used as reference panels.

A.1.4 Blast cleaned Test Panels

The panels shall be blast-cleaned to the visual standard of Sa 2½ in accordance with ISO 8501-1 at the time of coating.

A.2 APPLICATION OF COATING SYSTEMS

A.2.1 Application and curing conditions

The application and curing conditions data shall be recorded. All panels shall be cured in a ventilated room at a temperature of 18 °C to 24 °C and a relative humidity of 40 % to 60 %.

A.2.2 Dry film thickness measurements

The dry film thickness (DFT) shall be measured in accordance with (II-1.6.8.3).

A.3 TEST METHODS

A.3.1 Ballast wave tank

The wave tank apparatus should consist of at least three tanks (see Figure 2), mounted on a skid that is cyclically tilted to create wave movement in the tanks.

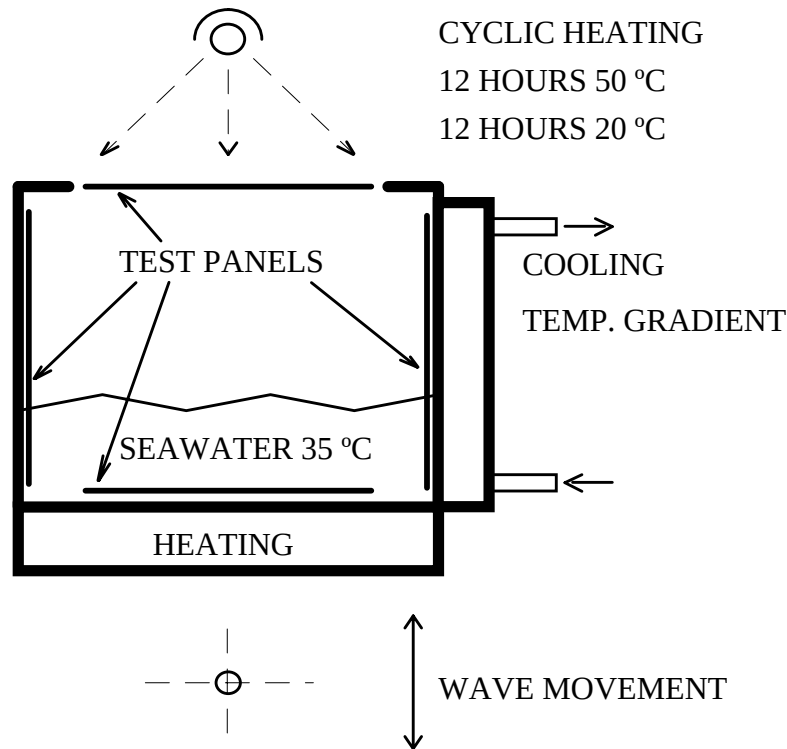


Figure 2 Wave tank for testing of ballast tank coatings

Four test panels shall be mounted in each tank, one at the top, one at the bottom, and two on opposite vertical sides. The test products shall be applied on the front side of the panels (facing towards the tank medium). The other side (facing towards the tank walls) shall be coated with a suitable epoxy coating.

The tank shall be filled to one-third of its volume with seawater at a temperature of 35 °C. The top panel shall be heated to 50 °C for 12 h and 20 °C for 12 h.

NOTE: This is done to simulate the heat from the sun (12 h at 50 °C) under deck in top-wing tanks, and a subsequent 12 h at ambient night temperature.

One of the vertical panels shall be cooled at the reverse side, giving a temperature gradient of approximately 20 °C through the coating. Such gradients have been found to be detrimental to many types of coatings. This will simulate, for example, cooled bulkhead in a ballast wing tank.

The other vertical panel shall not be heated or cooled. The bottom panel shall be cathodically protected by means of a sacrificial zinc anode. A circular artificial holiday down to bare steel shall be introduced on the test panel in order to evaluate the effect of the cathodic protection. The top panel and the two vertical panels shall have a horizontal scratch line down to bare steel. Both types of holidays are made using a facing/milling cutter.

The test cycle shall be run for two weeks with seawater and one week empty. When empty, some seawater shall be left in the bottom to achieve a high relative humidity in the tank. The level of the seawater shall be kept below the bottom panel during this period in order to simulate an empty tank with no effect from the anode. The three-week cycle shall be repeated until the total exposure time is reached

The exposure time shall be 180 days for coatings tested on zinc shop-primed, organic shop-primed and blast-cleaned panels.

A.3.2 Condensation chamber

This test shall be performed in accordance with ISO 6270-1 and ISO 6270-2, which is specially designed to evaluate coatings for the protection of steel in environments with high humidity and condensation, such as water ballast tanks. The test gives information regarding the water permeability of a coating system. The condensation chamber test shall be as follows:

A covered plastic chamber shall have fresh water at a temperature of 40 ± 2 °C in the bottom. The test panels shall be placed on the top of the chamber at an angle of 15° to the horizontal with the back side facing the room at a temperature of (23 ± 2) °C. Water evaporating from the bottom of the chamber condenses under the panels onto the coating to be tested.

For the systems tested, a minimum of four panels and one blast-cleaned panel shall be used. One (1) out of the four (4) shall not be exposed and kept as a reference panel.

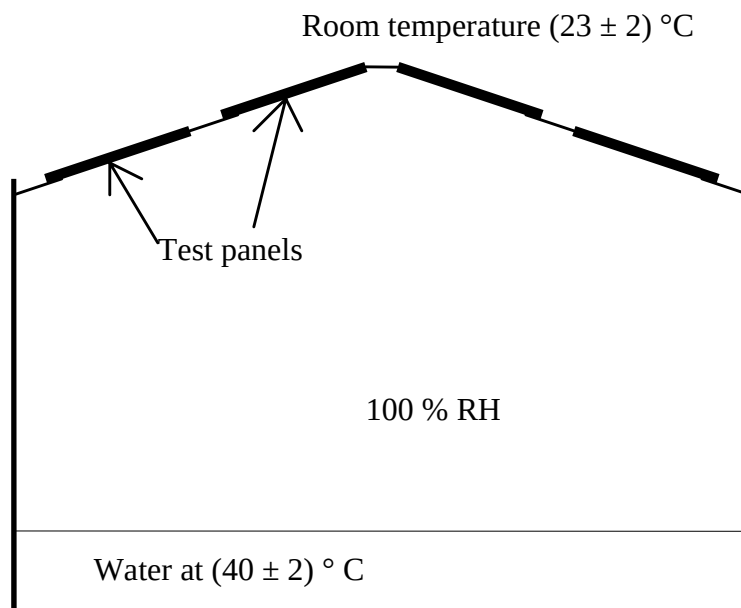


Figure 3 Condensation chamber

The exposure time shall be 180 days for coatings tested on zinc shop-primed, organic shop-primed and blast cleaned panels.

A.4 CLASSIFICATION OF PRODUCTS

A.4.1 Hard coatings

This is a coating which cures or dries and is used for long-term protection of steel surfaces.

A.4.2 Documentation and identification

Documentation and identification shall be in accordance with Part II Specification.

A.4.4 Evaluation and classification of hard coatings

A.4.4.1 Evaluation of blisters and rust

At intervals during the exposure and at the end of the test, the coatings shall be evaluated for the degree of blistering and of rusting according to the ISO 4628-1, ISO 4628-2 and ISO 4628-3. A minimum of two (2) out of three (3) panels shall pass the acceptance criteria.

A.4.4.2 Physical testing

Before exposure, panels shall be tested for pinholes with a low-voltage pinhole detector at 90 V. Pinholes shall be repaired.

After the tests have been completed, the top wave tank panel and a reference panel not exposed shall be tested for adhesion in accordance with ISO 4624. Three dollies shall be used on each panel, and equipment with automatically centered pulling force shall be used. The average of the three dollies on the top wave tank panel shall be used for the classification.

The effects of the waves, the heat and the temperature gradients shall be visually evaluated.

The undercutting (corrosion creep) along both sides of the scribe mark on each panel shall be measured and the maximum undercutting determined. The average of these three maximum recordings shall be used for the classification.

Flexibility shall be tested in accordance with a modified version of ASTM D 4145, modified as follows: 3 mm steel thickness, 350 μm coating, 150 mm cylindrical mandrel, at least 2 % elongation. Three pieces of size 5 cm x 15 cm shall be cut from the top panel of the wave tank and three shall be cut from the unexposed panel. The pieces shall be bent 90 ° over mandrels of 40 mm, 75 mm and 150 mm diameter, which corresponds to about 7.5 %, 4 % and 2 % elongation. The minimum diameter of mandrel for any cracking in the coating shall be reported.

For the panel with the anode, the current demand shall be calculated and the effect of the cathodic protection (disbonding/blistering) visually evaluated.

A.4.4.3 Classification of hard coatings

The classification shall be based on the density of blisters, the area rusted, undercutting from the scribe marks and the adhesion properties, according to Table A.2.

A.4.4.4 Acceptance criteria

The classification after the testing shall be Class B1 and no flaking or cracking of the exposed coating system is allowed. The maximum acceptable current demand for the bottom panel shall be 5 mA/m² and the cathodic disbonding from an artificial holiday shall be no more than 8 mm.

A.4.4.5 Test report

Unless otherwise agreed, the test report shall be in accordance with (II-2.2.14).

Table A.2 Classification of hard coatings

Class	Area blistered	Area rusted	Undercutting from scribe mark	Adhesion, adhesive failure ¹	
				On blast-cleaned panels	On all other substrates
B1	No blisters	Ri 0 (0 %)	less than 8 mm	more than 5 MPa	more than 3.5 MPa
B2	Density 1 to 2, either on any of the wave tank panels or on any of the condensation chamber panels	Ri 1 (0.05 %) on any panel	less than 10 mm	more than 4 MPa	more than 3 MPa
B3	Density 1 to 2 on any of the wave tank panels and on any of the condensation chamber panels	Ri 2 (0.5 %) on any panel	less than 12 mm	more than 3 MPa	more than 2.5 MPa
B4	Density 3 to 4, either on any of the wave tank panels or on any of the condensation chamber panels	Ri 3 (1 %) on any panel	less than 15 mm	more than 2.5 MPa	more than 2 MPa
B5	Density 3 to 4 on any of the wave tank panels and on any of the condensation chamber panels	Ri 4 (8 %) on any panel	less than 20 mm	more than 2 MPa	more than 1.5 MPa
B6	Density 4 to 5, either on any of the wave tank panels or on any of the condensation chamber panels	Ri 5 (40 % to 50 %) on any panel	more than 20 mm	less than 2 MPa	less than 1.5 MPa
The preparation of the substrate on which the coating has been tested shall be added to the classification, e.g. Class B1 pre-rusted, Class B1 hydro-jetted etc.					
¹ Adhesive failure between substrate and coating or between coats for 60 % or more of the area and cohesive failures in coating for 40 % or more of the area.					

APPENDIX B EXAMPLE OF AN INSPECTION AND TESTING PLAN (ITP) FOR COATING WORK

Inspection and Test Plan for Coating work of Offshore Facilities				No:.....		
Contractor:.....		Project:.....				
Coating system: FCM-2		Maintenance type: Refurbishment				
Date:						
Item	Inspection test items	Frequency	Acceptance standard	Report form (1)	Contractor (2)	Client (2)
1.0	Reference Documentation		Principal's technical coating specification Contractor quality manual, Doc No..... Contractor project quality plan, Doc No.....		R	R
2.0	Material receipt					
2.1	Coating material receipt	All	Principal's approved material/coating system		R	W
2.2	Coating material receipt	All	Coating material traceability Legible labels clearly identifying: -Supplier's name -Product name -Approved by Principal -Batch number -Shelf life -Storage instructions -Date of manufacture -Product data sheet -Material safety data sheets (MSDS)		M, V, R	W
2.3	Blasting material receipt	All	Traceability ISO 11126/ISO 11127 conformance Conductivity Legible labels clearly identifying: -Supplier's name -Product name -Batch number -Grading -Storage instructions		M, V, R	W
3.0	Inspection of surface condition	All surfaces	Check on excessive salt contamination. ISO 8502-6 and ISO 8502-9. Visible contamination etc.		R, W	W, M
3.1	Solvent or detergent cleaning	All surfaces	Pre-cleaning, No visible surface contamination from oil or grease etc.		R, W	W, M

Inspection and Test Plan for Coating work of Offshore Facilities				No:.....		
Contractor:.....		Project:.....				
Coating system: FCM-2		Maintenance type: Refurbishment				
Date:						
3.2	High pressure water/steam cleaning	All surfaces	Principal's technical specification, Section		R, W	M
3.3	Climatic conditions (air temperature and dew point readings)	Every two hours	The surface temperature shall be a minimum of 3 °C above the dew point, the relative humidity of the air shall be max. 85 %, the air or substrate temperature shall not be below 5 °C.		M, W, R	W
3.4	Steel temperature	Every two hours	Max. 40 °C		R	M
3.5	Compressed air supply blotter test	Twice/12 hours	No indication of oil discolouration, no indication of water contamination, ASTM D 4285		R, W	W, M
3.6	Blast nozzle pressure	Every 2 hours	7 bar minimum at nozzle		R	M
3.7	Surface profile	Once per 100 m ² or three times/ per blaster per day	40 µm to 70 µm (3 mils to 5 mils). ISO 8503, Testex tapes		W, R, M	W, M
3.8	Surface dust	Once per 100 m ² or three times/ per day	Rating 2, ISO 8502-3, clause 6.1		W, M, R	W, M
3.9	Presence of millscale	Once per 100 m ² or three times/ per day	Free of mill scale		W, M, R	W,M
3.10	Soluble salt contamination test (chlorides etc.)	Once per 100 m ² or three times/ per day	Residual chlorides shall be ≤ 50 mg/m ² ISO 8502-6 and ISO 8502-9 Pitted areas shall be checked for iron salts.		H, V, R	W, H
3.11	Visual inspection after abrasive blasting	All	SA 2½ acc. to ISO 8501 Minimum illuminance 500 lx		H, W, V, R	W, H
4.0	Calibration of inspection equipment	Start of production then every 3 hours	Dry film thickness gauges: start of shift and thereafter every three hours at the mid range of the coating thickness. Holiday detection: start of shift and thereafter every four hours. 2500 volts ±100 volts, Adhesion tester: daily		V, W, R	W
5.0	Spray pressure, tip size and fan angle.	At start of spraying	To match paint Supplier's recommendations		R	M
5.1	Primer application	All	60 µm dry film thickness. Measure wet film thickness (see Product Data Sheet)		W, R	M

Inspection and Test Plan for Coating work of Offshore Facilities				No:.....		
Contractor:.....		Project:.....				
Coating system: FCM-2		Maintenance type: Refurbishment				
Date:						
5.2	Stripe coat application of primer	All	Brush applied, worked into corners, edges and crevices		V, W, R	W
5.3	Dry film thickness	5 per m ²	Equal to or above 80 % of NDFT. Number of readings between 80 % of DFT and NDFT			
5.4	Second stripe coat application	All	Brush applied, worked into corners, edges and crevices		W, R	W
5.5	Second full coat application	All	120 µm dry film thickness. Measure wet film thickness (see Product Data Sheet)		W, V, R	M
5.6	Visual inspection	All	Uniform in colour, free from irregularities such as runs, sags, fish-eyes, orange peel etc		R, W, V	W
5.7	Dry film thickness	5 per m ²	Equal to or above 80 % of NDFT. Number of readings between 80 % of DFT and NDFT		H, R, W	H, W, M
5.8	Holiday test	100 % surface area	No holidays. 100 % of the coated surface shall be inspected in accordance with NACE RP 0188			
5.9	Cure Test	2× per sprayer per day	Solvent rub test in accordance with ASTM D 4752 for inorganic zinc primers: No softening		R, W	W
5.10	Adhesion test	1 per 5 m ²	Test shall be performed using a self-aligning tester in accordance with ASTM D 4541. Minimum acceptable value shall be 5 MPa.		R, V, W	W
5.11	Coating Repair	As required	Pinholes, mechanical damage from destructive adhesion testing etc, repair as per approved procedure. Re-test for thickness and porosity as per original. Under-thicknesses, prepare surface and re-coat as per approved procedure		R, V, W	W
Legend: H Hold M Monitor R Record V Visual W Witness NOTES: (1) Indicate reference to Contractor's Quality Control reporting forms or documents on which the quality data is to be recorded and/or reported. (2) These are examples of actions. Actions and action parties shall be agreed for each coating job.						

APPENDIX C FINISHING COLOUR SCHEDULE

Item	Colour	RAL code	Remarks
Structural steel	Broom yellow	1032	Including handrails, ladders, walkway framework (bordesses) and staircases
Vent stacks, flare booms and crane booms etc	White/red bands	9010/3002	Width of the band to be agreed (approx. 4.5 m)
Exterior of wall, cladding, bulkheads etc.	Carmine red	3002	
Internal of cladding and ceilings	Grey white	9002	
Wetted and intermittently-wetted	Black	9005	Broom yellow may be used if approved by the Principal
Closed deck areas	Dusty grey	7037	
Top-side helidecks	Leaf green	6032	Helideck markings shall be agreed with the Principal
Firewater piping and equipment	Carmine red	3002	
Piping, valves etc.	Grey white	9002	
NOTE: Unless otherwise specified by the Principal, stream identification and direction shall applied on piping systems after the final coats have been applied and cured, The type and model shall be agreed between the Principal and the Contractor. The banding systems shall be durable and in the form of plastic tape or self sprung coil of the appropriate size to fit the pipe. These shall not cause damage to either the coating or the pipe material and shall be applied at proper intervals to enable easy identification of the pipe, contents and fluid direction. For insulated lines this identification shall be applied to the outer surface of the insulation.			