

PROTECTIVE COATINGS FOR OFFSHORE FACILITIES

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DESIGN AND ENGINEERING PRACTICE



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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°C and above 450°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.