

DEP SPECIFICATION

PROTECTIVE COATINGS FOR ONSHORE AND OFFSHORE FACILITIES

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DESIGN AND ENGINEERING PRACTICE



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TABLE OF CONTENTS

1.	INTRODUCTION	5
1.1	SCOPE	5
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	5
1.3	DEFINITIONS	5
1.4	CROSS-REFERENCES	8
1.5	SUMMARY OF MAIN CHANGES.....	8
1.6	COMMENTS ON THIS DEP	9
1.7	DUAL UNITS.....	9
1.8	NON NORMATIVE TEXT (COMMENTARY).....	9
2.	GENERAL REQUIREMENTS	10
2.1	GENERAL.....	10
2.2	PERFORMANCE ASSURANCE	10
3.	PAINTING CONTRACTOR RESPONSIBILITY	10
3.1	HAZARDOUS COATING COMPONENTS	10
3.2	QUALITY OF COATING WORK.....	11
3.3	PERSONNEL	11
3.4	PROTECTION OF EQUIPMENT AND STRUCTURAL MEMBERS	11
3.5	BLASTING AND SPRAYING EQUIPMENT	11
4.	SURFACE PREPARATION	11
4.1	GENERAL.....	11
4.2	PRE-CLEANING	11
4.3	CLEANING OF SURFACES.....	12
5.	COATING APPLICATION.....	14
5.1	GENERAL.....	14
5.2	MIXING AND THINNING	15
5.3	COMPATIBILITY WITH EXISTING COATING SYSTEMS.....	15
5.4	OVERCOATING	15
5.5	SPRAY APPLICATION.....	15
5.6	BRUSH APPLICATION	15
5.7	ROLLER APPLICATION.....	15
5.8	STRIPE COAT	15
5.9	CARBON/STAINLESS STEEL JOINTS	16
5.10	REPAIR OF COATING DEFECTS	16
5.11	INTERNAL COATING OF TANKS, VESSELS AND EQUIPMENT	16
5.12	SHOP APPLIED ITEMS	16
5.13	MANUFACTURER/SUPPLIER'S STANDARD ITEMS.....	16
5.14	PIPING MEDIA IDENTIFICATION AND DIRECTION OF FLOW ARROWS	16
6.	QUALITY ASSURANCE AND CONTROL	17
6.1	GENERAL.....	17
6.2	REJECTED WORK AND EQUIPMENT.....	17
6.3	QUALITY PLAN	17
6.4	INSPECTION PERSONNEL AND EQUIPMENT	17
6.5	DEW POINT, AIR HUMIDITY AND SUBSTRATE TEMPERATURE	17
6.6	INSPECTION OF CLEANED SURFACES	18
6.7	APPLIED COATING INSPECTION	19
6.8	FINAL INSPECTION.....	21
7.	COATING MATERIALS AND SYSTEMS	22
7.1	COATING MATERIALS	22
7.2	COATING SYSTEMS	22
8.	PAINTING OF NEW CONSTRUCTION, MODIFICATIONS AND LARGE SCALE REFURBISHMENT PAINTING FOR ONSHORE FACILITIES	26
8.1	GENERAL.....	26
8.2	COATING SURFACES AND SYSTEMS- ONSHORE FACILITIES	26

9.	PAINTING OF NEW CONSTRUCTION, MODIFICATIONS AND REFURBISHMENT ON OFFSHORE FACILITIES	28
9.1	GENERAL.....	28
9.2	COATING SURFACES AND SYSTEMS- OFFSHORE FACILITIES	29
10.	INTERNAL COATING SYSTEMS FOR STEEL STORAGE TANKS, PRESSURE VESSELS AND EQUIPMENT	31
11.	STAINLESS STEEL – EXTERNAL SURFACES.....	33
12.	GALVANISED STEEL AND ALUMINIUM SURFACES– EXTERNAL.....	34
13.	LOW TEMPERATURE SERVICE – EXTERNAL.....	35
14.	PAINTING OF SUBMERGED ITEMS IN SUBSEA FOR NEW CONSTRUCTION AND MODIFICATIONS	35
14.1	GENERAL.....	35
14.2	CARBON STEELS, LOW ALLOY STEELS AND STAINLESS STEELS	35
15.	EXTERNAL PROTECTION OF BOLTS AND FASTENERS.....	36
15.1	GENERAL.....	36
15.2	COATING SYSTEMS	37
15.3	QUALITY CONTROL AND TESTING.....	37
15.4	PASSIVATION CONVERSION TREATMENT	38
15.5	WEAR RESISTANCE	38
15.6	THREAD FRICTION COEFFICIENT	39
15.7	HEAT TREATMENT AFTER PROCESSING	39
15.8	TESTING OF CORROSION RESISTANCE.....	39
16.	REFERENCES	40

1. INTRODUCTION

1.1 SCOPE

The DEP specifies requirements and gives recommendations for surface preparation and for painting and coating of new construction, modifications and large scale refurbishment of ferrous and non-ferrous metals. The large scale refurbishment painting is for complete full painting on a surface area of more than 1,000 m² (10,764 ft²) at one location.

This DEP is applicable for protective coatings of both onshore and offshore facilities including buried and subsea items.

This DEP is not applicable to:

- Buried pipelines and submerged pipelines;
- Internal coatings of tubing or drill pipes;
- Fusion bonded powder coatings;
- Equipment and components with a (continuous) service temperature below –100 °C (–148 °F) or above 595 °C (1103 °F);
- Temporary construction items;
- Coatings for buildings.

This DEP is a revision of the DEP of the same number dated February 2015, see (1.5) regarding the changes.

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. Any authorised access to DEPs does not for that reason constitute an authorisation to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could 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 regards 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 that 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 that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
Abrasive blast cleaning	The impingement of a high kinetic-energy stream of blast cleaning abrasive onto the surface being prepared.
Anchor profile	Contour of a blast-cleaned surface on a plane perpendicular to the surface.
Atmospheric zone in offshore facility	That part of an offshore facility structure 6 m (19.7 ft) above HAT.
CUI	Corrosion under insulation. An acceleration of corrosion due to ingress of moisture into external insulation where the operating temperature is in the range of -5 °C (23 °F) to 175 °C (347 °F).
Chalking	The appearance of a loosely adherent fine powder on the surface of a paint coating, arising from the degradation of one or more of its constituents, typically caused by UV attack.
Coating renovation	Coating maintenance programme based on complete removal of existing coatings followed by the overall application of a full coating system.
Cracking	The splitting of a dry paint film.
Crisping	Brittle and broken zinc layer defect on galvanized surface
Feathering	Beveling or tapering of the edge of a surface coating prior to repair of the coating at damaged areas.
Holiday/ Pinhole	Pinhole or very small size defect in a coating system, penetrating the entire thickness of the coating.
Hot dip galvanizing	Formation of a coating of zinc and/or zinc-iron alloys produced by dipping prepared steel in molten metallic zinc.
Offshore facilities	For the purpose of coating selection, facilities installed in open sea, or onshore within 10km (6 miles) of coastal waters.
Pore	Pinhole or very small size defect in a coating system, penetrating the entire thickness of the coating.
Refurbishment Painting	Where maintenance painting is required at an existing facility to restore the integrity of the coating.

Term	Definition
Rust back	Rust that occurs when freshly exposed bare steel is subjected to conditions of high humidity, moisture, or a corrosive atmosphere. It is the term used when steel cleaned by dry abrasive blasting or power tools begins to corrode.
Shop or prefabrication primer	Primers applied in a shop, fabrication or manufacturing facility to provide temporary protection to steel components during transport and/or fabrication.
Shot	Particles that are predominantly round, that have a length of less than twice the maximum particle width and that do not have edges, broken faces or other sharp surface defects.
Splash zone	Zone from 3 m (10 ft) below LAT up to 2 m (6.5 ft) 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.
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 (19.7 ft) above HAT.

1.3.3 Abbreviations

Term	Definition
CUI	Corrosion Under Insulation
DFT	Dry Film Thickness; the thickness of the dried or cured paint or coating film
FBE	Fusion Bonded Epoxy
HAT	Highest astronomical tide (deepest operating draught)
LAT	Lowest astronomical tide (lightest operating draught)
3LPE	Three layer polyethylene
3LPP	Three layer polypropylene
MSDS	Material Safety Data Sheet
N / M	The letter N is for new construction, modifications and M for Refurbishment. When it is indicated N / M, the coating system is suitable for all new construction, modifications and Refurbishment painting.
NDFT	Nominal (specified) Dry Film Thickness
PLEM	Pipe Line End Manifold

Term	Definition
PTFE	Fluoropolymer Coating
SBM	Single Buoy Mooring
TDFT	Total Dry Film Thickness; the overall thickness of the total number of coats in a paint system
TSA	Thermally Sprayed Aluminium
WFT	Wet Film Thickness; the thickness of the wet paint or coating

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (16).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2015. DEP 30.48.00.32-Gen. has been withdrawn and the content incorporated into this DEP. The following are the main, non-editorial changes

Section/Clause	Change
Table 7	Internal coatings for tanks, vessels and equipment merged in one table for both onshore and offshore facilities
Table 8	External coatings for all uninsulated and under insulated stainless steel surfaces merged in one table for both onshore and offshore facilities
Table 9	External coatings for galvanised surfaces and other surfaces merged in one table for both onshore and offshore facilities
Table 10	External coatings for cold services merged in one table for both onshore and offshore facilities
Table 16 & 18	External coatings for subsea items and risers merged in one table
Table 17	External coatings for submerged steel pipelines moved to informative part of DEP
'shall'	The number of 'shall' requirements reduced to avoid deviations and facilitate cost reduction.
Qualification requirements	The qualification requirements moved to DEP Informative part as it is not part of project activity.
Notes	Notes under the tables were moved to the text above the tables and repetitive information deleted.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://swwww.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. GENERAL REQUIREMENTS

2.1 GENERAL

1. All paint and coating systems shall meet the performance requirements and the coating systems as specified in this DEP with a minimum environment of C5-M, ISO 12944-2.
C5-M of ISO 12944-2 is designated environmental classification for atmospheric exposure to coastal and marine with industrial environment.
2. For long term corrosion protection of carbon steel and stainless steel items with a design life of 15 years or more, a Thermally Sprayed Aluminium (TSA) coating shall be applied in accordance with DEP 30.48.40.31-Gen.

2.2 PERFORMANCE ASSURANCE

2.2.1 Performance requirements

1. All coating systems shall be supplied with a manufacturer's warranty, with any conditions or exclusions agreed with the Principal prior to contract award, for the minimum lifetimes given below:
 - a. 5 years life for atmospheric exposure;
 - b. 10 years life for internal coating of tanks, vessels and equipment;
 - c. 15 years life for TSA coating.
2. The performance requirements for the coating system for the specified minimum lifetime (2.2.1, Item 1) shall be:
 - a. Adhesion between the coating system and the steel substrate and between the coating layers is not less than 70 % of the values specified in (6.7.5).
 - b. No blistering, visual cracking, mud-cracking or flaking of the coating system.
 - c. No discolouration, change in colour shade, and loss of gloss in the topcoats specified for the atmospheric zone except on steel floors but including the helideck.
3. The degree of rusting in accordance with ISO 4628-3 for the specified minimum lifetime (2.2.1, Item 1) shall be as follows:
 - a. not worse than Ri 2 (0.5 % rusting);
 - b. only in localized isolated locations and not scattered over the total surface area coated;
 - c. for TSA coatings, not worse than Ri 0 (0 % rusting);

3. PAINTING CONTRACTOR RESPONSIBILITY

3.1 HAZARDOUS COATING COMPONENTS

1. Coatings shall contain a maximum of 0.1 % (by mass) monomeric isocyanate at the time of painting.
2. Any anti-fouling coating system shall be free from tributyltin (TBT) compound.
3. Before commencing any surface preparation, the composition of any existing coating system shall be reviewed and checked for hazardous components by the painting Contractor and the Principal's nominee.

3.2 QUALITY OF COATING WORK

1. The Contractor shall ensure that carbon steel and stainless steel items are segregated before painting.
2. The painting Contractor shall provide the latest updated product technical data sheets of coating materials from the Manufacturer/Supplier for review by the Principal before commencing any painting.

3.3 PERSONNEL

1. The blasters and painters working on the painting job shall be certified in accordance with a scheme approved by the Principal (e.g., ASTM D4228).

3.4 PROTECTION OF EQUIPMENT AND STRUCTURAL MEMBERS

1. All equipment, structures and any other areas shall be protected from mechanical damage, environmental damage, blockage or obstruction, damage caused by over blasting, dripping paint, paint splashes and overspray.

3.5 BLASTING AND SPRAYING EQUIPMENT

1. Separators and traps shall be installed in the coolest part of the compressed air system in order to remove moisture and oil.
2. The presence of oil and water shall be determined in accordance with ASTM D4285 at least two times per 12 hours and following every compressor start-up.
3. In no case shall the temperature of the compressed air be allowed to exceed 100 °C (212 °F).
4. Blasting nozzles shall be discarded and replaced when either of the following apply:
 - a. the nozzle diameter has increased through wear by more than 50 % of the original diameter;
 - b. the specified minimum pressure, surface cleanliness and surface profile can no longer be achieved.

4. SURFACE PREPARATION

4.1 GENERAL

1. All edges shall be ground to a minimum radius of 2 mm (0.078 in).
2. Thermally cut areas and weld spatter shall be ground flush with the requirements of ISO 8501-3, preparation Grade P3.
3. Fabrication should be complete before surface preparation begins.
4. Where prefabrication primers are used, these shall be removed by blasting after assembly and blast cleaned to the initial specified surface cleanliness.
5. Stainless steel surfaces shall not be cleaned with carbon steel tools, or any tools previously used on carbon steel.

4.2 PRE-CLEANING

1. Prior to the blast cleaning and to any painting operation, the surface shall be dry, free of any contamination and all loose rust scale removed.
2. The salt contamination of parts that have been stored in or exposed to the open air shall be removed by washing with fresh water with chlorides less than 50 ppm prior to blast cleaning and assessed according to (6.6.2).

3. All bolt-holes should be solvent cleaned in accordance with SSPC SP1 prior to the commencement of blast cleaning.
4. When emulsion or detergent type degreasers / fresh water solutions are used for pre-cleaning carbon steel and low alloy steel surfaces, the treatment shall be followed by rinsing or pressure water wash using water with less than 250 ppmw chlorides, or steam cleaning.
 - a. In case of stainless steel surfaces, the water quality shall have chlorides less than 50 ppm and temperature less than 50 °C (122 °F).
 - b. Detergents with a pH > 9 shall not be used on aluminium substrates.
 - c. All degreasers shall be biologically degradable.
5. The large scale refurbishment of coating projects should start with high pressure steam/detergent cleaning to remove dirt, grease or salt deposits.
6. Welding flux, spatter, slivers, laminations and underlying mill scale not removed during fabrication and exposed before and during blast cleaning operations shall be removed by mechanical means so that edges are smooth or rendered flush.
7. Where rectification is required for blast-cleaned surfaces, the dressed areas shall be pre-cleaned as initially specified.

4.3 CLEANING OF SURFACES

4.3.1 General

1. To prevent dust and abrasive contamination, blast cleaning should not be done within 50 m (164 ft) of painting operations or wet coated surfaces.
 - a. A fire and dust protection cover should be provided for the blast cleaning area.
2. Minimum lighting requirement for abrasive blasting, painting and inspection shall be 500 lux.
3. Blast cleaned steel surfaces shall not be touched by bare hands.
4. If the surface being prepared lies adjacent to a coated surface, which is not part of the work, the following shall apply:
 - a. blast cleaning to overlap the coated surface by at least 50 mm (2 in);
 - b. the edges of the existing coating system to be feathered;
 - c. the remainder of the existing coated surface to be protected with shields or screens to prevent any over blast damage.
5. No acid washes, cleaning solvents or other chemical treatments shall be used on metal surfaces after they have been blast cleaned.
6. When galvanised or non-ferrous metal surfaces are painted, blast cleaning shall be carried out by smooth sweep blasting, using fine non-ferrous abrasives (e.g., aluminium oxide).
 - a. No defects such as break through or crisping of the zinc layer shall be permitted.
 - b. The surface roughness shall be in the range of 20 µm to 30 µm (0.75 mils to 1.2 mils).
7. When aluminium, galvanised components and zinc silicate primed carbon steel are painted, zinc or aluminium corrosion products (white rust) and any rust present shall be removed.

4.3.2 Surface cleanliness and profile

1. The surfaces of carbon and low alloy steelwork shall be blast-cleaned to the visual standard of Sa 2½ in accordance with ISO 8501-1 at the time of coating.

2. For the blast cleaning of vessel and tank internal surfaces, an inert blasting abrasive material (e.g., aluminium oxide) shall be used.
3. The surface profile and angular anchor pattern for carbon steel, low alloy steel and stainless steel surfaces shall be one of the following:
 - a. for coating system with DFT up to 500 μm (20 mils): 40 μm to 70 μm (1.5 mils to 3 mils);
 - b. for coating system with DFT above 500 μm (20 mils): 70 μm to 125 μm (3 mils to 5 mils), e.g., glass flake filled coating system.
4. The surface preparation for touch-up painting of welds (including field welds) and corroded and damaged areas with less than 50 cm^2 (7.75 in^2) shall be cleaned as a minimum by the bristle blaster method to obtain the required profile.

4.3.3 Abrasives

1. Abrasives for use in blast cleaning steels shall be in accordance with ISO 8504-2 and Table 1.
2. Test methods shall be in accordance with the tests specified in ISO 11127 and a test certificate for each batch of abrasive provided by the abrasive Manufacturer/Supplier.
3. The conductivity of abrasives for stainless steels shall be a maximum of 150 $\mu\text{S}/\text{cm}$ (381 $\mu\text{S}/\text{in}$).

Table 1 Abrasives specifications

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
	Garnet	Calcium iron silicate	ISO 11126-10
Synthetic mineral	Coal slag	Aluminium silicate	ISO 11126-4
	Aluminium oxide	Crystalline corundum	ISO 11126-7

4. The shot content in the mix with iron or steel grits shall:
 - a. not exceed 67 %;
 - b. contain no oil, grease or moisture;
 - c. have a soluble chloride salts content less than 100mg/L.
5. The abrasives should be supplied with certification documentation traceable to batches of material.

4.3.4 Grades of surface finish

1. The surface finish grades summarised in Table 2 shall be used.