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**Surface preparation and protective
coating**

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Foreword

NORSOK M-501:2022 was adopted as NORSOK Standard 2022-09-30. English version was published 2022-11-02.

NORSOK M-501:2022 supersedes NORSOK M-501 ed. 6, February 2012.

NORSOK is an acronym for the competitive position of the Norwegian continental shelf and comprise petroleum industry standards in Norway. The collaboration initiative in 1993 between the authorities and the petroleum industry initiated the development of NORSOK standards.

Reducing the project execution time and developing and operating cost for petroleum installations on the Norwegian shelf was the target.

The intention for the Petroleum industry is to develop and use standards providing good technical and cost-effective solutions to ensure that the petroleum resources are exploited and managed in the best possible way by the industry and the authorities. The industry will actively contribute to the development and use of international standards in the global market.

The NORSOK standards shall:

- bridge the gap based on experiences from the Norwegian continental shelf where the international standards are unsatisfactory;
- replace oil company specifications where possible;
- be available as references for the authorities' regulations;
- be cost effective; and
- promote the Norwegian sector as an attractive area for investments and activities.

Developing new NORSOK standards and regular maintenance of existing standards shall contribute to maintain the competitiveness both nationally and internationally for the Norwegian petroleum industry.

The NORSOK standards are developed by experts from the European petroleum industry with experience from the Norwegian Continental Shelf (NCS) and approved according to the consensus principles as laid down by the guidelines given in NORSOK A-001 N directive.

The NORSOK standards are owned by Offshore Norge, The Federation of Norwegian Industries and the Norwegian Shipowners' Association. They are managed and published by Standards Norway.

Annex A, F, G, H, and J are normative. Annex B, C, D, E, I, K and L are informative.

Introduction

The main changes included in this edition are:

- the corrosivity categories accounted for are described and also include buried conditions;
- the coating systems are divided into numbered sub-systems to distinguish substrate materials and varying operating conditions and described in separate coating system data sheets;
- new coating systems are introduced to cover:
 - cryogenic service;
 - high temperature service;
 - powder coatings;
 - passive fire protection in splash zone.
- quality control measures have been added for blasting abrasives;
- system pre-qualifications are introduced for additional coating systems;
- the requirements related to the coating procedure tests are outlined in more detail and an informative annex is included to visualise a typical test panel;
- the Health, Safety and Environment section (HSE) is rewritten;
- the passive fire protection section (PFP) has been extensively updated;
- a new section is included to cover repair of coating;
- a new section is included to cover quality management and performance assurance;
- a new section is included to cover coating selection tables;
- normative annexes are included to describe additional requirements related to the PFP pre-qualifications;
- a normative annex is included to describe the requirements related to the adhesion/cohesion testing;
- an informative annex is included to describe the qualification requirements for coating operators;
- an informative annex is included to describe overlapping zones between coating systems;
- an informative annex is included to describe maintenance coating.

The bibliography lists standards, norms, laws, regulations and other literature that may be relevant to the use of this document.

Normative text contains the requirements of the standard. Informative text is only guidance to the reader. All text in foreword and introduction is informative text. Note to entries in [Clause 3](#), Tables and Annexes to this document may be either normative or informative.

Surface preparation and protective coating

1 Scope

This document specifies the requirements for the selection of coating materials, surface preparation, application procedures and inspection for protective coatings to be applied during the construction and installation of offshore and coastal facilities and gives guidelines with respect to later maintenance work.

The objective of this document is to obtain coating systems that:

- meets the high durability range as defined in NS-EN ISO 12944-1;
- provides an optimal protection of the coated object with a minimum need for maintenance;
- are maintenance friendly;
- are application friendly;
- ensure health, safety and environmental impacts are evaluated and documented.

This document is not applicable to pipelines and pipeline risers.

It is further highlighted that a coating friendly design is a prerequisite for achieving a durable corrosion protection with limited maintenance and repairs. As a minimum the design of structures, equipment and items that shall be coated according to this document shall comply with the recommendation of NS-EN ISO 12944-3. To meet this requirement is outside the scope of a coating applicator since due considerations need to be taken at a much earlier design phase. This is a concern prior to any coating application, but is particularly emphasised for metallic spray applied systems. Due to the limitations related to metallic spray gun angles and distance restrictions, the additional design considerations and recommendations in NS-EN ISO 2063-1 shall be accounted for.

2 Normative references

The following referenced documents contain text which fully or in part is part of the requirements in the document. For dated references, only the edition cited applies. For undated references, the latest edition of the cited document applies (including amendments).

NORSOK M-001, *Materials selection*

NORSOK M-121, *Aluminium structural material*

NS-EN 1363-2, *Fire resistance tests — Part 2: Alternative and additional procedures*

NS-EN 13438:2013, *Paints and varnishes — Powder organic coatings for hot dip galvanised or sherardised steel products for construction purposes*

NS-EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

NS-EN ISO 2063-1, *Thermal spraying — Zinc, aluminium and their alloys — Part 1: Design considerations and quality requirements for corrosion protection systems*

NS-EN ISO 2063-2, *Thermal spraying — Zinc, aluminium and their alloys, Part 2: Execution of corrosion protection systems*

NS-EN ISO 2409, *Paints and varnishes — Cross-cut test*

NS-EN ISO 2812-1, *Paints and varnishes — Determination of resistance to liquids — Part 1: Immersion in liquids other than water*

NS-EN ISO 2812-2, *Paints and varnishes — Determination of resistance to liquids — Part 2: Water immersion method*

NS-EN ISO 3549, *Zinc dust pigments for paints — Specifications and test methods*

NS-EN ISO 4624, *Paints and varnishes — Pull-off test for adhesion*

NS-EN 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 1: General introduction and designation system*

NS-EN 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 2: Assessment of degree of blistering*

NS-EN ISO 4628-3, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 3: Assessment of degree of rusting*

NS-EN ISO 4628-4, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 4: Assessment of degree of cracking*

NS-EN ISO 4628-5, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 5: Assessment of degree of flaking*

NS-EN ISO 4628-6, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 6: Assessment of degree of chalking by tape method*

NS-EN ISO 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

NS-EN ISO 8501-3, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 3: Preparation grades of welds, edges and other areas with surface imperfections*

NS-EN ISO 8502-3, *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)*

NS-EN ISO 8502-4, *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*

NS-EN ISO 8502-6, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 6: Extraction of water soluble contaminants for analysis (Bresle method)*

NS-EN ISO 8502-9, *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*

NS-EN ISO 8503-1, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces*

NS-EN ISO 8503-2, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel — Comparator procedure*

NS-EN ISO 8503-4, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile — Stylus instrument procedure*

NS-EN ISO 8503-5, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 5: Replica tape method for the determination of the surface profile*

NS-EN ISO 8504-2, *Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 2: Abrasive blast cleaning*

NS-EN ISO 9001, *Quality management systems*

NS-EN ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

NS-EN ISO 11124-2, *Preparation of steel substrates before application of paints and related products — Specifications for metallic blast-cleaning abrasives — Part 2: Chilled-iron grit*

NS-EN ISO 11124-3, *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*

NS-EN ISO 11126-3, *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives — Part 3: Copper refinery slag*

NS-EN ISO 11126-4, *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives — Part 4: Coal furnace slag*

NS-EN ISO 11126-7, *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives — Part 7: Fused aluminium oxide*

NS-EN ISO 11126-8, *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives — Part 8: Olivine*

NS-EN ISO 11126-9, *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives — Part 9: Staurolite*

NS-EN ISO 11126-10, *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives — Part 10: Almandite garnet*

NS-EN ISO 12944-1, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 1: General introduction*

NS-EN ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

NS-EN ISO 12944-3, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 3: Design considerations*

NS-EN ISO 12944-4, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 4: Types of surface and surface preparation*

NS-EN ISO 12944-6, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 6: Laboratory performance test methods*

NS-EN ISO 12944-7, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 7: Execution and supervision of paint work*

NS-EN ISO 12944-9, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures*

NS-EN ISO 14713-2, *Zinc coatings — Guidelines and recommendations for the protection against corrosion of iron and steel in structures — Part 2: Hot dip galvanizing*

NS-EN ISO 14918, *Thermal spraying — Qualification testing of thermal sprayers*

NS-EN ISO 14919, *Thermal spraying — Wires, rods and cords for flame and arc spraying — Classification — Technical supply conditions*

NS-EN ISO 15711, *Paints and varnishes — Determination of resistance to cathodic disbonding of coatings exposed to sea water*

NS-EN ISO 16276-1, *Corrosion protection of steel structures by protective paint systems — Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating — Part 1: Pull-off testing*

NS-EN ISO 16276-2, *Corrosion protection of steel structures by protective paint systems — Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating — Part 2: Cross-cut testing and X-cut testing*

NS-EN ISO 16474-3, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

NS-EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

NS-EN ISO 19277, *Petroleum, petrochemical and natural gas industries — Qualification testing and acceptance criteria for protective coating systems under insulation*

NS-EN ISO 29601, *Paints and varnishes - Corrosion protection by protective paint systems - Assessment of porosity in a dry film*

NS-ISO 7888, *Water quality — Determination of electrical conductivity*

NS-ISO 19840, *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 22899-1:2021, *Determination of the resistance to jet fires of passive fire protection materials — Part 1: General requirements*

ISO/TS 29001, *Petroleum, petrochemical and natural gas industries — Sector-specific quality management systems — Requirements for product and service supply organizations*

ASTM A380, *Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub*

ASTM D2485, *Standard Test Methods for Evaluating Coatings For High Temperature Service*

ASTM D4285, *Standard Test Method for Indicating Oil or Water in Compressed Air*

ASTM D4752:20, *Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub*

ASTM D4940:15(2020), *Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blast Cleaning Abrasives*

ASTM D7393, *Standard Practice for Indicating Oil in Abrasives*

ASTM F22, *Standard Test Method for Hydrophobic Surface Films by the Water-Break Test*

ASTM G42:11, *Standard Test Method for Cathodic Disbonding of Pipeline Coatings Subjected to Elevated Temperatures*

NACE No. 12/AWS C2.23M/SSPC-CS 23.00, *Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel*

BS 476-20:1987, *Fire Tests on Building Materials and Structures — Part 20: Method for Determination of the Fire Resistance of Elements of Construction (General Principles)*

EI Standard 1541, *Requirements for internal protective coating systems used in aviation fuel handling systems*

IMO PSPC.MSC.215(82), *Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-sided skin spaces of bulk carriers*

IMO PSPC MSC.288(87), *Performance Standard for Protective Coatings for Cargo Oil Tanks of Crude Oil Tankers*

NACE TM0185, *Standard Test Method — Evaluation of Internal Plastic Coatings for Corrosion Control of Tubular Goods by Autoclave Testing*

NACE TM0404, *Offshore Platform Atmospheric and Splash Zone New Construction Coating System Evaluation*

NACE SP0198:2017, *Control of Corrosion under Thermal Insulation and Fireproofing Materials — A Systems Approach*

ASTM G14:04(2018), *Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)*

API Spec Q1, *Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry, Ninth Edition, Includes Errata (2014), Errata 2 (2014), Errata 3 (2019), Addendum 1 (2016) and Addendum 2 (2018) (Addendums Available in English Only)*

SSPC-SP 16, *Brush-off blast cleaning of coated and uncoated galvanised steel, stainless steels, and non-ferrous metals*

UL 1709, *Rapid Rise Fire Tests of Protection Materials for Structural Steel.*

UL 2431, *UL Standard for safety durability of fire resistive coatings and materials*

3 Terms and definitions

In this document, the following terms and definitions apply.

3.1**can (possibility and capability)**

1: expression in the content of a document conveying expected or conceivable material, physical or causal outcome.

2: expression in the content of a document conveying the ability, fitness, or quality necessary to do or achieve a specified thing

Note 1 to entry:

- Possibility and capability are expressed using the verbal forms specified in in ISO/IEC Directives, Part 2 Clause 7.5 Table 6. verbal form used for statements of possibility and capability, whether material, physical or casual

3.2**may (permission)**

expression in the content of a document conveying consent or liberty (or opportunity) to do something

Note 1 to entry:

- Permissions are expressed using the verbal forms specified in ISO/IEC Directives, Part 2 Clause 7.4 Table 5.

3.3**shall (requirement)**

expression in the content of a document conveying objectively verifiable criteria to be fulfilled and from which no deviation is permitted if compliance with the document is to be claimed

Note 1 to entry:

- Requirements are expressed using the verbal forms specified in ISO/IEC Directives, Part 2 Clause 7.2 Table 3.

3.4**should (recommendation)**

expression in the content of a document conveying a suggested possible choice or course of action deemed to be particularly suitable without necessarily mentioning or excluding others

Note 1 to entry:

- Recommendations are expressed using the verbal forms specified in ISO/IEC Directives, Part 2 Clause 7.3 Table 4.

Note 2 to entry:

- In the negative form, a recommendation is the expression that a suggested possible choice or course of action is not preferred but it is not prohibited.

3.5**cleanliness**

the minimum acceptable visual appearance of a substrate surface prior to coating application

3.6**coat-back**

continuation of passive fire protection along non fire critical steel work from primary structural steel work, to reduce heat transfer

3.7**coastal areas**

locations with direct exposure to the prevailing seaside wheather conditions and thereby to a humid and saliferous environment

3.8**coating**

layer formed from a single or multiple layers of a coating material to a substrate

3.9

coating material

product, in liquid, paste, melted metal or powder form, that when applied to a substrate forms a layer possessing protective, decorative or specific properties

3.10

coating dry film thickness

DFT

thickness after curing and after deduction of the relevant correction value

Note 1 to entry:

- The DFT shall be measured, adjusted according to the relevant correction value and recorded in accordance with NS-ISO 19840.

Note 2 to entry:

- Specified for each coating layer and also for the complete coating system

3.11

correction value

allowance for the influence of the abrasive blast cleaned roughened surface on the reading on the film thickness instrument

3.12

feathered

gradual taper in thickness from a coated surface

3.13

end user

company or organisation that is responsible for the operation of the installation or facility where the coated objects are to be located

3.14

holiday

discontinuity in a coating, which exhibits electrical conductivity, when exposed to a specific voltage

3.15

maximum operating temperature

maximum temperature the coating is able to withstand in continuous service

Note 1 to entry:

- This does not account for temporary higher temperatures that can be experienced under unstable conditions including start-up/shutdown, and process upsets.

3.16

maximum acceptable dry film thickness

maximum acceptable *DFT* [\(3.10\)](#) reading adjusted for the relevant correction value

3.17

minimum dry film thickness

minimum acceptable *DFT* [\(3.10\)](#) reading adjusted for the relevant correction value, e.g., no individual readings below this value is acceptable.

3.18

mist coat

a thinned coating applied on porous substrates or coatings to seal the inherent porosity, usually a thinned version of the subsequent coat of the coating system

3.19**nominal dry film thickness**

DFT [3.10] specified for each coat meeting the acceptance criteria specified in NS-ISO 19840.

3.20**off-the-shelf**

item available for purchase and use without having been specifically designed or custom made

3.21**pre-production trial**

alternative to CPT for internal coating of storage tanks and process vessels

Note 1 to entry:

— These trials can be done on the object or on a mock-up.

3.22**sealer**

coating material applied to fill pores in a porous coating surface

3.23**shop primer/prefabrication primer**

protective coating applied for temporary protection during transport and storage and/or during fabrication

3.24**stripe coat**

supplementary coat typically applied by brush to ensure adequate protection of critical areas like edges, welds etc.

3.25**tie coat**

coating material designed to improve intercoat adhesion

4 Abbreviations

For this document, the following abbreviations apply.

AISI	American Iron and Steel Institute
ASTM	The American Society for Testing and Materials
CADS	coating application data sheet
COQT	coating operator qualification test
CP	cathodic protection
CPS	coating procedure specification
CPT	coating procedure test
CSDS	coating system data sheet
DFT	dry film thickness
FROSIO	Faglig Råd for Opplæring og Sertifisering av Inspektører innen Overflatebehandling (The Norwegian Professional Council for Education and Certification of Inspectors for Surface Treatment)
HDG	hot-dip galvanising
HVAC	heating ventilation and air conditioning
IMO	International Maritime Organization
ISO	International Organization for Standardization
ITP	inspection and test plan
MEK	methyl ethyl ketone
MDFT	minimum dry film thickness
MSC	Maritime Safety Committee

NACE	NACE International (former National Association of Corrosion Engineers)
NDFT	nominal dry film thickness
NS	Norwegian Standard
PFP	passive fire protection
RAL	colour definitions issued by RAL (Deutsches Institut für Gütesicherung und Kennzeichnung e.V.)
RH	relative humidity
TSA	thermally sprayed aluminium
TSZ	thermally sprayed zinc
QC	quality control

5 General requirements

5.1 General

The selection of coating systems and application procedures shall be made with due consideration to the conditions during fabrication, installation, and service of the installation. To account for the service conditions the minimum, maximum, and cyclic temperatures that the item can be exposed to during commissioning, start-up, shutdown, upset cases, and the heat radiation potentially coming from the flare (if applicable) shall be evaluated.

The corrosivity categories defined in [NS-EN ISO 12944-2](#) shall be accounted for as specified below:

- corrosivity category CX applies for offshore and coastal facilities located above splash zone/tidal zone and exposed to the prevailing weather conditions;
- corrosivity category Im4 applies for offshore and coastal facilities permanently immersed in seawater;
- both corrosivity categories CX and Im4 apply for offshore and coastal facilities exposed to the splash zone or the tidal zone, and for sea water filled compartments;
- corrosivity category Im3 applies for underground piping in coastal facilities;

NOTE Note: This does not apply for pipelines (i.e; piping that is transporting oil and gas from the production area to an export loading terminal or refinery);

- corrosivity category C1 applies for offshore and coastal facilities located within Heating Ventilation and Air Conditioning (HVAC) controlled environment.

Specific qualification requirements for materials, personnel and companies are given in [Clause 11](#).

5.2 Design and planning

If the structures, equipment, or items to be protected against corrosion by coating do not comply with the recommendation of [NS-EN ISO 12944-3](#), mitigating actions need to be discussed and agreed upon. All activities shall be fully incorporated in the quality plan and shall be detailed in the inspection and test plan (ITP). See [Clause 14](#) for further details.

Details of management, inspectors, operators, facilities, equipment, and qualified procedures shall be established and documented before commencing work.

5.3 Equipment protection and clean up

All equipment and structures shall be fully protected from mechanical damage, ingress of abrasives and dust from blast cleaning. Adjacent areas not to be coated and any adjacent areas where coating work is

completed shall be protected to avoid damage from blasting and coating spills. On completion of the work in any area, all masking materials, used abrasives, equipment etc. shall be removed and the protected areas shall be inspected to verify no damage and no coating spills.

5.4 Ambient conditions

No final blast cleaning or coating application shall be done if the relative humidity exceeds 85 % and when the steel temperature is less than 3 °C above the dew point. Coating shall only be applied and cured within the limits specified by the coating manufacturer in the relevant coating application data sheet (CADS). The maximum metal surface temperature during coating application shall not exceed 50 °C unless a different temperature is specified in the CADS. A higher temperature is for example acceptable prior to the application of metallic coatings.

A CADS shall be prepared by the coating manufacturer identifying all coating materials within each coating system. The required content of a CADS is listed in [8.1](#).

5.5 Coating materials and coating systems

For all coating materials to be utilised according to this document technical data sheets having the information required according to [NS-EN ISO 12944-9](#) shall be readily available from the coating manufacturer.

The selected coating materials shall be suitable for the intended use and shall be selected after an evaluation of all relevant aspects such as:

- corrosion protective properties;
- requirements to health, safety, and environment;
- properties related to application conditions, (e.g., coating friendly design etc.) equipment, and personnel;
- experience with the coating materials and coating system;
- availability and economics of the coating materials.

All coating materials and solvents shall be protected from ignition sources and shall remain within the storage temperatures and storage conditions recommended by the coating manufacturer.

All coating materials and solvents shall be stored in the original container bearing the manufacturer's label and instructions. The label shall include the information requested by [NS-EN ISO 12944-9](#).

Damaged containers with breaching containment or materials that have exceeded their shelf life shall be rejected.

The coating systems covered by this document are specified in coating system data sheets (CSDSs) in [Annex A](#). The CSDSs form the generic requirements that apply for each system described in this document. Each system shall comply with the minimum requirements in terms of DFT and number of coats outlined in the respective CSDSs. Systems with more coats and higher total DFT are also considered to comply with such requirements if permitted by the coating manufacturer's recommendations. It must be observed that the temperature range given in each CSDS corresponds to the minimum and maximum operating temperature for the generic coating system. Additional restrictions may apply for specific materials based on the coating manufacturer's recommendations and qualification tests.

The actual coating materials to be utilised to form systems [CSDS no. 1A](#), [CSDS no. 1B](#), [CSDS no. 1D](#), [CSDS no. 1F](#), [CSDS no. 3A](#), [CSDS no. 3B](#), [CSDS no. 3C](#), [CSDS no. 3D](#), [CSDS no. 3E](#), [CSDS no. 3F](#), [CSDS no. 3G](#), [CSDS no. 4A](#), [CSDS no. 4B](#), [CSDS no. 5A](#), [CSDS no. 5S](#), [CSDS no. 6C](#), [CSDS no. 7A](#), [CSDS no. 7B](#), [CSDS no. 7C](#), [CSDS no. 9](#), [CSDS no. 10A](#) and [CSDS no. 10B](#) shall be pre-qualified according to the requirements in [Clause 11](#).

Topcoat colours should be in accordance with [Annex B](#). Light colours shall be used in ballast and freshwater tanks.

5.5.1 Supports and pipe penetrations

There is no requirement to change the coating system for coated piping going through a pipe penetration.

For piping that only requires coating under insulation, this coating system shall be applied to the pipe section going through the penetration and extend 50 cm to each side when measured from the sleeves.

If coating is not required for the piping material under insulation, the same applies when running through a pipe penetration.

Pipe penetration sleeves that have coating requirements shall be coated prior to running the pipe.

Any saddles, support plates, wear pads and belts that have coating requirements shall be coated prior to installation when not welded to the equipment or pipe.

5.6 Steel materials

Steel subject to surface preparation in new building phase shall not exceed rust-grade B according to [NS-EN ISO 8501-1](#).

5.7 The shop primer

Shop primers shall be regarded as temporary corrosion protection and shall be removed prior to the application of the coating system.

NOTE It should be noted that shop primers have under certain conditions previously been allowed to form an integrated part of the coating system. Experience has revealed that the strict surface preparation requirements that apply prior to the application of a coating system according to this document are difficult to control and to document at the steel mill.

5.8 Uncoated surfaces

The following items, when not submerged in seawater, shall not be coated for corrosion protection unless otherwise specified in [NORSOK M-001](#) or by the end user:

- aluminium;
- titanium;
- uninsulated stainless steel;
- insulated stainless steel heating/ventilation/air-conditioning ducts;
- copper;
- brass;
- lead;
- plastics and other non-metallic materials;
- jacketing materials on insulated surfaces.

If submerged in seawater, any coating requirements need to be agreed with end-user.

In addition, the below list reveals examples of items/surface areas that typically are not coated for corrosion protection:

- PTFE-coated, electroplated, hard faced or other specially coated items;
- machined mating surfaces;
- sealing contact area of flange and hub;
- ring joints contact surfaces;
- flange facing including wedge of compact flanges;
- weld bevels after final machining;
- signs, tags, notices, nameplates, lettering;
- sight glasses and light fittings;
- valve stems;
- cylinder rods;
- active surface areas of cathodic protection (CP) anodes;
- electrical contact points;
- bursting discs;
- tubing;
- galvanised grating.

If stainless steel is connected to carbon steel, the stainless steel part shall be coated 50 mm beyond the weld zone. The objective is to limit galvanic corrosion. If the length of the stainless steel part is less than 50 mm, the complete length shall be coated. For piping and pressure vessels, the coating for the stainless steel part shall not contain metallic zinc, or any other low melting point metals such as tin or lead.

5.9 Handling and shipping of coated items

Degreased, blast cleaned or coated items shall be carefully handled to avoid contaminations or damage to the surfaces. Handling of coated items shall comply with the CADS requirements.

5.10 Pre-qualification of materials, personnel, and procedures

The pre-qualification requirements described in [Clause 11](#) shall be fulfilled and documented prior to commencement of any work in accordance with this document.

5.11 Hot-dip galvanising

Hot-dip galvanising (HDG) shall be in accordance with [NS-EN ISO 1461](#). Minimum coating thickness for structural items and outfitting steel is 100 µm and 705 g/m². This is generally achievable for structural shapes with thicknesses exceeding 6 mm and for steel plates exceeding 16 mm thickness. If the required minimum HDG thickness is not possible to achieve, as is typically the case for thinner structures, an agreement on HDG acceptance level shall be made. [NS-EN ISO 14713-2](#) shall be consulted for guidance on the effect alloying elements have on the galvanising process of steel and regarding the advise to blast clean the surface prior to pickling. By blast cleaning prior to pickling increased HDG thickness is achieved. Structural items shall therefore be blast cleaned before HDG when this is feasible.

Coating system 6B is the default system to be used if additional corrosion protection is specified.

Metallic coating by thermal spraying shall be in accordance with the requirements in [Clause 9](#).

5.12 Records and reports

All measurements and inspection results required by this document shall be recorded. The records shall provide traceability to the coated objects or associated parts of the coated objects, the applied coating procedure specification (CPS) and the corresponding qualification by the coating procedure test (CPT). All steps i.e. pre-blasting operation, blasting and coating application shall be recorded in the coating report. This includes all inspections and tests according to [Table 2](#) like:

- conditions during blasting, coating application and curing including temperature and relative humidity (RH) recordings during final curing;
- records of the dry film thickness (DFT) measurements including the average, minimum and maximum values, and the number of measurements;
- all adhesion test results and the average adhesion test result from the corresponding CPT;
- curing test for zinc ethyl silicate (when applicable);
- percentage of thinner added to each coat;
- the acceptance criteria for each applicable test /inspection activity along with the obtained results;
- description of defective work and repairs;
- the relevant CADs from the coating manufacturer shall be attached.

The test reports shall be signed by the responsible inspector and include inspector name in capital letters, type of certificate and level, inspector number and the name of inspector employer. [11.2.5](#) covers the qualification requirements for inspectors.

The coating report shall be submitted to purchaser if not otherwise agreed. An example of a coating report template is given in [Annex D](#).

5.13 Additional requirements to equipment

The following additional general requirements are applicable for the surface protection of valves, actuators, gearboxes, pumps, motors and instruments:

- hand wheels and handles shall be in stainless steel or hot dip galvanised carbon steel according to [NS-EN ISO 1461](#);
- all bolt holes, where coating is not practical and/or not exposed to CP, shall as a minimum requirement, be preserved with wax. Unused treaded bolt holes, etc. shall be plugged or sealed;
- parts in carbon steel shall be coated prior to assembly, while parts in stainless steel may be coated after assembly.

Signs shall be fastened when the coating operations are finished, and the coated object is ready to be moved/transported.

Coating for corrosion protection can not be applied to tack welded areas exposed to offshore and coastal environments.

Gaps and voids with insufficient access for blast cleaning and coating application shall be closed according to [NS-EN ISO 12944-3](#).

All exposed surfaces on valves and flanges shall be blast cleaned and painted up to raised face or gasket area.

Care shall be taken to prevent blasting or coating of any stem, valve stem thread, packing, packing nuts and bolts or other items which in normal operation are subject to frequent usage. Precautions shall be made to protect the bolts and nuts during the blasting and coating operations.

5.13.1 Isolation joints

Coatings containing conductive components (e.g. zinc rich coating, metallic zinc or aluminium) shall not be used on isolation joints.

5.14 Overlap zones

The overlap sequence in the transition zone between two coating systems depends upon the compatibility of the involved coating materials and any additional limitations. Recommendations are given in [Annex K](#).

6 Health, safety and environment

When evaluating coating systems, the following documentation shall be provided:

- safety data sheets for all coating materials;
- any additional application instructions or ventilation requirements (safe use mixture information);
- relevant material safety certifications, like potable water certifications or hygiene certifications;
- other documentation including environmental profile of the coating systems should also be provided.

All coating materials shall as a minimum be compliant with the EU REACH regulation or the regional equivalent with respect to content of substances requiring Authorisation (Annex XIV of EC 1907/2006) and regarding any Restrictions (Annex XVII of EC 1907/2006).

Furthermore, the content of silica and heavy metals in blast cleaning abrasives (see [NS-EN ISO 8504-2](#)) and the coating materials shall comply with the local regulations in the country where these operations takes place.

To avoid growth of microbes in potable watertanks, the coating appearance is a key to be considered with great care. Rollers shall not be used.

To avoid operators being exposed to decomposition of coating during hot work the coating system adjacent to the heat affected zone including that on the opposite side shall be removed to a distance large enough to avoid any release of hazardous materials.

6.1 HSE during coating work processes

Companies performing work in accordance with this document shall have the safety data sheets for the blasting abrasives, coating materials and thinners that are being used readily available. Companies performing work in accordance with this document are responsible for having the required personal protective equipment available and ensuring that this equipment is correctly used.

7 Surface preparation

7.1 Pre-blasting preparations

Sharp edges, fillets, corners, and welds shall be rounded or smoothed by grinding to grade P3 as defined in [NS-EN ISO 8501-3](#) (minimum radius 2 mm). Welds do not need to be prepared flush with the surface,

rounding to make the surface even is sufficient. All welds shall be inspected and, if necessary, repaired prior to final blast cleaning of the area. Surface pores, cavities, weld spatter, rough capping, undercut and slag shall be removed by suitable mechanical means or weld repair.

Grade P2 is acceptable for substrates to be coated with system 8. The same also apply for substates only to be coated to limit current drain to a CP system.

Hard surface layers (e.g. resulting from flame cutting) shall be removed by grinding prior to blast cleaning.

Any major surface defects, particularly surface laminations are detrimental to the protective coating system and shall be removed by suitable mechanical means. Where such defects have been revealed during blast cleaning, necessary preparations shall be repeated to achieve the specified requirements.

The surfaces shall be free from any foreign matter such as weld flux, slivers, oil, grease, machining fluids, salts etc. prior to blast cleaning. Any oil and grease contamination shall be removed in accordance with [NS-EN ISO 12944-4](#) and all surfaces shall be washed with clean fresh water prior to blast cleaning. Upon completion, water break test as per [ASTM F22](#) shall be carried out as per [Table 2](#), activity 12.4.

7.2 Blast cleaning

Blasting abrasives shall be dry, clean, and free from contaminants that will be detrimental to the coating performance.

The size of abrasive particles for blast cleaning shall be selected to meet the surface profile height (anchor pattern profile) requested for the applicable coating system. The surface profile shall be graded in accordance with [NS-EN ISO 8503-1](#), [NS-EN ISO 8503-2](#), [NS-EN ISO 8503-4](#) and/or [NS-EN ISO 8503-5](#). Grit shall be used as blast medium. No mixture with shot abrasives is allowed. The grit shall be non-metallic and free from chlorides when used on stainless steel and non-ferrous substrates.

Any metallic abrasive to be used shall comply with [NS-EN ISO 11124-2](#) or [NS-EN ISO 11124-3](#). Any non-metallic abrasive to be used shall comply with [NS-EN ISO 11126-3](#), [NS-EN ISO 11126-4](#), [NS-EN ISO 11126-7](#), [NS-EN ISO 11126-8](#), [NS-EN ISO 11126-9](#) or [NS-EN ISO 11126-10](#).

The abrasives shall be supplied in sealed packages and stored in a dry environment away from possible contaminations. Abrasive products delivered in defective packaging shall be rejected.

The contamination of abrasives shall be controlled as per [Table 2](#), activity 12.6.

Prior to blasting the compressed air quality shall be controlled as per [Table 2](#), activity 12.5. The adjacent surfaces not to be blasted shall be preserved to avoid contamination and damage by blasting.

The cleanliness of the blast cleaned surface shall be as required for the relevant coating system in [Annex A](#).

Recycling of blasting abrasives shall only be allowed if the requirements related to the abrasive are within the limits of the relevant standard. Blasting media used on carbon steel shall not be used on stainless steel. If necessary, the ferroxyl test for free ions, as per [ASTM A380](#), may be used on stainless steel substrates to detect any iron contamination.

7.3 Final surface condition

The surface areas to be coated shall be prepared until meeting the required steel preparation grade, and be clean, dry, free from oil and grease. The specified roughness and cleanliness shall be maintained until the first coat is applied.

Dust, blast abrasives etc. shall be removed from the surface after blast cleaning such that both the particle quantity and the particle size do not exceed rating 2 of [NS-EN ISO 8502-3](#).

The maximum content of soluble impurities on the blasted surface when sampled as per [NS-EN ISO 8502-6](#) and using distilled water, shall not exceed 20 mg/m² when measured in accordance with [NS-EN ISO 8502-9](#). This limit applies for all new construction/new builds. The requirements for maintenance coating are covered in [Annex L](#).

The inspection frequency of the final surface conditions shall be according to [Table 2](#).

7.4 Stainless steels and non-ferrous substrates

Stainless steel and non-ferrous substrates shall be segregated from carbon steel during surface preparation and application of primer. When segregation is not possible, the coating contractor shall demonstrate how carbon steel contaminations on the stainless steel and/or non-ferrous substrates are prevented. This may be by using non-metallic abrasives, stainless steel tools or by masking.

Halide-free detergents and clean fresh water shall be used for pre-cleaning and rinsing.

7.4.1 HDG substrates

HDG substrates to be painted shall be de-greased using an emulsifying detergent followed by rinsing with clean fresh water. The substrates shall be sweep blasted in accordance with [SSPC-SP 16](#) using non-metallic abrasives. If the surface preparation reveals defects in the galvanised layer mitigating actions shall be discussed with the end user.

7.4.2 Aluminium substrates

Aluminium substrates to be painted shall be de-greased using an emulsifying detergent followed by rinsing with clean fresh water. A non-metallic grit abrasive shall be used at an adjusted pressure to meet a roughness grade corresponding to comparator grit segment 1 as per [NS-EN ISO 8503-1](#).

8 Coating application

8.1 General

Contrasting colours shall be used for each coating layer. Acceptable coverage of the topcoat shall be verified during the CPT and included as an activity in the ITP.

The coating manufacturer shall provide a CADS for each system to be used. When a CADS for a pre-qualified system shall be prepared, the DFT of each coat shall never be less than applied during the pre-qualification. Each CADS shall contain at least the following information:

- surface preparation requirements;
- the DFT (maximum, minimum and specified) for each coat;
- the minimum and maximum application temperature (air and substrate);
- the maximum and minimum re-coating intervals at relevant temperatures;
- the curing time to service at relevant temperatures including the effect of thinner, thickness and humidity;
- information on thinners to be used (quantities and type);
- coating repair system (qualified in accordance with [Clause 13](#));
- the applicable methods and equipment for coating application;
- any other relevant limitations related to the application and curing conditions.

8.2 Application equipment

The method of application shall be governed by the coating manufacturer's recommendation for the particular coating material being applied.

8.3 Application

Application of the first coat shall only be carried out on substrates having the required surface cleanliness and roughness. If these requirements are not met the coating application shall be halted. The coating application shall not resume before the substrate surfaces have been re-blasted and thereby regained the required surface conditions.

For each coat, a stripe coat shall be applied by brush to all welds, corners, behind angles, edges of beams etc. and areas not fully reachable by spray in order to obtain the specified coverage and thickness. This may be done before or after each coat.

Edges of existing coating shall be feathered towards the substrate prior to overcoating.

Each coat shall be applied uniformly over the entire surface. Skips, runs, sags and drips shall be completely removed and the area repaired to meet the required DFT. Each coat shall be free from pinholes, blisters, and holidays.

Contaminations on painted surfaces between coats shall be avoided. Any contamination shall be removed.

Inorganic zinc must be applied to the correct thickness prior to curing. Repair or adding extra inorganic zinc is material specific and shall be covered in the CADS repair instructions. These repair procedures shall also be demonstrated as a part of the CPT.

For other coating materials an additional layer of the same coat shall be applied in accordance with the CPS if the initial DFT is too low.

Successive coats shall be applied within the overcoating interval specified in the CADS. During application wet film thickness measurements shall be carried out regularly for all individual coats. If the maximum overcoating time is exceeded or the successive coat has been applied before the minimum overcoating time, repairs shall be carried out in accordance with [Clause 13](#).

The DFT requirements provided in the qualified CPS shall be met for each individual coat and for the complete system. Any areas with DFTs outside the specified values shall be adjusted/repaired in accordance with [Clause 13](#). The drying and curing shall be carried out within the limits advised in the relevant CADS.

Prior to recording DFT values the measuring device shall be adjusted against verified calibration foils (shims) with known DFTs covering the complete DFT target range. After completion of the DFT readings the measuring device shall be re-checked against the known DFTs to verify that the readings are reliable. The recorded measurements shall be adjusted to compensate for the surface profile effect according to [NS-ISO 19840](#).

The default masking distance to areas to be cut and/or welded shall be 150 mm.

If the substrate is carbon steel and not subject to CP the nut bearing area and boltholes shall only be coated with the primer. If subject to CP the nut bearing area and bolt holes shall be left uncoated. For stainless steel substrates, no primer is needed in the nut bearing area or in the bolt holes. The remaining coats of the system shall be applied around the nut bearing areas after installation.

Hub surfaces mating with clamps shall only be coated with the primer, when coating is required.

For internal lining of process vessels and tanks all surface areas to be coated shall be made fully accessible for the relevant coating application. All loose internals shall be taken out and the corresponding mounting bolt-holes shall be protected to allow simple reinstallation. Any weld-in vortex breakers on outlet nozzles

may require to be removed and replaced with removable types. If the coating system integrity is not achievable within small bore nozzles an alternative method of corrosion protection need to be evaluated and agreed. When refitting the internals care must be taken to prevent mechanical damage to the coating system. Particular care shall be taken to avoid coating damage in highly wear exposed areas adjacent to the manholes and to the areas exposed during installation and dismantling of any internal scaffolding. Thereafter a final coating integrity check shall be carried out.

When the inside of an isolation spool requires coating the application shall be in accordance with the requirements given for the selected coating system.

9 Thermally sprayed metallic coatings

9.1 General

Thermally sprayed metallic coating of aluminium (TSA) or zinc (TSZ) shall be applied in accordance with [NS-EN ISO 2063-1](#) and [NS-EN ISO 2063-2](#) or [NACE No. 12/AWS C2.23M/SSPC-CS 23.00](#) and the requirements in this document.

TSZ shall not be used on pressure retaining stainless steels. Furthermore, TSZ shall not be used in seawater immersion service, or in splash or tidal zones if exposed to a cathodic protection system based on aluminium anodes.

9.2 Metallic coating materials

The materials for thermal spray shall be in accordance with the following:

- Al99,5 in accordance with [NS-EN ISO 14919](#), code number 3.2 or equivalent;
- AlMg5 in accordance with [NS-EN ISO 14919](#), code number 3.3 or equivalent;
- Zn99,99 in accordance with [NS-EN ISO 14919](#), code number 2.1 or equivalent;
- Zn99 in accordance with [NS-EN ISO 14919](#), code number 2.2 or equivalent;
- ZnAl15 in accordance with [NS-EN ISO 14919](#), code number 2.3 or equivalent.

These materials shall be supplied with material data sheets and quality control certificates, and be marked with the manufacturer's name, manufacturing standard, metal composition, weight, and date of manufacturing.

The maximum operating temperature for TSA is 595 °C as per [NACE SP0198:2017](#).

The metallic coatings shall be sealed or overcoated as specified for the system [CSDS no. 2A](#), [CSDS no. 2B](#) and [CSDS no. 2C](#) in [Annex A](#).

Only sealers recommended by coating manufacturers are to be used to seal the inherent porosity of TSA. No other coating shall be applied on TSA. If overcoating of TSA is unavoidable, e.g. at transitions to other coating systems, only a system 1A or 1B approved zinc rich primer shall be applied, see [Annex K](#). If CP is also provided for corrosion protection the sealer on top of TSA may be omitted.

On TSZ, the surface after sealer application shall be inspected to verify that no pinholes have been formed. The subsequent coating materials shall be confirmed compatible with the selected sealer.

9.3 Application of thermally sprayed coating

Each coat shall be applied uniformly over the entire surface. The coat shall be applied in multiple layers and shall overlap on each pass of the spraying gun.

The coating shall be firmly adherent and have a uniform appearance without any lumps, loosely adherent spattered metal, bubbles, ash formation, defects, or uncoated spots.

Before application of any subsequent coat, any damage to the previous coat shall be repaired. The thermally sprayed coating shall be kept dry and free from contaminations prior to the application of the subsequent sealer or coating system.

The purpose of the sealer is to fill the metal pores, and the DFT thickness shall be less than 20 µm. Drying of the sealer coat before handling shall conform to sealer manufacturer's instructions. Topcoats shall not be applied to the sealed TSA surface, except for safety markings. The topcoat for safety markings shall have a maximum DFT of 40 µm.

NOTE A thickness of 20 µm is hardly measurable and is only stated as a measure to quantify that it shall not form any film on top of the metallic coat.

9.4 Repair, field coating of pipes and coating of in-fill steel

All requirements, including adhesion, applicable to metal spraying, shall apply.

Prior to TSA or TSZ application, the surface shall be prepared and handled to allow continuous and uniform application of the metallic coating.

Before the thermal spraying operation starts, the area 30 cm to 40 cm in distance from the weld zone shall be sweep-blasted to ensure that all contaminations are removed. The uncoated welding zone shall be blast cleaned as specified for the coating system and the application shall be performed according to [9.3](#).

A subsequent build-up of the metallic coating can be done without further surface preparation provided that the surface is clean, dry, free from any contaminations and no oxidation is visible.

Areas of damaged coating exposing the steel substrate shall be re-blasted and re-coated in accordance with the original application requirements. Any silicon sealer applied needs to be removed prior to blasting.

Areas of visible coating damage not exposing the steel substrate shall have the remaining intact coating thickness checked. If the remaining thickness exceeds the specified minimum dry film thickness (MDFT), only the sealer coat shall be applied. If the coating thickness is less than the specified MDFT an additional layer shall be applied to reach the target MDFT. If a surface areas in need of repairs is contaminated and/or oxidation is visible, the damaged area shall be re-blasted and the metallic coating re-applied. Any silicon sealer needs to be removed prior to blasting. After removal of damaged coating the edges of the intact coating shall be feathered to provide a minimum 50 mm overlap with the repair.

TSA shall be repaired with new TSA, also in the field.

Any damage of the organic coating system applied on TSZ shall be repaired according to [Clause 13](#).

10 Passive fire protection coatings

10.1 General

The requirements provided in this document are applicable for spray applied and hand applied passive fire protection (PFP) to structural steel, process equipment and pipework.

Information regarding the selection of PFP materials, thicknesses, and areas to be protected are not within the scope of this document.

10.2 The PFP coating systems

The PFP coating systems, including type of mesh and studs, shall be applied, and installed in accordance with the type approval certification or design verification, PFP manufacturer recommendation and project specific regulatory requirements.

Where wire mesh is used, it shall be mechanically fixed to the steel substrate by studs and be properly embedded into the PFP coating. The wire mesh shall be galvanized carbon steel for carbon steel substrates and AISI 316L for stainless steel substrates. Welded studs shall have a minimum size of 2 mm x 30 mm and be copper coated carbon steel for carbon steel substrates and AISI 316L for stainless steel substrates. For tubular steel sections the mesh can be secured by a wire seam of the same material composition as the mesh.

The generic coating materials that form a part of the PFP systems are described in [Annex A](#), see the CSDSs [CSDS no. 5A](#), [CSDS no. 5C](#) and [CSDS no. 5S](#). The top-coat shall be pre-qualified as part of systems [CSDS no. 1A](#) or [CSDS no. 1B](#). The PFP systems shall be pre-qualified in accordance with [Clause 11](#) without any additional coatings or chemical treatments applied on top of the PFP (e.g. surface cure or physical property modifiers, tie-coats, top-coats). Pre-qualification testing is only required for systems [CSDS no. 5A](#) and [CSDS no. 5S](#).

During construction, alternative primers than those used in the pre-qualification test for system [CSDS no. 5A](#) can be utilized, provided these materials are already pre-qualified in accordance with system [CSDS no. 1A](#) or [CSDS no. 1B](#). Alternative primers shall be approved by the end user. Epoxy tie coat shall be qualified by the PFP supplier and approved by end user. For stainless steel (system [CSDS no. 5C](#)), galvanised steel (which shall be sweep blasted in accordance with PFP manufacturer recommendations) and thermally sprayed zinc surfaces, an epoxy tie coat, which is qualified by the PFP supplier, is required between the substrate and the PFP material.

When using PFP on structures or equipment located in the splash zone, tidal zone or partially submerged, the qualification requirements for system [CSDS no. 5S](#) apply.

Additional testing may be required to qualify the durability and insulation performance for specific fire scenarios. These include but are not limited to conditions where the PFP system is:

- used on substrates operating above ambient conditions;
- exposed to external heating from activities such as flaring;
- covered by a non-skid epoxy screed or high build coatings for horizontal plated areas (e.g. deck areas / roof of module).

For all conditions, the requirements related to the substrate, the surface preparation, primers, tie-coats and top-coats shall be qualified by the PFP manufacturer.

10.3 Application

Specific quality control requirements (e.g. routine for cleaning static mixer, mix ratio checks, etc.) and monitoring, witness and hold points shall be agreed by all parties and documented in the ITP prior to project start up.

Where mesh is utilised, the procedure for encapsulation of the mesh at different stages in the application shall follow the PFP manufacturer's guidance.

PFP systems using fibre mesh, such as glass or carbon fibre woven fabrics, and types not requiring any reinforcement shall be applied around the whole member and thereby avoid terminations in the fire zone (e.g. "4-sided" protection). Where this is unavoidable due to design constraints (e.g. sliding supports), a verification of the structural fire integrity is required early in the design phase. Where the termination is to a deck plate not requiring fire protection, the PFP system shall extend for an agreed coat-back length from the junction of the plate with the flange tip of the supporting beam. PFP terminations at free edges

within the fire zone shall be additionally reinforced using wire mesh and anchored by mechanical attachment. The metal mesh strip shall have a minimum width of 100 mm and not be placed closer than 10 mm to the free edge of the PFP system to prevent exposure of the mesh edge.

When welded pins or other mechanical attachments are used to secure the metal mesh applied to structural members, firewalls and fire rated decks, the maximum distance between each anchoring point shall be 300 mm in any direction. In areas where the mesh ends at the termination of the PFP the maximum distance between welded pins or other mechanical attachment shall be 200 mm.

On highly stressed structural steelwork and process equipment, the metal mesh shall be secured without involving any hot work or mechanical modifications of the substrate.

10.4 Repairs

The damaged area shall be removed and reinstated in line with the recommendations given by the PFP manufacturer.

If the corrosion protection is damaged, the area shall be blast cleaned in accordance with the surface preparation requirements in this document and repaired according to [Clause 13](#) prior to application of the PFP coating.

11 Qualification requirements

11.1 Pre-qualification of materials

The coating manufacturers are responsible for the pre-qualification of their materials that form a coating system according to this document. The pre-qualification requirements of coating materials to form various coating system are given in [Table 1](#). The acceptance criteria listed shall be considered as representing the minimum performance requirements. For coating systems to be utilised at elevated temperatures the pre-qualification report must state the steel test temperature.

The pre-qualification of materials shall be carried out by an independent laboratory certified to [NS-EN ISO/IEC 17025](#) with an accreditation scope covering [NS-EN ISO 12944-9](#) or all of the test and assessment methods; [NS-EN ISO 9227](#), [NS-EN ISO 16474-3](#), [NS-EN ISO 15711](#), and [NS-EN ISO 4624](#). Application of the coating shall be in accordance with the manufacturer's CADS for the system and shall be witnessed by a 3rd party inspector accepted by the testing laboratory. Testing and inspection shall be carried out in accordance with [Table 2](#) and documented in the pre-qualification report. The film thickness of each coat shall be controlled by the 3rd party inspector to ensure that the specified DFT ranges for the coating system are met.

The DFT shall be measured in accordance with requirements in [NS-ISO 19840](#) and the average thickness of each coat shall as a minimum meet the defined NDFT and be:

- 1) less than $1,5 \times$ the NDFT if the NDFT is $\leq 60 \mu\text{m}$, or
- 2) less than $1,25 \times$ the NDFT if the NDFT is $> 60 \mu\text{m}$.

Unless otherwise specified, pre-qualifications carried out according to edition 5 or 6 of this document are valid for all coating systems except those related to systems 5A, 5C and 5S provided that the following requirements are met:

- 3) the coating system fulfils all other test requirement in this edition, and;
- 4) the pre-qualification testing was started before this edition was issued;
and in addition for system 7A/7D;
- 5) the pre-qualification meets the DFT requirements stated in the CSDS.

For the PFP systems, pre-qualifications carried out according to editions 5 and 6 are valid for a period of 2 years after the publication of this revision.

If agreed with the end user, the approved topcoat in a pre-qualified coating system, may substitute another pre-qualified topcoat, provided the intermediate coating material is the same and the DFT of the topcoats are equal.

No shop primer is allowed as an integrated part of any of the coating systems. All coating systems shall be pre-qualified without a shop primer.

Table 1 — Pre-qualification tests for coating materials

Activity	Pre-qualification test	Acceptance criteria ^{Note 1}	Applicable for coating systems
11.1	Ageing resistance according to <u>NS-EN ISO 12944-9</u> , Annex B cyclic aging test.	According to <u>NS-EN ISO 12944-9</u> with the following supplementary requirements: 1) Chalking (see <u>NS-EN ISO 4628-6</u>): Maximum rating 2 for systems 1A and 1B. 2) Pull off testing (see <u>NS-EN ISO 4624</u>): Adhesion failure: Maximum 50 % reduction from original value, but never below 5 MPa. Cohesive failure: Minimum 2MPa for systems 5A and 5S only ^{Note 2}. 3) Overcoatable without remedial abrasion obtaining minimum adhesion of 5 MPa 4) Water uptake (see <u>Annex F</u>) after exposure testing: <2% for systems 5A and 5S only. 5) Fire test verification (see <u>Annex H</u>) for systems 5A and 5S only.	CSDS no. 1A, CSDS no. 1B, CSDS no. 4A, CSDS no. 4B, CSDS no. 5A ^{Notes 4,5,6}, CSDS no. 5S ^{Notes 4, 5, 6}, and CSDS no. 7A ^{Note 7}
11.2	Seawater cycling immersion testing according to <u>NS-EN ISO 2812-2</u> / -15 °C freeze / +23 °C dry. (See Annex G)	According to <u>NS-EN ISO 12944-9</u> to evaluate coating degradation and corrosion scribe creep and the following supplementary requirements: 1) Pull-off testing (see <u>NS-EN ISO 4624</u>): Adhesion failure at the steel or primer interface: Minimum 5 MPa ref. <u>NS-EN ISO 12944-9</u>. Cohesive failure: Minimum 2MPa. 2) Water uptake (see <u>Annex F</u>) after exposure testing: <10% 3) Fire test verification according to Annex H	CSDS no. 5S ^{Notes 4, 5, 6}
11.3	Ageing resistance according to <u>UL 2431</u> Wet Freeze Dry Cycle or equivalent.	According to <u>NS-EN ISO 12944-9</u> to evaluate coating degradation and the following supplementary requirement: 1) Fire test verification (see Annex H)	CSDS no. 5A ^{Notes 4, 6} and CSDS no. 5S ^{Notes 4, 6}
11.4	Cathodic disbonding according to <u>NS-EN ISO 12944-9</u> ^{Note 3, Note 7}	According to <u>NS-EN ISO 12944-9</u>	CSDS no. 1F, CSDS no. 3C ^{Note 3}, CSDS no. 5S ^{Note 4}, CSDS no. 7A ^{Note 7}, CSDS no. 7B ^{Note 7}, and CSDS no. 7C ^{Note 7}
11.5	Additional testing of cathodic disbonding for systems	According to <u>NS-EN ISO 12944-9</u>	CSDS no. 7A ^{Note 7}, and CSDS no. 7C

Table 1 — Pre-qualification tests for coating materials *(continued)*

Activity	Pre-qualification test	Acceptance criteria ^{Note 1}	Applicable for coating systems
	operating at temperature > +50 °C (see Annex C)		
11.6	Artificial aging and thermal cycling tests according to <u>NS-EN ISO 19277</u> category CUI-3	According to <u>NS-EN ISO 19277</u> . (Multiphase CUI cyclic corrosion test is not mandatory.)	CSDS no. 1D and CSDS no. 10A (both tests) Only thermal cyclic testing for systems: CSDS no. 6C and CSDS no. 10B
11.7	Corrosion under insulation test according to <u>NS-EN ISO 19277</u> (Vertical Pipe Test) category CUI-3	According to <u>NS-EN ISO 19277</u> , with the temperature of the hotplate to be set to ensure a minimum temperature of 200 °C at least 100 mm above the hotplate during the test	CSDS no. 1D
11.8	High temperature static heat test Heat test panels in an oven with an initial ramp rate of 10°C/min up to a temperature of 204°C and hold for 28 days. Remove from oven and allow to cool to ambient	As per <u>NS-EN ISO 19277</u> regarding blistering, cracking, flaking and pre- and post-test adhesion	CSDS no. 1D , CSDS no. 6C , CSDS no. 10A and CSDS no. 10B
11.9	Water immersion testing according to <u>NS-EN ISO 2812-2</u>	1) Adhesion failure (see <u>NS-EN ISO 4624</u>): Maximum 30 % reduction from original value, but never below 10 MPa ^{Note 2} 2) Visual evaluation as per <u>NS-EN ISO 4628-2</u> , <u>NS-EN ISO 4628-3</u> , <u>NS-EN ISO 4628-4</u> and <u>NS-EN ISO 4628-5</u> . Nil (0%) regarding blistering, rusting, cracking and flaking.	CSDS no. 3A ^{Note 9}
11.10	Seawater ballast tank test according to <u>IMO PSPC.MSC.215(82)</u> , Appendix 1	According to <u>IMO PSPC.MSC.215(82)</u> using acceptance criteria for epoxy-based systems applied according to table 1 of the resolution. Pre-qualification at MDFT 320µm is acceptable.	CSDS no. 3B ^{Note3}
11.11	Cargo oil tank test according to <u>IMO PSPC MSC.288(87)</u> , Appendix 1 and 2	According to <u>IMO PSPC MSC.288(87)</u> . Pre-qualification at MDFT 320µm is acceptable.	CSDS no. 3C ^{Note3}
11.12	Thermal cycling test according to <u>NACE TM0404</u> section 9	According to <u>NACE TM0404</u> section 9 Visual evaluation as per <u>NS-EN ISO 4628-4</u> and <u>NS-EN ISO 4628-5</u> . Nil (0%) regarding cracking and flaking	CSDS no. 3A , CSDS no. 3D , CSDS no. 3E and CSDS no. 3F

Table 1 — Pre-qualification tests for coating materials *(continued)*

Activity	Pre-qualification test	Acceptance criteria ^{Note 1}	Applicable for coating systems
11.13	Immersion testing according to <u>NS-EN ISO 2812-1</u>	According to <u>NS-EN ISO 2812-1</u> with the following supplementary requirements: 1) Adhesion shall be evaluated as per <u>NS-EN ISO 16276-2</u> or <u>NS-EN ISO 2409</u> meeting classification: 0-2. 2) Visual evaluation as per <u>NS-EN ISO 4628-2</u> , <u>NS-EN ISO 4628-3</u> , <u>NS-EN ISO 4628-4</u> and <u>NS-EN ISO 4628-5</u> . Nil (0%) regarding blistering, rusting, cracking and flaking.	CSDS no. 3G ^{Note 9}
11.14	Elevated temperature and pressure testing according to <u>NACE TM0185</u>	According to <u>NACE TM0185</u> with the following supplementary requirements: 1) Adhesion failure (see <u>NS-EN ISO 4624</u>): Maximum 30 % reduction from original value, but never below 5MPa for vinyl esters, and never below 10 MPa for the other generic types ^{Note 2} 2) Visual evaluation as per <u>NS-EN ISO 4628-2</u> , <u>NS-EN ISO 4628-3</u> , <u>NS-EN ISO 4628-4</u> and <u>NS-EN ISO 4628-5</u> . Nil (0%) regarding blistering, rusting, cracking and flaking.	CSDS no. 3D ^{Notes 8, 9} , CSDS no. 3E ^{Notes 8, 9} and CSDS no. 3F ^{Notes 8, 9}
11.15	Cathodic disbonding according to <u>ASTM G42:11</u> , +80 °C	According to <u>ASTM G42:11</u> with the following supplementary requirements: 1) Equivalent circuit diameter <20mm	CSDS no. 1F
11.16	Corrosion testing for immersion category Im3 durability High according to <u>NS-EN ISO 12944-6</u>	According to <u>NS-EN ISO 12944-6</u> with the following supplementary requirements: 1) Average 1.5 mm corrosion at scribe after salt spray 2) Average 6.0 mm corrosion at scribe as after sea water immersion 3) Pull off testing (see <u>NS-EN ISO 4624</u>): Adhesion failure: Minimum 5MPa and maximum 50 % reduction from original value.	CSDS no. 1F
11.17	Impact test according to <u>ASTM G14:04(2018)</u> using minimum 3 specimens and 20 impact readings	According to <u>ASTM G14:04(2018)</u> with the following supplementary requirements: 1) Minimum 5.6 Joules	CSDS no. 1F , CSDS no. 7A ^{Note 7}
11.18	Test for cryogenic service as per optional testing for CUI-3-cryo in <u>NS-EN ISO 19277</u>	According to <u>NS-EN ISO 19277</u>	CSDS no. 9
NOTE 1	Acceptance criteria are considered as minimum performance requirements.		
NOTE 2	Pull off testing shall be performed by using equipment with an automatically centred pulling force. For systems CSDS no. 4A and CSDS no. 4B , adhesion testing pre and post exposure shall be conducted on test panels coated with non-skid aggregates. In addition, adhesion can be tested without aggregates. Further details are given in Annex I		

Table 1 — Pre-qualification tests for coating materials (continued)

NOTE 3	For systems CSDS no. 3B and CSDS no. 3C testing shall be completed without shop primer.
NOTE 4	The thickness of systems CSDS no. 5A and CSDS no. 5S shall be 6 mm.
NOTE 5	Corrosion tests and pull off tests on systems CSDS no. 5A and CSDS no. 5S shall be performed on the certified scheme with respect to mesh requirements. Fire test verification is to be conducted on the certified scheme with respect to mesh requirements. For systems where the mesh or mesh type is optional based upon thickness/fire rating, schemes need to be tested with and without mesh.
NOTE 6	Tests on system CSDS no. 5A and CSDS no. 5S shall be carried out on system without tie coat/topcoat.
NOTE 7	Qualification of system 7 shall be done on carbon steel. The system is then also qualified for stainless steel.
NOTE 8	Post-test pull-off testing as per NS-EN ISO 4624 shall be carried out in each of the liquid and gas phase areas of the test panel.
NOTE 9	Where specific cargoes are to be used in immersion testing these shall be detailed in the notes section of the appropriate CSDS.

11.2 Qualification of applicator contractors and personnel

11.2.1 Applicator contractors

Companies performing work in accordance with this document i.e. the applicator contractor shall document experience in organizing, planning and execution of work with similar size and complexity according to [NS-EN ISO 12944-7](#). Subcontracted work in different shops and/or locations shall also comply to these requirements.

The documentation of experience shall be in accordance with FROSIO GuiD-CP [\[1\]](#), NIICAP [\[2\]](#), SSPC QP-3 [\[3\]](#) but 3rd party qualification of the applicator contractor is not required, or as agreed with end user.

The applicator contractors performing work in accordance with this document shall have a quality management and performance assurance system meeting the requirements in [Clause 14](#).

11.2.2 Qualification of coating operators

Operators shall be qualified as blast-cleaner, coating applicator etc. according to one of the following:

- the Norwegian tradesman education for surface preparation and protective coating application;
- operator training programs approved by end user.

Alternatively, these operators can be qualified according to [Annex I](#) of this document. All personnel shall have relevant knowledge of health and safety hazard, use of personal protective equipment, the coating materials, mixing and thinning of coatings, coating pot-life, surface preparation requirements and the tools and equipment used for coating application.

11.2.3 Qualification of metal spray operators

Prior to commencement of work, thermal spray operators shall be qualified in accordance with [NS-EN ISO 14918 Annex A.2](#). The thermal spraying process shall be demonstrated on a test specimen including similar geometrical shapes as on the actual object, or as described in [Annex E](#).

The accept criteria shall be according to Table 2 and include 3 measurement series.

The period of validity of the qualification shall be according to [NS-EN ISO 14918](#).

Thermal sprayer qualification records shall be according to [NS-EN ISO 14918](#).

Alternatively, these operators can be qualified according to [Annex I](#) of this document.

11.2.4 Qualification of passive fire protection operators

Operators, including the pump machine operator, shall be qualified, trained and certified according to the PFP manufacturer's procedures for the material being used for the Project. Qualification validity is maximum 2 years. Thereafter refreshment training is required.

Before any stud welding, the welders, and the welding procedures shall be qualified in accordance with the PFP manufacturer's procedures.

For operators and stud welders without relevant working experience for the last 2 years, the applicator contractor shall document that necessary supplementary training have been given before the start of any work.

11.2.5 Qualification of supervisors, foremen and Quality Control personnel

Personnel carrying out inspection or verification shall be qualified in accordance with FROSIO Surface Treatment Inspector level III, NACE coating inspector level III or ICorr inspector level III. Inspectors according to FROSIO Surface Treatment, NACE or ICorr to Inspector level II, may carry out the inspection work under the supervision of an inspector level III.

Supervisors and foremen shall be qualified according to [11.2.2](#) and shall also be qualified in accordance with FROSIO Surface Treatment, NACE or ICorr to Inspector level II.

Supervisors, foremen or Quality Control (QC) personnel involved in application of PFP shall in addition, be trained and certified according to the procedures of the PFP manufacturer.

11.3 Qualification of procedures

11.3.1 Coating procedure specification (CPS)

A detailed CPS based on the requirements of this document shall be prepared by the applicator contractor to perform the work. This company is responsible for ensuring that the operators understand the relevant parts of the CPS. The CPS shall contain the following:

- step by step information of the process (control of received objects (substrate, materials etc.), cleaning, blasting, coating, and QC);
- identification of equipment for surface preparation and application;
- a copy of the relevant CADs;
- the technical data sheets for each coating material;
- a project specific ITP based on [Table 2](#);
- a copy of coating report/daily log template;
- a description of repair procedure(s);
- procedures for overlapping zones (when relevant).

When using coating materials that will come in contact with potable water or jet fuel, a copy of the approval test certificate for such exposure shall be enclosed in the CPS.

For system [CSDS no. 5A](#), [CSDS no. 5C](#) and [CSDS no. 5S](#) (the PFP systems), the CPS shall, in addition, contain information regarding maximum allowable time between application of the different layers, method and frequency of measuring thicknesses, location of the reinforcement related to the different thicknesses and restrictions for use of solvents.

The CPS shall be qualified in accordance with [11.3.2](#). All coating related work shall be carried out in accordance with the CPS.

Any of the following changes of the coating application parameters will require the CPS to be re-qualified:

- change of coating material;
- change of method for surface preparation;
- change of equipment for surface preparation;
- change of method for coating application;
- change of equipment for coating application.

The CPS shall be written in the language(s) specified by the end user. If no language requirements have been advised the default language is English.

11.3.2 Coating procedure test (CPT) and pre-production trial (PPT)

The objective of the CPT and PPT is to document that the CPS will meet the defined acceptance criteria. A separate CPT is required for each applicator contractor executing coating work according to this document, except for system [CSDS no. 8](#). A CPT shall be prepared for each relevant CADs.

The CPT can be carried out as follows:

- on a test panel being minimum 1 m², typically 0.8 m. x 1.2 m. or 1 m. x 1 m., and containing at least 1 pipe-end, 2 pipes, 1 angle and 1 flat bar.

Note 1 This alternative is suitable when the coating work shall be carried out on structures, objects and items with multiple geometries. Test panel examples are enclosed in [Annex E](#);

- on a component similar to the structure to be coated.

Note 2 This alternative is suitable when the coating work shall be carried out on items with a uniform geometry, for example pipes. If CPT is to be done on an object this shall be agreed with end user. Alternatively, a mock-up can be prepared for a PPT.

When a CPS is prepared for various substrates the CPT can reflect additional substrates by including test panels for adhesion testing in these material grades. These test panels shall be surface prepared and coated according to the CPS that apply for the relevant substrates. The test panel minimum size is 10 cm x 50 cm.

The CPT shall be documented in a report containing:

- a reference to relevant CPS;
- all inspection and test results according to the ITP, and the corresponding acceptance criteria;
- photo or drawing of test panel or test object and test panels (if relevant);
- photo documentation of all production steps;
- name of the operator(s);
- supervising inspector name, certification level and number.

The test panels can be reused once the CPT results including photo documentation have been approved.

The coating procedures shall be qualified under realistic conditions likely to be present during coating application. This means the CPT shall be carried out under the same environmental conditions as the actual coating work.

The inspection and testing requirements for the CPT, including acceptance criteria, are given in [Clause 12](#).

The adhesion test shall be carried out once the curing has been completed as per the relevant CADs.

CPTs are valid for maximum 3 years after approval for a specific CPS. The CPT may be utilised on later projects provided the relevant coating procedure has been used within the last year and provided that all test and inspection requirements in the new project are met. This does, however, not apply for CPTs related to the PFP systems.

For the PFP systems, the CPT shall be performed on an area accepted by the parties involved. The area shall be clearly marked and shall serve as a reference area throughout the project. The application of the fire protection shall comply with the applicable procedures and the type of PFP finish (roller or spray) shall be agreed by end user. The surface finish appearance on the CPT area, and quality of the work, shall be used as a reference with respect to the acceptable quality of work to be done during production.

Various configurations with respect to the number of PFP layers and the number of mesh layers/overlaps shall be qualified as a part of the CPT prior to the start of the project. For spray and hand applied PFP materials, minimum adhesion, and cohesion value shall be 5MPa regardless of mesh inclusion. A new CPT shall be performed if the ambient conditions are outside the parameters stated in the CPS. The CPT shall be qualified with the mesh requirements as certified and include representative hand and spray applied areas reflecting the CPS.

CPTs for system [CSDS no. 5A](#), [CSDS no. 5C](#) and [CSDS no. 5S](#) shall be prepared for each project and each site. Hence, no time specific validity period exists for systems [CSDS no. 5A](#), [CSDS no. 5C](#) and [CSDS no. 5S](#).

For tank and vessel linings a CPT can be performed on a defined area inside the tank/vessel if accepted by the end user or on a mock-up. The surface finish/appearance on the CPT area and the quality of work shall be used as a reference identifying the acceptable quality of work during production. Any damage to the integrity of the lining caused by inspection tests shall be fully repaired prior to entering service.

12 Inspection and testing

Testing and inspection shall be carried out in accordance with [Table 2](#). Surfaces shall be accessible until final inspection is carried out.

Table 2 — Inspection and testing

Activity	Activity description	Method	Frequency ^{Note 1}	Acceptance criteria	Consequence of failure
Activities prior to surface cleaning					
12.1	Substrate/object reception control	NS-EN ISO 8501-3	100%	Maximum rust grade B	Substrate rejected
12.2	Visual examination of substrate preparations	NS-EN ISO 8501-3 Preparation grades of welds, edges, and other surface imperfections	100 % of all surfaces	As specified in the CSDS	Defects to be repaired
Activities during surface preparation					
12.3	Recording of environmental conditions	NS-EN ISO 8502-4	Before start of each shift + minimum twice per shift.	As specified in 5.3	No blasting or coating
12.4	Visual examination of surface cleaning	ASTM F22 Water break test	Spot checks	No water pearls, ref. picture "Clean" in ASTM F22	Re-clean as specified in 7.1 until criterion is met
12.5	Compressed Air quality	ASTM D4285 Blotter test	Before each shift	No oil or water drops	Rectify air supply
12.6	Blast Media control	ASTM D7393 Check of any oil content	Spot checks	No oil	Replace blast media
		ASTM D4940:15(2020) Check the presence of any salt	Spot checks	150 µS/cm	Replace blast media
12.7	Surface cleanliness after abrasive blast cleaning	NS-EN ISO 8501-1	100 % visual of all surfaces	As specified in the CSDS	Re-blasting
		NS-EN ISO 8502-3	Spot checks	Maximum quantity and size rating 2	Re-cleaning and retesting until acceptable
12.8	Surface cleanliness after sweep blasting	SSPC-SP 16	100 % visual of all surfaces	As specified in the CSDS	Re-blasting and re-testing until acceptable ^{Note 11}
		NS-EN ISO 8502-3	Spot checks	Maximum quantity and size rating 2	Re-cleaning and retesting until acceptable
12.9	Surface salt contaminations	NS-EN ISO 8502-6 and NS-EN ISO 8502-9	Spot checks	As specified in the CSDS	Re-clean with potable water until the acceptance criterion is met followed by re-blasting
12.10	Roughness examination	NS-EN ISO 8503-1, NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5	Each component or once per 10 m ²	As specified in the CSDS	Reblasting

Table 2 — Inspection and testing *(continued)*

Activity	Activity description	Method	Frequency ^{Note 1}	Acceptance criteria	Consequence of failure
Activities during coating application					
12.11	Curing test (for Zn silicate).	<u>ASTM D4752:20</u>	Each component or once per 100 m ²	Rating 4 to 5	Allow to cure
12.12	Visual examination of the coating application	Detect surface defects e.g. poor curing, contaminations, pinholes, popping, sagging, zinc salts (white rust)	100 % of surface after each coat	No defects	Repair of defects
Activities after curing of the coating					
12.13	Film thickness measurements	<u>NS-ISO 19840</u> . Calibration on a smooth surface	<u>NS-ISO 19840</u>	<u>NS-ISO 19840</u> , and CSDS	Repair, additional coats and/or recoating
12.14	Holiday detection ^{Note 14}	<u>NS-EN ISO 29601</u> ^{Note 12}	See Note 13	No holidays	Repair and retesting
12.15A	Adhesion ^{Note 2} or	<u>NS-EN ISO 16276-1</u>	Spot checks ^{Note 3}	See notes 4, 5, 6, 7 and 8	Coating to be rejected
12.15B	Cohesion strength test	<u>NS-EN ISO 16276-2</u> or <u>NS-EN ISO 2409</u>	Spot checks	See note 9	Coating to be rejected
12.16	Visual examination of thermal sprayed coating	Detect surface defects e.g. lumps, loosely adherent spattered metal, bubbles, ash formation, uncoated spots	100% of surface after each coat	No defects	Repair of defects
12.17	Visual examination after sealer application	10 X magnification	Spot checks and 100% of surface ^{Note 10}	No open pores present at the surface	Add sealer to meet the criteria
12.18	Overall TSA application quality by Bend test	<u>NS-EN ISO 2063-2</u> or <u>NACE No. 12/AWS C2.23M/SSPC-CS 23.00</u> 13 mm mandrel (for thicknesses advised herein)	Before each shift	TSA: Minor cracks accepted but no lifting or spalling of the coating	Coating to be rejected
NOTE 1 Spot checks shall be defined and agreed on before start of each project and included in the ITP. The definition of spot check frequency shall be stated in the CPS. NOTE 2 See additional requirements in Annex J. NOTE 3 A representative adhesion value equals the average value from 3 dollies and equals one measurement. NOTE 4 For systems CSDS no. 2A and CSDS no. 2C, adhesion during CPT shall be minimum 9 MPa. Adhesion measured during production shall be minimum 7 MPa for any measurement. Testing to be performed <u>without</u> sealer. NOTE 5 For systems CSDS no. 3A, CSDS no. 3C, CSDS no. 3D, CSDS no. 3E and CSDS no. 3F, maximum 30 % reduction from the CPT is acceptable. Adhesion measured during production shall be minimum 5 MPa for any measurement. NOTE 6 For sprayed on and hand applied PFP during application, minimum adhesion, and cohesion value according to <u>NS-EN ISO 16276-1</u> and <u>NS-EN ISO 16276-2</u> shall be 5MPa regardless of mesh inclusion. The end user shall decide whether test panels or actual structure should be used for the pull off tests.					

Table 2 — Inspection and testing (continued)

NOTE 7	No more than 50 % reduction of the average adhesion value from the CPT is acceptable during production for systems CSDS no. 1A , CSDS no. 1B , CSDS no. 1D , CSDS no. 1F , CSDS no. 2B , CSDS no. 3B , CSDS no. 4A , CSDS no. 4B , CSDS no. 6A , CSDS no. 6B , CSDS no. 6C , CSDS no. 6D , CSDS no. 7A , CSDS no. 7B , CSDS no. 7C , CSDS no. 7D , CSDS no. 7E and CSDS no. 7F provided that no measurements are below 5MPa.
NOTE 8	For adhesion test during CPT, fractures exhibiting 80% or more in glue failure with values below 15 MPa is not accepted.
NOTE 9	For systems CSDS no. 3G , CSDS no. 6E , CSDS no. 6F , CSDS no. 9 and CSDS no. 10A and CSDS no. 10B , adhesion during CPT is to be determined by cross-cut test. Acceptance criteria is classification 0-2 apply for DFTs up to 250µm. For DFTs exceeding 250µm X-cut test shall be selected. Acceptance criteria for X-cut is max level 2.
NOTE 10	For systems CSDS no. 2A , CSDS no. 2B and CSDS no. 2C , visual examination with 10X magnification of CPT test panel after application of sealer. Spot checks during production.
NOTE 11	Keep surface roughness within the specified limit
NOTE 12	Holiday testing is required for systems CSDS no. 1F , CSDS no. 3A , CSDS no. 3B , CSDS no. 3C , CSDS no. 3D , CSDS no. 3E , CSDS no. 3F , CSDS no. 6C , CSDS no. 7A , CSDS no. 7B , CSDS no. 7C , CSDS no. 7D , CSDS no. 7E and CSDS no. 7F . High voltage spark test shall be used when the average DFT is 500µm or higher.
NOTE 13	100% test frequency is required for systems CSDS no. 1D , CSDS no. 1F , CSDS no. 3A , CSDS no. 3B , CSDS no. 3C , CSDS no. 3D , CSDS no. 3E , CSDS no. 3F , CSDS no. 6C , CSDS no. 7A and CSDS no. 7D . 100% for welds are sufficient for systems CSDS no. 7B , CSDS no. 7C , CSDS no. 7E and CSDS no. 7F .
NOTE 14	It should be noted that conductive coating materials can cause incorrect holiday alarms.

13 Repair of coating

13.1 General

Coating damage and defects shall be repaired prior to delivery in accordance with the repair systems advised in the CSDS. The surface preparation, the specified system or the required coats of the specified system shall be re-applied in accordance with the qualified CPS and the inspections shall comply with [Clause 12](#).

Repair of HDG damaged during fabrication, transportation, erection, or installation shall be carried out according to [NS-EN ISO 1461](#).

Repair of thermally sprayed metallic systems shall comply with [9.4](#).

Repair of PFP systems shall comply with [10.4](#).

13.2 Repair of low or high DFT

If the required DFT is not achieved and the maximum overcoating time has exceeded the following alternatives apply:

- 1) re-blast to bare metal and coat with the originally specified system, or;
- 2) abrade the surface prior to application of the same coat according to the CADS.

Except where a stripe coat is applied, areas exceeding the maximum DFT specified in the CADS shall be re-blasted to bare metal and re-coated with the specified system.

13.3 Removal of coating damage

The repair procedures shall cover both coating damage not reaching the substrate and damage reaching substrate surface and shall be described in the CPS.

Abrasive blast cleaning shall be used where the coating needs to be removed completely.

Damaged coating shall be completely removed. The edges of the remaining, intact coating shall be feathered down over a length of at least 50 mm in all directions. Thereafter surface preparation and coating application shall be carried out in accordance with [Clause 7](#) and [Clause 8](#).

If the coating damage does not reach the steel surface the intact coats can be kept provided this does not impair the adhesion to the new coats.

14 Quality management and performance assurance

Coating manufacturers and applicator contractors shall have a quality management system certified to NS-EN ISO 9001, ISO/TS 29001 or API Spec Q1.

Thermal spray contractors shall have a quality management system meeting the requirements in NS-EN ISO 2063-2.

Coating work shall be supervised by personnel qualified according to [11.2.5](#).

All instruments and gauges shall be calibrated in accordance with equipment manufacturer requirements and the calibration certificate shall be readily available.

A quality plan shall be prepared with a unique reference to the project/work order. The objective is to identify the work to be carried out, the methods to be used and schedule the activities. This includes:

- work plan with schedule;
- scope of the work: identify items and/or surface areas and the relevant coating systems;
- list of generic responsibilities and reporting lines for the various activities;
- detailing any sub-contractor and sub-contracted activities;
- control of equipment calibration;
- list of candidate operators and their qualifications, ref. [11.2](#).

The quality plan shall also cross reference the ITP. The ITP shall in an orderly manner list all activities to be performed (i.e. before, during and after coating application) and shall include the testing frequencies, acceptance criteria and mitigating actions in case of failure.

15 Selection of a NORSOK system

The coating system to be selected depends upon:

- substrate material;
- item to be coated;
- external exposure conditions;
- operating conditions;
- project requirements.

The systems covered by this document are presented by the CSDSs in [Annex A](#), [Table 3](#), [Table 4](#) and [Table 5](#) give a generic overview of where and when these are applicable.

Table 3 — Coating selection table for structural items

Substrate material	Item to be coated	Exposure conditions	Default System Note 8
Carbon steel	Structures and structural components including frames, base plates, enclosures, permanent lifting beams and lugs	Offshore and coastal areas	CSDS no. 1A
		Splash zone and tidal zone, and up to and including underside of cellar deck or other deck directly exposed above sea	CSDS no. 7A
		Submerged, max +50 °C	CSDS no. 7B
		Submerged, above +50 °C	CSDS no. 7C
		Buried structures	CSDS no. 1F
	Bridges, crane boom, A-frames, lifeboat stations and rescue areas	Offshore and coastal areas	CSDS no. 1A
	Exhaust stack, flare stack	Offshore and coastal areas	CSDS no. 2A
	Escape routes, walkways, deck areas, lay down	Offshore and coastal areas	CSDS no. 4A , Note 7
	Structures	HVAC	CSDS no. 8 , Note 1
Stainless steel	Structures and structural components and outfitting	Offshore and coastal areas	Note 2
		Splash zone/tidal zone and submerged	Note 3
	Lifeboat stations and rescue areas	Offshore and coastal areas	Note 4
	Structures	HVAC	NA
HDG carbon steel	Handrails and ladders	Offshore and coastal areas	Note 5
	Foundations, frames and structures	Offshore and coastal areas	CSDS no. 6B
	Handrails, ladders, foundations, frames and structures	HVAC	NA
Aluminium	Structures and structural components	Offshore and coastal areas	CSDS no. 6A , Note 6
		HVAC	NA
Any	Any	Offshore and coastal areas and PFP	CSDS no. 5A
		Splash zone and tidal zone, and up to and including underside of cellar deck or other deck directly exposed above sea and PFP	CSDS no. 5S
Stainless steel	Any	Offshore and coastal areas and PFP	CSDS no. 5C
NOTE 1	Manufacturer standard coating system may be used if accepted by Project.		
NOTE 2	Coating requirements depends on stainless steel material grade and Project requirements. When coating is required system CSDS no. 6A is the default.		
NOTE 3	Coating requirements depends on stainless steel material grade and Project requirements. When coating is required system CSDS no. 7D is the default.		

Table 3 — Coating selection table for structural items *(continued)*

NOTE 4	Colour coding will be required. When coating is required for corrosion protection coating system CSDS no. 6A is the default.
NOTE 5	Coating requirements depends on Project requirements. When coating is required system CSDS no. 6B is the default.
NOTE 6	Coating requirements depends on aluminium grade and Project requirements. Applicable aluminium grades are defined in NORSOK M-121 . When coating is required system CSDS no. 6A is the default.
NOTE 7	A change from system CSDS no. 4A to CSDS no. 4B can be agreed case by case for light and normal duty deck areas.
NOTE 8	The default systems listed represent the <u>minimum</u> requirement to meet the high durability range as defined in NS-EN ISO 12944-1 .

Table 4 — Coating selection table for pressure vessels, equipment, piping and valves

Substrate material	Item to be coated	Exposure conditions	Default System Note 10
Carbon steel	Pressure vessels, equipment, piping and valves, pumps	Offshore and coastal areas, non-insulated, $T \leq +80\text{ °C}$	CSDS no. 1A
		Offshore and coastal areas, non-insulated, $+80\text{ °C} < T < +595\text{ °C}$	CSDS no. 2A
		Offshore and coastal areas, non-insulated, $T > +400\text{ °C}$	Note 1
		Offshore and coastal areas, insulated, $T \leq +200\text{ °C}$	CSDS no. 2A Note 2
		Offshore and coastal areas, insulated, $+200\text{ °C} < T < +595\text{ °C}$	CSDS no. 2A Note 7
		Buried piping	CSDS no. 1F
		Splash zone and tidal zone	CSDS no. 7A
		Submerged, $T \leq +50\text{ °C}$	CSDS no. 7B
		Submerged, $T > +50\text{ °C}$	CSDS no. 7C
		Above splash zone and up to and including underside of cellar deck or other deck directly exposed above sea	CSDS no. 7A
	Actuator, gear box	Offshore and coastal areas	CSDS no. 1A
		Offshore and coastal areas, insulated	CSDS no. 1D
	Generators, Motors, Engines, Turbines, Transformers, Compressors	Offshore and coastal areas	CSDS no. 1A or CSDS no. 2B
		Offshore and coastal areas, low voltage motors	CSDS no. 1B or CSDS no. 2B
	General	HVAC	CSDS no. 8 Note 3
Stainless steel	Pressure vessels, equipment, piping and valves, pumps	Offshore and coastal areas, non-insulated, additional protection by coating required due to operating temperature.	CSDS no. 2C Note 7
		Splash zone and submerged, $T \leq +50\text{ °C}$	CSDS no. 7E Note 4
		Submerged, $T > +50\text{ °C}$	CSDS no. 7F Note 4

Table 4 — Coating selection table for pressure vessels, equipment, piping and valves *(continued)*

Substrate material	Item to be coated	Exposure conditions	Default System Note 10
		Offshore and coastal areas, insulated	CSDS no. 2C ^{Note 9}
		Cryogenic service, T < -50 °C	CSDS no. 9 ^{Note 8}
	Actuator, gear box	Offshore and coastal areas	NA
		Offshore and coastal areas, insulated	CSDS no. 6C
HDG carbon steel	Misc. equipment	Offshore and coastal areas	CSDS no. 6B ^{Note 5}
Aluminium	Misc. equipment	Offshore and coastal areas	CSDS no. 6A ^{Note 6}
Stainless steel, HDG Aluminium.	General, misc. piping and equipment	HVAC, non-insulated and insulated	NA
Carbon steel	Any	Offshore and coastal areas and PFP	CSDS no. 5A
Stainless steel	Any	Offshore and coastal areas and PFP	CSDS no. 5C
NOTE 1 The system must be suitable for corrosion protection during planned down time.			
NOTE 2 System CSDS no. 1D is an acceptable alternative when pre-qualified to the required maximum operating temperature.			
NOTE 3 Manufacturer standard coating system may be used if accepted by Project.			
NOTE 4 The need for corrosion protection by coating depends upon the selected stainless steel grade. Coating may also be needed to limit current drain from the CP system.			
NOTE 5 Coating requirements depends upon Project requirements. When coating is required system CSDS no. 6B is the default.			
NOTE 6 Coating requirements depends upon aluminium grade and Project requirements. When coating is required system CSDS no. 6A is the default.			
NOTE 7 System CSDS no. 10A and CSDS no. 10B are acceptable alternatives if pre-qualified to the required maximum operating temperature.			
NOTE 8 Coating system to be pre-qualified to the required minimum operating temperature. System CSDS no. 2A is an acceptable alternative.			
NOTE 9 System CSDS no. 6C is an acceptable alternative when pre-qualified to the required maximum operating temperature.			
NOTE 10 The default systems listed represent the minimum requirement to meet the high durability range as defined in NS-EN ISO 12944-1 .			

Table 5 — Coating selection table for internal lining in storage tanks and pressure vessels

Substrate material	Item to be coated	Exposure conditions	Default System
Carbon steel	Storage tanks	Potable water	CSDS no. 3A
		Ballast water, Seawater, Firewater, Slops, Oily water, Open drain, Closed drain	CSDS no. 3B
		Diesel, Condensate, Stabilized crude	CSDS no. 3C
		Demineralised water, Hydrocarbons, Un-stabilized crude, Produced water, Fuel, Aviation fuels, Sewage	CSDS no. 3D
		Methanol, ethanol, MEG, TEG	CSDS no. 3G
	Process vessels	Hydrocarbon liquids mixed with vapour, Produced water, Seawater	CSDS no. 3D
		Operating pressure $\leq 0.3\text{MPa}$	
		Operating temperature $\leq +75\text{ }^{\circ}\text{C}$	
		Hydrocarbon liquids mixed with vapour, Produced water, Seawater	CSDS no. 3E
		Operating pressure $\leq 7\text{MPa}$	
		Operating temperature $\leq +80\text{ }^{\circ}\text{C}$	
		Hydrocarbon liquids mixed with vapour, Produced water, Seawater	CSDS no. 3F
		Operating pressure $\leq 3\text{MPa}$	
		Operating temperature $\leq +130\text{ }^{\circ}\text{C}$	

Annex A
(normative)

Coating system data sheet

An overview of the systems covered by this document is given in a chronologically order following an established CSDS numbering system among oil and gas producers in [Table A.1](#).

Table A.1 — Coating systems data sheet overview

CSDS	Substrate	Service/exposure conditions	Comments
CSDS no. 1A	Carbon steel	Offshore and coastal environment, non-insulated, -50 °C to +80 °C	
CSDS no. 1B	Carbon steel	Offshore and coastal environment, non-insulated, -50 °C to +80 °C	When agreed with end user
CSDS no. 1D	Carbon steel	Under insulation, -50 °C to +200 °C	
CSDS no. 1F	Carbon steel	Buried in soil, -50 °C to +80 °C	
CSDS no. 2A	Carbon steel	Offshore and coastal environment, insulated and non-insulated, + 80 °C to +595 °C	Suitable also below +120 °C
CSDS no. 2B	Carbon steel	Offshore and coastal environment, non-insulated, -50 °C to +80 °C	
CSDS no. 2C	Stainless steel	Offshore and coastal environment, insulated and non-insulated, + 80 °C to +595 °C	Suitable also below +120 °C
CSDS no. 3A	Carbon steel	Internal lining of tanks for potable water, -20 °C to +40 °C	
CSDS no. 3B	Carbon steel	Internal lining combined with CP for tanks containing corrosive waters, -20 °C to +50 °C	
CSDS no. 3C	Carbon steel	Internal lining, for tanks containing crude/diesel and condensate -20 °C to +50 °C	
CSDS no. 3D	Carbon steel	Internal lining of pressure vessels containing hydrocarbons, produced water, aviation fuel, -20 °C to +75 °C	P<0.3MPa
CSDS no. 3E	Carbon steel	Internal lining of pressure vessels containing hydrocarbons, produced water, -20 °C to +80 °C	P<7.0MPa
CSDS no. 3F	Carbon steel	Internal lining of pressure vessels containing hydrocarbons, produced water, -20 °C to +130 °C	P<3.0MPa
CSDS no. 3G	Carbon steel	Internal lining of tanks containing methanol, ethanol, mono ethyl glycol and similar, -20 °C to +40 °C	
CSDS no. 4A	Carbon steel	Offshore and coastal environment, non-insulated, -20 °C to +80 °C	
CSDS no. 4B	Carbon steel	Offshore and coastal environment, non-insulated, -20 °C to +80 °C	When agreed with end user
CSDS no. 5A	Carbon steel	Offshore and coastal environment, PFP required, -50 °C to +80 °C	
CSDS no. 5C	Stainless steel	Offshore and coastal environment, PFP required, -50 °C to +80 °C	Also applicable for other substrates
CSDS no. 5S	Carbon steel	Splash zone, PFP required, -50 °C to +80 °C	
CSDS no. 6A	Stainless steel	Offshore and coastal environment, non-insulated, -50 °C to +80 °C	When coating is specified
CSDS no. 6B	HDG	Offshore and coastal environment, non-insulated, -50 °C to +80 °C	When coating is specified
CSDS no. 6C	Stainless steel	Offshore and coastal environment, insulated, -50 °C to +200 °C	

Table A.1 — Coating systems data sheet overview *(continued)*

CSDS	Substrate	Service/exposure conditions	Comments
CSDS no. 6D	Aluminium	Offshore and coastal environment, non-insulated, -50 °C to +80 °C	When coating is specified
CSDS no. 6E	HDG	Offshore and coastal environment, non-insulated, -50 °C to +80 °C	When agreed with end user
CSDS no. 6F	Aluminium	Offshore and coastal environment, non-insulated, -50 °C to +80 °C	When agreed with end user
CSDS no. 7A	Carbon steel	Splash zone, tidal zone and combined with CP, up to +50 °C	
CSDS no. 7B	Carbon steel	Seawater combined with CP, up to +50 °C	
CSDS no. 7C	Carbon steel	Seawater combined with CP, up to +150 °C	
CSDS no. 7D	Stainless steel	Splash zone, tidal zone and combined with CP, up to +50 °C	System pre-qualified by CSDS no. 7A
CSDS no. 7E	Stainless steel	Seawater combined with CP, up to +50 °C	System pre-qualified by CSDS no. 7B
CSDS no. 7F	Stainless steel	Seawater combined with CP, up to +150 °C	System pre-qualified by CSDS no. 7C
CSDS no. 8	Carbon steel	HVAC controlled environment, -50 °C to +80 °C	
CSDS no. 9	Stainless steel	Offshore and coastal environment, insulated, below -50 °C	
CSDS no. 10A	Carbon steel	Offshore and coastal environment, non-insulated, above +200 °C	
CSDS no. 10B	Stainless steel	Offshore and coastal environment, non-insulated, above +200 °C	

CSDS no. 1A

Coating System Data Sheet		CSDS no. 1A ^{Note 1}	Rev. 01
Substrate material: Carbon steel		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, structural components, frames, base plates, enclosures, permanent lifting beams and lugs, bridges, crane boom, A-frames, lifeboat stations and rescue areas, equipment items, piping and valves.			
Service: Offshore and coastal environment, non-insulated			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 2} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type	MDFT ^{Note 3}	MAX DFT
1: (Primer)	Zinc silicate ^{Note 4}	60 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2:	Sealer coat ^{Note 5}	NA	
3:	Epoxy	DFTs shall be as per the qualified system	
4: (Topcoat)	UV-resistant topcoat		
Total MDFT		300 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activity: 11.1			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.11, 12.12, 12.13 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	It is experienced that a coating damage in field develops slower for systems with zinc silicate primers compared to other generic primers. Hence, increased durability (very high, ref. NS-EN ISO 12944-1) can be achieved.		
NOTE 2	For castings steel preparations grade P2 is permitted.		
NOTE 3	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840 .		
NOTE 4	Zinc silicate primer shall contain minimum 85% zinc dust by mass in the dry film. Zinc dust pigment shall comply with NS-EN ISO 3549 .		
NOTE 5	The objective of a sealer coat shall close pores to avoid popping and pin holes, not to add a specific thickness. Mist coat technique is optional if covered in the CPS. When mist coat is used, the extent of thinning shall be covered in the CPS in accordance with the guidelines from the coating manufacturer		

CSDS no. 1B

Coating System Data Sheet		CSDS no. 1B	Rev. 01
Substrate material: Carbon steel		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: As for system 1A. For use when accepted by end user.			
Service: Offshore and coastal environment, non-insulated			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 1} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m², ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type	MDFT ^{Note 2}	MAX DFT
1: (Primer)	Zinc rich epoxy ^{Note 3 and 4}	60 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2:	Epoxy	DFTs shall be as per the qualified system	
3: (Topcoat)	UV-resistant topcoat		
Total MDFT		300 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activity: 11.1			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	For castings steel preparations grade P2 is permitted		
NOTE 2	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840 .		
NOTE 3	Zinc rich epoxy primer shall contain minimum 80% zinc dust by mass in the dry film. Zinc dust pigment shall comply with NS-EN ISO 3549 .		
NOTE 4	A tie coat shall be applied over the zinc rich primer if there is a reason to believe that zinc salts otherwise may form before the application of the second layer can be carried out. The CADS shall give advice with respect allowable conditions and time intervals. The DFT of the tie coat shall be in accordance with manufacturer recommendation. If a tie coat is used, it shall be pre-qualified as part of the coating system.		

CSDS no. 1D

Coating System Data Sheet		CSDS no. 1D	Rev. 01
Substrate material: Carbon steel		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Offshore and coastal environment, insulated			
Operating temperature range: -50 °C to +200 °C ^{Note 1}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 2} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type	DFT	MAX DFT
1: (Primer)	Epoxy, Epoxy phenolic, Epoxy novolac	125 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Epoxy, Epoxy phenolic, Epoxy novolac	125 µm	
Total DFT		250 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activities: 11.6, 11.7 and 11.8			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	The selected coating material shall be qualified for the actual maximum operating temperature.		
NOTE 2	For castings steel preparations grade P2 is permitted.		

CSDS no. 1F

Coating System Data Sheet		CSDS no. 1F	Rev. 01
Substrate material: Carbon steel		Corrosivity category: Im3, ref. <u>NS-EN ISO 12944-2</u>	
Items to be coated: Structures and piping			
Service: Buried in soil			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. <u>NS-EN ISO 8501-3</u> . Surface cleaning to meet: “clean”, ref. <u>ASTM F22</u> Water break test			
Surface cleanliness: Sa 2½, ref. <u>NS-EN ISO 8501-1</u> Dust level max quantity and rating 2, ref. <u>NS-EN ISO 8502-3</u>			
Surface roughness: 75 µm to 100 µm ref. <u>NS-EN ISO 8503-1</u> , <u>NS-EN ISO 8503-2</u> with grit comparator only, <u>NS-EN ISO 8503-4</u> and/or			
Max. level of water-soluble salts: 20 mg/m², ref. <u>NS-EN ISO 8502-6/NS-EN ISO 8502-9</u>			
Generic description of the coating system			
Coat number	Generic type ^{Note 1 and 2}	DFT	MAX DFT
1: (Primer)	Epoxy or polyester	500 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Epoxy or polyester	500 µm	
Total DFT		1000 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activities number: 11.4, 11.15, 11.16 and 11.7			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system			
NOTE 1	An additional UV-resistant topcoat may be applied to increase chemical resistance and to avoid chalking on any above ground transitions.		
NOTE 2	The selected products shall demonstrate durability for the exposure conditions relevant for the required service life sincethe objective is to avoid maintenance and repairs.		

CSDS no. 2A

Coating System Data Sheet		CSDS no. 2A ^{Note 1}	Rev. 01
Substrate material: Carbon steel		Corrosivity category: CX, CX+Im4, Im4, Im3, ref. NS-EN ISO 12944-2	
Items to be coated: Exhaust stack, flare stack, pressure vessels, equipment, piping and valves, pumps			
Service: Offshore and coastal environment, submerged, buried, insulated and non-insulated			
Operating temperature range: > +80 °C to +595 °C ^{Note 2}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3. Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1, NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6/NS-EN ISO 8502-9			
Generic description of the coating system ^{Note 3}			
Coat number	Generic type	MDFT ^{Note 5}	MAX DFT
1: (TSA coat)	Thermally sprayed aluminium or alloys of aluminium ^{Note 4}	200 µm	The maximum DFT to be qualified by CPT, but shall never exceed 400 µm
2:	Sealer ^{Note 6}	See Note 7	
Total MDFT		200 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA			
Inspections during CPT and production: Table 2, activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.13, 12.15A, 12.16., 12.17 and 12.18			
Adhesion: During CPT min. 9 MPa, during production min. 7 MPa for any measurement. Tests to be performed without sealer ref. ref. Table 2, notes 4 and 8. See details in Annex J.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Same requirements apply as for the original system			
NOTE 1	Very high durability (ref. NS-EN ISO 12944-1) has been experienced with this system.		
NOTE 2	The system may also be used at lower temperatures. The sealer shall be two-component epoxy for operating temperatures below +80 °C and aluminium silicone above +80 °C.		
NOTE 3	For welding after coating application, 5 to 10 cm from the bevel area shall be uncoated.		
NOTE 4	The materials for metal spraying shall comply with 9.2		
NOTE 5	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840.		
NOTE 6	The sealer is not required for immersed service (Im4) and buried service (Im3) if the minimum DFT is in accordance with NS-EN ISO 2063-1, Table C.1 and CP is provided.		
NOTE 7	The sealer shall fill the metal pores. It shall be applied until absorption is complete. There should not be a measurable overlay of sealer on the metallic coating after application. When mist coat is used, the extent of thinning shall be covered in the CPS in accordance with the guidelines from the coating manufacturer		

CSDS no. 2B

Coating System Data Sheet		CSDS no. 2B ^{Note 1}	Rev. 01
Substrate material: Carbon steel		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Offshore and coastal environment, non-insulated			
Operating temperature range: > -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3. Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1, NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6/NS-EN ISO 8502-9			
Generic description of the coating system ^{Note 2}			
Coat number	Generic type	MDFT ^{Note 4}	MAX DFT
1: (TSZ coat)	Thermally sprayed zinc or alloys of zinc ^{Note 3}	100 µm	The maximum DFT for TSZ as per the CPT. The maximum DFT for the other coats shall be within the limits given in the relevant CADS
2:	Sealer ^{Note 5}	See Note 6	
3:	Epoxy ^{Note 6}	125 µm	
4: (Topcoat)	UV-resistant topcoat	75 µm	
Total MDFT		300 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA			
Inspections during CPT and production: Table 2, activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.15A, 12.16 and 12.17			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2, notes 7 and 8. See details in Annex J.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	Very high durability (ref. NS-EN ISO 12944-1) has been experienced with this system.		
NOTE 2	For welding after coating application, 5 to 10 cm from the bevel area shall be uncoated. The next section, up to 30 - 40 cm measured from the bevel area shall have TSZ only.		
NOTE 3	The materials for metal spraying shall comply with 9.2		
NOTE 4	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840.		
NOTE 5	The sealer shall be in accordance with manufacturer’s recommendation.		
NOTE 6	The sealer and the subsequent coats shall be pre-qualified as part of system 1A. The pre-qualification may have been carried out at different film thicknesses. No additional pre-qualification to fit with system 2B is required. When a mist coat is used, the extent of thinning shall be covered in the CPS in accordance with the guidelines from the coating manufacturer.		

CSDS no. 2C

Coating System Data Sheet		CSDS no. 2C ^{Note 1}	Rev. 01
Substrate material: Stainless steel		Corrosivity category: CX, CX+Im4, Im4, Im3, ref. NS-EN ISO 12944-2	
Items to be coated: Exhaust stack, flare stack, pressure vessels, equipment, piping and valves, pumps			
Service: Offshore and coastal environment, submerged, buried, insulated and non-insulated			
Operating temperature range: > +80 °C to +595 °C ^{Note 2}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3. Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness ^{Note 3} : Sweep blast, ref. SSPC-SP 16 to meet surface roughness. Dust level max quantity and rating 2 ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm, ref. NS-EN ISO 8503-1, NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6/NS-EN ISO 8502-9			
Generic description of the coating system ^{Note 4}			
Coat number	Generic type	MDFT ^{Note 6}	MAX DFT
1: (TSA coat)	Thermally sprayed aluminium or alloys of aluminium ^{Note 5}	200 µm	The maximum DFT to be qualified by CPT, but shall never exceed 400 µm
2:	Sealer ^{Note 7}	See Note 8	
Total MDFT		200 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA			
Inspections during CPT and production: Table 2, activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.13, 12.15A, 12.16, 12.17 and 12.18			
Adhesion: During CPT min. 9 MPa, during production min. 7 MPa for any measurement. Tests to be performed without sealer ref. Table 2, notes 4 and 8. See details in Annex I.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Same requirements apply as for the original system			
NOTE 1	Very high durability (ref. NS-EN ISO 12944-1) has been experienced with this system.		
NOTE 2	System may also be used at lower temperatures.		
NOTE 3	Only non-metallic and chloride free abrasive shall be used.		
NOTE 4	For welding after coating application, 5 to 10 cm from the bevel area shall be uncoated.		
NOTE 5	The materials for metal spraying shall comply with 9.2.		
NOTE 6	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840		
NOTE 7	The sealer shall be two-component epoxy for operating temperatures below +80 °C and aluminium silicone above +80 °C. No sealer is required for immersed service (Im4) and buried service (Im3) if the MDFT is in accordance with NS-EN ISO 2063-1, Table C.1 and CP is provided.		
NOTE 8	Sealer to fill the metal pores, applied till absorption is complete with no measurable overlay.		

CSDS no. 3A

Coating System Data Sheet		CSDS no. 3A	Rev. 01
Substrate material: Carbon steel		Corrosivity category: NA	
Items to be coated: Internal surface of carbon steel tanks.			
Service: Potable water			
Operating temperature range: > -20 °C to +40 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system ^{Note 1}			
Coat number	Generic type ^{Note 2 and 3}	MDFT ^{Note 4}	MAX DFT
1: (Primer)	Epoxy	300 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADs
2: (Topcoat)	Epoxy	300 µm	
Total MDFT		600 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activities: 11.9 ^{Note 5} and 11.12			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 30 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 5 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	To be externally marked with black letters stating: INTERNALLY LINED, NO HOT WORK		
NOTE 2	Coating material shall be certified to local regulatory requirements for material in contact with potable water.		
NOTE 3	Solvent free epoxy with minimum 98 % solids by volume shall be used.		
NOTE 4	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840 .		
NOTE 5	Testing as per ISO 2812 for 4200 hours in fresh water.		

CSDS no. 3B

Coating System Data Sheet		CSDS no. 3B	Rev. 01
Substrate material: Carbon steel		Corrosivity category: NA	
Items to be coated: Internal surface of carbon steel tanks.			
Service: Seawater, service water, slop, open drain etc in combination with CP			
Operating temperature range: > -20 °C to +50 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m², ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system ^{Note 1}			
Coat number	Generic type	MDFT ^{Note 2}	MAX DFT
1: (Primer)	Epoxy	The minimum DFT for each coat shall be as qualified by the coating manufacturer and given in the relevant CADS	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Epoxy		
Total MDFT		350 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1, activities: 11.10			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing the steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	To be externally marked with black letters stating: INTERNALLY LINED, NO HOT WORK		
NOTE 2	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840.		

CSDS no. 3C

Coating System Data Sheet		CSDS no. 3C	Rev. 01
Substrate material: Carbon steel		Corrosivity category: NA	
Items to be coated: Internal surface of carbon steel tanks.			
Service: Stabilized crude, diesel and condensate			
Operating temperature range: > -20 °C to +50 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m², ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system ^{Note 1}			
Coat number	Generic type ^{Note 2}	MDFT ^{Note 3}	MAX DFT
1: (Primer)	Epoxy	The minimum DFT for each coat shall be as qualified by the coating manufacturer and given in the relevant CADS	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Epoxy		
Total MDFT		300 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activities: 11.4 and 11.11			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 30 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 5 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing the steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	To be externally marked with black letters stating: INTERNALLY LINED, NO HOT WORK		
NOTE 2	The coating system shall be applied to the tank bottom and walls up to the specified highest water level and to the tank roof and upper 1m of the tank walls.		
NOTE 3	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840.		

CSDS no. 3D

Coating System Data Sheet		CSDS no. 3D	Rev. 01
Substrate material: Carbon steel		Corrosivity category: NA	
Items to be coated: Internal coating of process vessels			
Service: Hydrocarbon liquids and vapour, produced water, aviation fuel ^{Note 1} . Max. operating pressure 0.3 MPa			
Operating temperature range: > -20 °C to +75 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system ^{Note 2}			
Coat number	Generic type ^{Note 3}	MDFT ^{Note 4}	MAX DFT
1: (Primer)	Epoxy, phenolic epoxy, epoxy novolac, vinylester	The minimum DFT for each coat shall be as qualified by the coating manufacturer and given in the relevant CADS	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Epoxy, phenolic epoxy, epoxy novolac, vinyl ester		
Total MDFT		250 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activities: 11.12, 11.14 ^{Note 5 and 6}			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 30 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 5 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing the steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	Coating for vessels containing aviation fuel is subject to approval by EI Standard 1541		
NOTE 2	To be externally marked with black letters stating: INTERNALLY LINED, NO HOT WORK		
NOTE 3	The coating should be cured as close to operating temperature as possible		
NOTE 4	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840 .		
NOTE 5	Testing as per NACE TM0185 shall be carried out at +75°C for 2016 hours in a 50:50 mixture of crude oil and 3 weight% NaCl solution. A gas overpressure of 0.3 MPa shall be added using a gas mixture of Methane and Carbon dioxide in the ratio of 90:10 by partial pressure.		
NOTE 6	Min. 1 hot rapid decompression from test temp. and pressure to 1 atm within 15 minutes.		

CSDS no. 3E

Coating System Data Sheet		CSDS no. 3E	Rev. 01
Substrate material: Carbon steel		Corrosivity category: NA	
Items to be coated: Internal coating of process vessels			
Service: Hydrocarbon liquids and vapour, produced water. Max. operating pressure 7.0 MPa			
Operating temperature range: > -20 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m², ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system ^{Note 1}			
Coat number	Generic type ^{Note 2}	MDFT ^{Note 3}	MAX DFT
1: (Primer)	Epoxy, phenolic epoxy, epoxy novolac, vinyl ester	The minimum DFT for each coat shall be as qualified by the coating manufacturer and given in the relevant CADs	The maximum DFT for each coat shall be within the limits given in the relevant CADs
2: (Topcoat)	Epoxy, phenolic epoxy, epoxy novolac, vinyl ester		
Total MDFT		250 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activities: 11.12 and 11.14 ^{Note 4 and 5}			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 30 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 5 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing the steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	To be externally marked with black letters stating: INTERNALLY LINED, NO HOT WORK		
NOTE 2	The coating should be cured as close to operating temperature as possible		
NOTE 3	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840 .		
NOTE 4	Testing as per NACE TM0185 shall be carried out at +80°C for 2016 hours in a 50:50 mixture of crude oil and 3 weight% NaCl solution. A gas overpressure of 7.0 MPa shall be added using a gas mixture of Methane and Carbon dioxide in the ratio of 90:10 by partial pressure.		
NOTE 5	Min. 1 hot rapid decompression from test temp. and pressure to 1 atm within 15 minutes.		

CSDS no. 3F

Coating System Data Sheet		CSDS no. 3F	Rev. 01
Substrate material: Carbon steel		Corrosivity category: NA	
Items to be coated: Internal coating of process vessels			
Service: Hydrocarbon liquids and vapour, produced water. Max. operating pressure 3.0 MPa			
Operating temperature range: > -20 °C to +130 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m², ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system ^{Note 1}			
Coat number	Generic type ^{Note 2}	MDFT ^{Note 3}	MAX DFT
1: (Primer)	Epoxy, phenolic epoxy, epoxy novolac, vinyl ester	The minimum DFT for each coat shall be as qualified by the coating manufacturer and given in the relevant CADS	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Epoxy, phenolic epoxy, epoxy novolac, vinyl ester		
Total MDFT		250 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activities: 11.12 and 11.14 ^{Note 4 and 5}			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 30 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 5 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing the steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	To be externally marked with black letters stating: INTERNALLY LINED, NO HOT WORK		
NOTE 2	The coating should be cured as close to operating temperature as possible.		
NOTE 3	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840 .		
NOTE 4	Testing as per NACE TM0185 shall be carried out at +130°C for 2016 hours using a 50:50 mixture of crude oil and 3 weight% NaCl solution. A gas overpressure of 3.0 MPa shall be added using a gas mixture of Methane and Carbon dioxide in the ratio of 90:10 by partial pressure.		
NOTE 5	Min. 1 hot rapid decompression from test temp. and pressure to 1 atm within 15 minutes.		

CSDS no. 3G

Coating System Data Sheet		CSDS no. 3G	Rev. 01
Substrate material: Carbon steel		Corrosivity category: NA	
Items to be coated: Internal coating of storage vessels			
Service: Methanol, ethanol, mono ethyl glycol and similar ^{Note 1}			
Operating temperature range: > -20 °C to +40 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. <u>NS-EN ISO 8501-3</u> . Surface cleaning to meet: “clean”, ref. <u>ASTM F22</u> Water break test			
Surface cleanliness: Sa 2½, ref. <u>NS-EN ISO 8501-1</u> Dust level max quantity and rating 2, ref. <u>NS-EN ISO 8502-3</u>			
Surface roughness: 50 µm to 85 µm ref. <u>NS-EN ISO 8503-1</u> , <u>NS-EN ISO 8503-2</u> with grit comparator only, <u>NS-EN ISO 8503-4</u> and/or <u>NS-EN ISO 8503-5</u>			
Max. level of water-soluble salts: 20 mg/m², ref. <u>NS-EN ISO 8502-6</u> / <u>NS-EN ISO 8502-9</u>			
Generic description of the coating system ^{Note 2}			
Coat number	Generic type	MDFT	MAX DFT
1: (Primer)	Zinc ethyl silicate	The minimum DFT shall be as qualified by the coating manufacturer and given in the relevant CADS	The maximum DFT shall be within the limits given in the relevant CADS
2: (Topcoat)	NA		
Total MDFT		60 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: <u>Table 1</u> , activity: 11.13 ^{Note 3}			
Inspections during CPT and production: <u>Table 2</u> , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13 and 12.15B			
Adhesion: Cross cut test, meeting classification 0-2, ref. <u>Table 2</u> , note 9.			
Repair requirements of damage on newly applied coating			
Damage exposing the steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: NA			
NOTE 1	Only for lean solutions i.e. solutions containing max. 3 weight% water. For higher water contents system 3F shall be used.		
NOTE 2	To be externally marked with black letters stating: INTERNALLY LINED, NO HOT WORK		
NOTE 3	Immersion testing as per <u>NS-EN ISO 2812-1</u> shall be carried out at +40°C in a 97:3 mixture of methanol and water for 6 months.		

CSDS no. 4A

Coating System Data Sheet		CSDS no. 4A	Rev. 01
Substrate material: Carbon steel		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Walkways, escape routes, decks and floors, helideck, heavy duty			
Service: Offshore and coastal environment, non-insulated			
Operating temperature range: -20 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m², ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 1}	MDFT	MAX DFT
As the pre-qualification	Non-skid epoxy screed aggregates according to the CADS ^{Note 2}	The DFT for each coat shall be as per the qualified system	The maximum DFT for each coat shall be within the limits given in the relevant CADS
Topcoat (optional)	Epoxy ^{Note 3}		
Total MDFT		3000 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activity: 11.1			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing the steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	The system build-up shall be according to the pre-qualification. It can be a one coat system or consist of several coating layers. Other generic materials than epoxy are optional.		
NOTE 2	Aggregates shall be non-metallic. It can be pre-mixed in the liquid epoxy coating or evenly distributed on top of a coating layer. Aggregate particle size shall meet the required friction coefficient, comply with local safety requirements and, for helideck, meet aviation regulations.		
NOTE 3	An additional UV-resistant topcoat may be applied for marking and to prevent chalking.		

CSDS no. 4B

Coating System Data Sheet		CSDS no. 4B	Rev. 01
Substrate material: Carbon steel		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Decks and floors when and where agreed with end user			
Service: Offshore and coastal environment, non-insulated			
Operating temperature range: -20 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20mg/m², ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 1}	MDFT ^{Note 4}	MAX DFT
As the pre-qualification	Non-skid epoxy screed aggregates according to the CADS ^{Note 2}	The DFT for each coat shall be as per the qualified system	The maximum DFT for each coat shall be within the limits given in the relevant CADS
Topcoat (optional)	Epoxy ^{Note 3}		
Total MDFT		500 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activity: 11.1			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing the steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	The system build-up shall be according to the pre-qualification. It can be a one coat system or consist of several coating layers. Other generic materials than epoxy are optional.		
NOTE 2	Aggregates shall be non-metallic. It can be pre-mixed in the liquid epoxy coating or evenly distributed on top of a coating layer. Aggregate particle size shall meet the required friction coefficient, comply with local safety requirements and, for helideck, meet aviation regulations.		
NOTE 3	An additional UV-resistant topcoat may be applied for marking and to prevent chalking.		
NOTE 4	Additional coating layer to increase the total DFT of the system when agreed with end user.		

CSDS no. 5A

Coating System Data Sheet		CSDS no. 5A	Rev. 01
Substrate material: Carbon steel		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, frames, equipment items etc. in need of passive fire protection			
Service: Offshore and coastal environment			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 1 and 2} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1, NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m², ref. NS-EN ISO 8502-6/NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type	MDFT	MAX DFT
1: (Primer)	Zinc rich ^{Note 3, 4 and 5}	60 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2:	Epoxy tie coat ^{Note 5}	25 µm	
3:	PFP material	Specified DFT ^{Note 6}	
4:	Epoxy tie coat	25 µm	
5: (Topcoat)	UV-resistant topcoat	As the qualified system	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1, activities: 11.1 and 11.3			
Inspections during CPT and production: Table 2, activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13 and 12.15A			
Adhesion: Any measurement shall be min. 5 MPa ref. Table 2, notes 6 and 8. See details in Annex J.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: See 10.4. Repair following steps recommended by the PFP supplier.			
NOTE 1	For castings steel preparations grade P2 is permitted.		
NOTE 2	Stud welding shall be done before final blasting.		
NOTE 3	Equal requirements for zinc rich primer as for zinc rich primer in system CSDS no. 1A or CSDS no. 1B apply. For practical reasons the same primer as defined in the project specification is recommended.		
NOTE 4	Primer can be replaced by thermally sprayed zinc.		
NOTE 5	The primer can be epoxy with an MDFT of 75 µm if accepted by the end user. Tie coat is then not required.		
NOTE 6	Specified DFT to achieve the required PFP properties and in accordance with third party certification or design verification.		

CSDS no. 5C

Coating System Data Sheet		CSDS no. 5C	Rev. 01
Substrate material: Stainless steel ^{Note 1}		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, frames, equipment items etc. in need of passive fire protection			
Service: Offshore and coastal environment			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 2 and 3} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sweep blast, ref. SSPC-SP 16 to meet surface roughness. Dust level max quantity and rating 2 ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type	MDFT	MAX DFT
1: (Primer)	Epoxy	50 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2:	PFP material	Specified DFT ^{Note 4}	
3:	Epoxy tie coat	25 µm	
4: (Topcoat)	UV-resistant topcoat	As the qualified system	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: As stated in 10.2 for 5A and 5S. The primer shall be in accordance with the PFP manufacturers recommendation			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13 and 12.15A			
Adhesion: Any measurement shall be min. 5 MPa ref. Table 2 , notes 6 and 8. See details in Annex I .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: See 10.4 Repair following steps recommended by the PFP supplier.			
NOTE 1	The system can be used on other substrates without additional pre-qualifications provided the surface preparation requirements are discussed and agreed with PFP supplier and end user.		
NOTE 2	For castings steel preparations grade P2 is permitted.		
NOTE 3	Stud welding shall be done before final blasting.		
NOTE 4	Specified DFT to achieve the required PFP properties and in accordance with third party certification or design verification.		

CSDS no. 5S

Coating System Data Sheet		CSDS no. 5S	Rev. 01
Substrate material: Carbon steel ^{Note 1}		Corrosivity category: CX, Im2, Im4, ref. <u>NS-EN ISO 12944-2</u>	
Items to be coated: Structures in need of passive fire protection			
Service: Splash zone			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. <u>NS-EN ISO 8501-3</u> ^{Note 2} . Surface cleaning to meet: “clean”, ref. <u>ASTM F22</u> Water break test			
Surface cleanliness: Sa 2½, ref. <u>NS-EN ISO 8501-1</u> Dust level max quantity and rating 2, ref. <u>NS-EN ISO 8502-3</u>			
Surface roughness: 50 µm to 85 µm ref. <u>NS-EN ISO 8503-1</u> , <u>NS-EN ISO 8503-2</u> with grit comparator only, <u>NS-EN ISO 8503-4</u> and/or <u>NS-EN ISO 8503-5</u>			
Max. level of water-soluble salts: 20 mg/m ² , ref. <u>NS-EN ISO 8502-6</u> / <u>NS-EN ISO 8502-9</u>			
Generic description of the coating system			
Coat number	Generic type	MDFT	MAX DFT
1: (Primer)	Epoxy	50 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2:	PFP material	Specified DFT ^{Note 3}	
3:	Epoxy tie coat	25 µm	
4: (Topcoat)	UV-resistant topcoat	As the qualified system	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activities: 11.1, 11.2, 11.3 and 11.4			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, and 12.15A			
Adhesion: Any measurement shall be min. 5 MPa ref. Table 2 , notes 6 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: See 10.4 . Repair following steps recommended by the PFP supplier.			
NOTE 1	The systems can be used on other substrates without additional pre-qualifications provided the surface preparation requirements are discussed and agreed with PFP supplier and end user.		
NOTE 2	For castings steel preparations grade P2 is permitted		
NOTE 3	Specified DFT to achieve the required PFP properties and in accordance with third party certification or design verification.		

CSDS no. 6A

Coating System Data Sheet		CSDS no. 6A	Rev. 01
Substrate material: Stainless steel when coating is specified		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Offshore and coastal environment, uninsulated			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 1} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness ^{Note 2} : Sweep blast, ref. SSPC-SP 16 to meet surface roughness. Dust level max quantity and rating 2 ref. NS-EN ISO 8502-3			
Surface roughness: 25 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 3}	NDFT ^{Note 4}	MAX DFT
1: (Primer)	Epoxy	50 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
	Epoxy	DFTs shall be as per the	
3: (Topcoat)	UV-resistant topcoat ^{Note 5}	CADS	
Total DFT		225 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13, and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	For castings steel preparations grade P2 is permitted. Steel preparation grade P2 is also acceptable for coating not applied for corrosion protection i.e. coating for colour coding and/or coating to limit current drain to a CP system.		
NOTE 2	Only non-metallic and chloride free abrasive shall be used.		
NOTE 3	Coatings for stainless steel shall not contain metallic zinc.		
NOTE 4	If the actual surface roughness exceeds 85 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840 .		
NOTE 5	Only topcoats already pre-qualified in any of system 1 sub-systems shall be used.		

CSDS no. 6B

Coating System Data Sheet		CSDS no. 6B	Rev. 01
Substrate material: Hot dip galvanised steel when coating is specified		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Offshore and coastal environment, uninsulated			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 1} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Clean with an emulsifying detergent and rinse with water ^{Note 2} . Sweep blast, ref. SSPC-SP 16 to meet surface roughness. Dust level max quantity and rating 2 ref. NS-EN ISO 8502-3			
Surface roughness: As per SSPC-SP 16 requirement i.e. min 19 µm			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type	NDFT ^{Note 3}	MAX DFT
1: (Primer)	Epoxy	50 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
	Epoxy	DFTs shall be as per the	
3: (Topcoat)	UV-resistant topcoat ^{Note 3}	CADS	
Total DFT		225 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13, and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	For castings steel preparations grade P2 is permitted.		
NOTE 2	The emulsifying detergent shall be completely removed by rinsing with clean, fresh water.		
NOTE 3	Only topcoats already pre-qualified in any of system 1 sub-systems shall be used.		

CSDS no. 6C

Coating System Data Sheet		CSDS no. 6C	Rev. 01
Substrate material: Stainless steel		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Pressure vessels, piping and valves.			
Service: Offshore and coastal environment, insulated			
Operating temperature range: -50 °C to +200 °C ^{Note 1}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. <u>NS-EN ISO 8501-3</u> ^{Note 2} . Surface cleaning to meet: “clean”, ref. <u>ASTM F22</u> Water break test			
Surface cleanliness ^{Note 3} : Sweep blast, ref. <u>SSPC-SP 16</u> to meet surface roughness. Dust level max quantity and rating 2 ref. <u>NS-EN ISO 8502-3</u>			
Surface roughness: 25 µm to 85 µm ref. <u>NS-EN ISO 8503-1</u> , <u>NS-EN ISO 8503-2</u> with grit comparator only, <u>NS-EN ISO 8503-4</u> and/or <u>NS-EN ISO 8503-5</u>			
Max. level of water-soluble salts: 20 mg/m ² , ref. <u>NS-EN ISO 8502-6</u> / <u>NS-EN ISO 8502-9</u>			
Generic description of the coating system			
Coat number	Generic type ^{Note 4}	NDFT	MAX DFT
1: (Primer)	Epoxy, Epoxy phenolic, Epoxy novolac	125 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Epoxy, Epoxy phenolic, Epoxy novolac	125 µm	
Total DFT		250 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: <u>Table 1</u> , activities:11. 6, 11.8			
Inspections during CPT and production: <u>Table 2</u> , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. <u>Table 2</u> , notes 7 and 8. See details in <u>Annex J</u> .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in <u>Clause 13</u> and re-apply the missing coating layers as per the qualified system.			
NOTE 1	The selected coating material shall be qualified for the actual maximum operating temperature.		
NOTE 2	For castings steel preparations grade P2 is permitted.		
NOTE 3	Only non-metallic and chloride free abrasive shall be used.		
NOTE 4	Coatings for stainless steel shall not contain metallic zinc.		

CSDS no. 6D

Coating System Data Sheet		CSDS no. 6D	Rev. 01
Substrate material: Aluminium when coating is specified ^{Note 1}		Corrosivity category: CX, ref. <u>NS-EN ISO 12944-2</u>	
Items to be coated: Structures, structural components, equipment items.			
Service: Offshore and coastal environment, uninsulated			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. <u>NS-EN ISO 8501-3</u> ^{Note 2} . Surface cleaning to meet: “clean”, ref. <u>ASTM F22</u> Water break test			
Surface cleanliness: Clean with an emulsifying detergent, and rinse with water ^{Note 2} . Sweep blast, ref. <u>SSPC-SP 16</u> to meet surface roughness. Dust level max quantity and rating 2 ref. <u>NS-EN ISO 8502-3</u>			
Surface roughness: Grit comparator, segment 1 ref. <u>NS-EN ISO 8503-1</u> , <u>NS-EN ISO 8503-2</u> with grit comparator only, <u>NS-EN ISO 8503-4</u> and/or <u>NS-EN ISO 8503-5</u>			
Max. level of water-soluble salts: 20 mg/m ² , ref. <u>NS-EN ISO 8502-6</u> / <u>NS-EN ISO 8502-9</u>			
Generic description of the coating system			
Coat number	Generic type	NDFT ^{Note 3}	MAX DFT
1: (Primer)	Epoxy	50 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
	Epoxy	DFTs shall be as per the CADS	
3: (Topcoat)	UV-resistant topcoat ^{Note 4}		
Total DFT		225 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13, and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing aluminium surface: Same requirements apply as for the original system.			
Damage not exposing the aluminium surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers of this system.			
NOTE 1	Due to impurities in the casting the desired corrosion protection by coating on cast aluminium is challenging and not always achievable.		
NOTE 2	For castings preparations grade P2 is permitted.		
NOTE 3	The emulsifying detergent shall be completely removed by rinsing with clean, fresh water.		
NOTE 4	Only topcoats already pre-qualified in any of system 1 sub-systems shall be used.		

CSDS no. 6E

Coating System Data Sheet		CSDS no. 6E	Rev. 01
Substrate material: Hot dip galvanized steel when coating is specified ^{Note 1}		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Structural components, staircases, railing, hand wheels and handles, and other items suitable for powder coating			
Service: Offshore and coastal environment			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 2} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: ZnMn phosphate conversion coating, ref. NS-EN 13438:2013 Annex B.1, B.2 and B.3.1 ^{Note 3}			
Surface roughness: NA			
Max. level of water-soluble salts: Max. 30µS measured in water used for rinsing after surface cleaning, ref. NS-ISO 7888			
Generic description of the coating system			
Coat number	Generic type	MDFT	MAX DFT
1:	Polyester powder coating	75 µm	NA
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA			
Pre-production Trial: Test panel to run through the complete surface preparation and powder application at the start-up of the project. Same inspections and requirements as during production			
Inspections during application: Table 2 , activities: 12.2, 12.4, 12.12, 12.13 and 12.15B. Plus: Inspections to NS-EN 13438:2013 Table 1 Clauses 6.5.2/D.3.1, 6.5.6/D.3.5			
Adhesion: Cross cut test, meeting classification 0-2, ref. Table 2 , note 9.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: CSDS no. 1A or CSDS no. 1B as per this document			
Damage exposing zinc surface: The approved epoxy barrier coat and UV resistant topcoat of CSDS no. 1A or CSDS no. 1B as per this document.			
Damage not exposing the zinc surface: Clean and feather as stated in Clause 13 and apply any UV resistant topcoat already pre-qualified in CSDS no. 1A or CSDS no. 1B .			
NOTE 1	Hot-dip galvanising shall be in accordance with NS-EN ISO 1461 , see 5.11 .		
NOTE 2	Object reception control shall include mechanical removal of any HDG surface impurities like zinc ashes and inclusions of hard zinc-iron crystals.		
NOTE 3	The ZnMn phosphating process shall be carried out and documented as requested from the supplier of the pre-treatment chemicals, ref. NS-EN 13438:2013 , Annex B, Table B1.		

CSDS no. 6F

Coating System Data Sheet		CSDS no. 6F	Rev. 01
Substrate material: Aluminium when coating is specified ^{Note 1}		Corrosivity category: C1-CX, ref. <u>NS-EN ISO 12944-2</u>	
Items to be coated: Items suitable for powder coating			
Service: Offshore and coastal environment			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Aluminium preparation grade: P3, ref. <u>NS-EN ISO 8501-3</u> ^{Note 2} . Surface cleaning to meet: “clean”, ref. <u>ASTM F22</u> Water break test			
Surface cleanliness: Chromate free conversion coating ^{Note 3} approved by GSB ^{Note 4} / QUALICOAT ^{Note 5}			
Surface roughness: NA			
Max. level of water-soluble salts: Max. 30µS measured in water used for rinsing after surface cleaning, ref <u>NS-ISO 7888</u>			
Generic description of the coating system			
Coat number	Generic type	MDFT	MAX DFT
1:	Polyester powder coating	75 µm	NA
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA			
Pre-production Trial: Test panel to run through the complete surface preparation and powder application at the start-up of the project. Same inspections and requirements as during production.			
Inspections during application: Table 2 , activities 12.2, 12.4, 12.12, 12.13 and 12.15B. Plus: Control of conversion coating chemicals, powder coating film thickness, dry adhesion and curing according to GSB ^{Note 4} or QUALICOAT ^{Note 5} .			
Adhesion: Cross cut test, meeting classification 0-2, ref. Table 2 , note 9.			
Repair requirements of damage on newly applied coating			
Damage exposing aluminium surface: Apply CSDS no. 6D			
Damage not exposing the aluminium surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers of this system			
NOTE 1	The coating application on cast aluminium is challenging and may not always give the desired corrosion protection result due to impurities in the casting.		
NOTE 2	For castings preparations grade P2 is permitted.		
NOTE 3	Chromium (III) is non-toxic and recommended due to its built in corrosion protection. Shall be used if the powder coating application can not reach all areas 100%.		
NOTE 4	GSB AL 631		
NOTE 5	QUALICOAT, P.O: Box 1507, CH-8027 Zurich		

CSDS no. 7A

Coating System Data Sheet		CSDS no. 7A	Rev. 01
Substrate material: Carbon steel		Corrosivity category: CX, CX+Im4 ref. <u>NS-EN ISO 12944-2</u>	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Splash zone, tidal zone in combination with CP			
Operating temperature range: -50 °C to +50 °C ^{Note 1}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. <u>NS-EN ISO 8501-3</u> . Surface cleaning to meet: “clean”, ref. <u>ASTM F22</u> Water break test			
Surface cleanliness: Sa 2½, ref. <u>NS-EN ISO 8501-1</u> Dust level max quantity and rating 2, ref. <u>NS-EN ISO 8502-3</u>			
Surface roughness: 50 µm to 130 µm ref. <u>NS-EN ISO 8503-1</u> , <u>NS-EN ISO 8503-2</u> with grit comparator only, <u>NS-EN ISO 8503-4</u> and/or <u>NS-EN ISO 8503-5</u>			
Max. level of water-soluble salts: 20 mg/m²,ref. <u>NS-EN ISO 8502-6/NS-EN ISO 8502-9</u>			
Generic description of the coating system			
Coat number	Generic type ^{Note 2, 3 and 4}	MDFT	MAX DFT
1: (Primer)	Epoxy or polyester	500 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADs
2:	Epoxy or polyester	500 µm	
Total DFT		1000 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: <u>Table 1</u> , activities: 11. 1, 11.4, 11. 5 ^{Note 1} and 11.17			
Inspections during CPT and production: <u>Table 2</u> , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. <u>Table 2</u> , notes 7 and 8. See details in <u>Annex J</u> .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in <u>Clause 13</u> and re-apply the missing coating layers as per the qualified system.			
NOTE 1	If exposure to temp. > +50 °C, additional testing as per Table 1 activity 11. 5 is required.		
NOTE 2	The selected products shall demonstrate durability in the splash zone relevant for the required service life since later since the objective is to avoid later maintenance and repairs. Many glass flake polyesters have good track records for expsoure in splash zone and very high durability has been experienced.		
NOTE 3	If a topcoat is required, the selected material shall be pre-qualified in any of system 1 sub-systems. The DFT of topcoat to be added to the total DFT stated.		
NOTE 4	If needed a fouling release or anti-fouling system is to be applied on top.		

CSDS no. 7B

Coating System Data Sheet		CSDS no. 7B	Rev. 01
Substrate material: Carbon steel		Corrosivity category: Im4, ref. <u>NS-EN ISO 12944-2</u>	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Submerged in seawater in combination with CP			
Operating temperature range: -50 °C to +50 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. <u>NS-EN ISO 8501-3</u> . Surface cleaning to meet: “clean”, ref. <u>ASTM F22</u> Water break test			
Surface cleanliness: Sa 2½, ref. <u>NS-EN ISO 8501-1</u> Dust level max quantity and rating 2, ref. <u>NS-EN ISO 8502-3</u>			
Surface roughness: 50 µm to 85 µm ref. <u>NS-EN ISO 8503-1</u> , <u>NS-EN ISO 8503-2</u> with grit comparator only, <u>NS-EN ISO 8503-4</u> and/or <u>NS-EN ISO 8503-5</u>			
Max. level of water-soluble salts: 20 mg/m ² , ref. <u>NS-EN ISO 8502-6</u> / <u>NS-EN ISO 8502-9</u>			
Generic description of the coating system			
Coat number	Generic type ^{Note 1, 2 and 3}	MDFT	MAX DFT
1: (Primer)	Epoxy, Epoxy phenolic, Epoxy novolac	175 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2:	Epoxy, Epoxy phenolic, Epoxy novolac	175 µm	
Total DFT		350 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activities: 11.4			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2 , notes 7 and 8. See details in Annex J .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	Glass flake or fibre reinforced epoxy coat or high solid, high build epoxy are optional.		
NOTE 2	Extended storage at yards or laydown areas prior to subsea installation will require measures to prevent UV-degradation and mechanical damage since system performance is linked to CP.		
NOTE 3	If needed a fouling release or anti-fouling system is to be applied on top.		

CSDS no. 7C

Coating System Data Sheet		CSDS no. 7C	Rev. 01
Substrate material: Carbon steel		Corrosivity category: Im4, ref. <u>NS-EN ISO 12944-2</u>	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Submerged in seawater in combination with CP			
Operating temperature range: Typically, up to +150 °C ^{Note 1}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. <u>NS-EN ISO 8501-3</u> . Surface cleaning to meet: “clean”, ref. <u>ASTM F22</u> Water break test			
Surface cleanliness ^{Note 2} : Sa 2½, ref. <u>NS-EN ISO 8501-1</u> Dust level max quantity and rating 2, ref. <u>NS-EN ISO 8502-3</u>			
Surface roughness: 50 µm to 85 µm ref. <u>NS-EN ISO 8503-1</u> , <u>NS-EN ISO 8503-2</u> with grit comparator only, <u>NS-EN ISO 8503-4</u> and/or <u>NS-EN ISO 8503-5</u>			
Max. level of water-soluble salts: 20 mg/m ² , ref. <u>NS-EN ISO 8502-6/NS-EN ISO 8502-9</u>			
Generic description of the coating system			
Coat number	Generic type ^{Note 3 and 4}	MDFT	MAX DFT
1: (Primer)	Epoxy, Epoxy phenolic, Epoxy novolac	175 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2:	Epoxy, Epoxy phenolic, Epoxy novolac	175 µm	
Total DFT		350 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: <u>Table 1</u> , activities: 11.4 and 11.5			
Inspections during CPT and production: <u>Table 2</u> , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. <u>Table 2</u> , notes 7 and 8. See details in <u>Annex J</u> .			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in <u>Clause 13</u> and re-apply the missing coating layers as per the qualified system.			
NOTE 1	The upper temperature limit shall correspond with the maximum operating temperature of the material's pre-qualification.		
NOTE 2	If wet thermal insulation is applied, the surface preparation shall be to Sa 3.		
NOTE 3	Extended storage at yards or laydown areas prior to subsea installation will require measures to prevent UV-degradation and mechanical damage since system performance is linked to CP.		
NOTE 4	If needed a fouling release or anti-fouling system is to be applied on top.		

CSDS no. 7D

Coating System Data Sheet		CSDS no. 7D	Rev. 01
Substrate material: Stainless steel and non-ferrous alloys when coating is specified		Corrosivity category: CX, CX+Im4, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Splash zone, tidal zone in combination with CP			
Operating temperature range: -50 °C to +50 °C ^{Note 1}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 2} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness ^{Note 3} : Sweep blast, ref. SSPC-SP 16 to meet surface roughness. Dust level max quantity and rating 2 ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1, NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6/NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 4, 5 and 6}	DFT	MAX DFT
1: (Primer)	Epoxy or polyester	500 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADs
2:	Epoxy or polyester	500 µm	
Total DFT		1000 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA, ref. Table 1 note 7.			
Inspections during CPT and production: Table 2, activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2, notes 7 and 8. See details in Annex J.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	If exposure to temp. > + 50 °C, additional testing as per Table 1 activity 11. 5 is required.		
NOTE 2	Steel preparation grade P2 is acceptable for coating not applied for corrosion protection.		
NOTE 3	Only non-metallic and chloride free abrasive shall be used.		
NOTE 4	The selected products shall demonstrate durability in the splash zone relevant for the required service life since later since the objective is to avoid later maintenance and repairs. Many glass flake polyesters have good track records for expsoure in splash zone.		
NOTE 5	If a topcoat is required, the selected material shall be pre-qualified in any of system 1 sub-systems. The DFT of topcoat to be added to the total DFT stated.		
NOTE 6	If needed a fouling release or anti-fouling system is to be applied on top.		

CSDS no. 7E

Coating System Data Sheet		CSDS no. 7E	Rev. 01
Substrate material: Stainless steel and non-ferrous alloys when coating is specified		Corrosivity category: Im4, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Submerged in seawater in combination with CP			
Operating temperature range: -50 °C to +50 °C			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 1} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness ^{Note 2} : Sweep blast, ref. SSPC-SP 16 to meet surface roughness. Dust level max quantity and rating 2 ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1, NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6/NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 3, 4 and 5}	MDFT	MAX DFT
1: (Primer)	Epoxy, Epoxy phenolic, Epoxy novolac	175 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2:	Epoxy, Epoxy phenolic, Epoxy novolac	175 µm	
Total DFT		350 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA, ref. Table 1 note 7.			
Inspections during CPT and production: Table 2, activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2, notes 7 and 8. See details in Annex J.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	Steel preparation grade P2 is acceptable for coating not applied for corrosion protection.		
NOTE 2	Only non-metallic and chloride free abrasive shall be used.		
NOTE 3	Glass flake or fibre reinforced epoxy coat or high solid, high build epoxy are optional. The coating materials shall not contain any zinc.		
NOTE 4	Extended storage at yards or laydown areas prior to subsea installation will require measures to prevent UV-degradation and mechanical damage since system performance is linked to CP.		
NOTE 5	If needed a fouling release or anti-fouling system is to be applied on top.		

CSDS no. 7F

Coating System Data Sheet		CSDS no. 7F	Rev. 01
Substrate material: Stainless steel and non-ferrous alloys when coating is specified		Corrosivity category: Im4, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: Submerged in seawater in combination with CP			
Operating temperature range: up to +150 °C ^{Note 1}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 ^{Note 2} . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness ^{Note 3} : Sweep blast, ref. SSPC-SP 16 to meet surface roughness. Dust level max quantity and rating 2 ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1, NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6/NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 4 and 5}	MDFT	MAX DFT
1: (Primer)	Epoxy, Epoxy phenolic, Epoxy novolac	175 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2:	Epoxy, Epoxy phenolic, Epoxy novolac	175 µm	
Total DFT		350 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA, ref. Table 1 note 7.			
Inspections during CPT and production: Table 2, activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13, 12.14 and 12.15A			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa ref. Table 2, notes 7 and 8. See details in Annex J.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	The upper temperature limit shall correspond with the maximum operating temperature of the material's pre-qualification.		
NOTE 2	Steel preparation grade P2 is acceptable for coating not applied for corrosion protection.		
NOTE 3	Only non-metallic and chloride free abrasive shall be used.		
NOTE 4	Glass flake or fibre reinforced epoxy coat or high solid, high build epoxy are optional. The coating materials shall not contain any zinc. If needed a fouling release or anti-fouling system is to be applied on top.		
NOTE 5	Extended storage at yards or laydown areas prior to subsea installation will require measures to prevent UV-degradation and mechanical damage since system performance is linked to CP.		

CSDS no. 8

Coating System Data Sheet		CSDS no. 8	Rev. 01
Substrate material: Carbon steel		Corrosivity category: C1, ref. NS-EN ISO 12944-2	
Items to be coated: Structures, structural components, equipment items, piping and valves.			
Service: In HVAC controlled environment ^{Note 1}			
Operating temperature range: -50 °C to +80 °C			
Surface preparation requirements			
Pre-blasting preparation: P2, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break testt			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 25 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 50 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 2}	MDFT	MAX DFT
1: (Primer)	Epoxy	150 µm	The maximum DFT shall be within the limits given in the relevant CADS
Total DFT		150 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: NA			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12 and 12.13			
Adhesion: NA			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	This coating system is acceptable provided that protection during transport and storage is secured to avoid exposure to corrosive environment prior to operation.		
NOTE 2	Alternative coating systems can be proposed.		

CSDS no. 9

Coating System Data Sheet		CSDS no. 9	Rev. 01
Substrate material: Stainless steel, Non-ferrous metals		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Equipment items, piping and valves in cryogenic service			
Service: Offshore and coastal environment, insulated			
Operating temperature range: <-50 °C ^{Note 1}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness ^{Note 2} : Sweep blast, ref. SSPC-SP 16 to meet surface roughness. Dust level max quantity and rating 2 ref. NS-EN ISO 8502-3			
Surface roughness: 25 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 3}	MDFT	MAX DFT
1: (Primer)	Inorganic copolymer, inert multi polymeric matrix coating or epoxy	DFTs shall be as per the qualified system	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Inorganic copolymer, inert multi polymeric matrix coating or epoxy		
Total DFT			
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1 , activity: 11.18			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13 and 12.5B			
Adhesion: Cross cut test, meeting classification 0-2, ref. Table 2 , note 9. If the DFT exceeds 250µm X-cut testing shall be performed and shall meet max level 2.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	The actual temperature range shall be prequalified		
NOTE 2	Only non-metallic and chloride free abrasive shall be used.		
NOTE 3	The required downtime needs to be accounted for when selecting coating materials		

CSDS no. 10A

Coating System Data Sheet		CSDS no. 10A	Rev. 01
Substrate material: Carbon steel and low alloyed steel		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Equipment items, piping and valves for high temperature service			
Service: Offshore and coastal environment, non-insulated			
Operating temperature range: > +200 °C ^{Note 1}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness: Sa 2½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 50 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 2}	MDFT	MAX DFT
1: (Primer)	Inorganic copolymer, inert multi polymeric matrix coating	DFTs shall be as per the qualified system	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Inorganic copolymer, inert multi polymeric matrix coating		
Total DFT			
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests ^{Note 3} : Table 1 , activities: 11.6 and 11.8			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.9, 12.10, 12.12, 12.13 and 12.5B			
Adhesion: Cross cut test, meeting classification 0-2, ref. Table 2 , note 9. If the DFT exceeds 250µm X-cut testing shall be performed and meet max level 2.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	The actual temperature range needs to be pre-qualified.		
NOTE 2	The required downtime needs to be accounted for when selecting coating materials		
NOTE 3	In addition, high temperature testing according to ASTM D2485 Method B or alternative testing specified by the purchaser is required.		

CSDS no. 10B

Coating System Data Sheet		CSDS no. 10B	Rev. 01
Substrate material: Stainless steel, Non-ferrous metals		Corrosivity category: CX, ref. NS-EN ISO 12944-2	
Items to be coated: Equipment items, piping and valves for high temperature service			
Service: Offshore and coastal environment, non-insulated			
Operating temperature range: > +200 °C ^{Note 1}			
Surface preparation requirements			
Pre-blasting preparation: P3, ref. NS-EN ISO 8501-3 . Surface cleaning to meet: “clean”, ref. ASTM F22 Water break test			
Surface cleanliness ^{Note 2} : Sweep blast, ref. SSPC-SP 16 to meet surface roughness. Dust level max quantity and rating 2 ref. NS-EN ISO 8502-3			
Surface roughness: 25 µm to 85 µm ref. NS-EN ISO 8503-1 , NS-EN ISO 8503-2 with grit comparator only, NS-EN ISO 8503-4 and/or NS-EN ISO 8503-5			
Max. level of water-soluble salts: 20 mg/m ² , ref. NS-EN ISO 8502-6 / NS-EN ISO 8502-9			
Generic description of the coating system			
Coat number	Generic type ^{Note 3}	MDFT	MAX DFT
1: (Primer)	Inorganic copolymer, inert multi polymeric matrix coating	DFTs shall be as per the qualified system	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Inorganic copolymer, inert multi polymeric matrix coating		
Total DFT			
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests ^{Note 4} : Table 1 , activities: 11.6 and 11.8			
Inspections during CPT and production: Table 2 , activities: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8, 12.9, 12.10, 12.12, 12.13 and 12.5B			
Adhesion: Cross cut test, meeting classification 0-2, ref. Table 2 , note 9. If the DFT exceeds 250µm X-cut testing shall be performed and meet max level 2.			
Repair requirements of damage on newly applied coating			
Damage exposing steel surface: Same requirements apply as for the original system.			
Damage not exposing the steel surface: Clean and feather as stated in Clause 13 and re-apply the missing coating layers as per the qualified system.			
NOTE 1	The actual temperature range needs to be pre-qualified.		
NOTE 2	Only non-metallic and chloride free abrasive shall be used.		
NOTE 3	The required downtime needs to be accounted for when selecting coating materials		
NOTE 4	In addition, high temperature testing according to ASTM D2485 Method B or alternative testing specified by the purchaser is required.		

Annex B
(informative)

Colours

The topcoat colours should be selected from [Table B.1](#):

Table B.1 — Top colours

Colour	RAL-1K designation
White	RAL 9002 (Grauweiss)
Blue	RAL 5015 (Himmelblau)
Grey	RAL 7038 (Achalgrau)
Green	RAL 6002 (Laubgrün)
Red	RAL 3000 (Feuerrot)
Yellow	RAL 1004 (Goldgelb)
Orange	RAL 2004 (Reinorange)
Black	RAL 9017 (Verkehrsschwarz)
NOTE Additional safety colours may apply	

Annex C (informative)

High temperature cathodic disbonding testing

C.1 Test procedures

This additional cathodic disbonding test is applicable for coating systems operating at temperatures above +50 °C. Test details:

- Electrolyte: 3,5 % NaCl.
- Electrolyte temperature: +30 °C.
- Electrolyte pH: 6.5 – 8.5 (measure minimum once per week).
- Potential: -1.2 V vs Standard Calomel Electrode.
- Oxygen concentration: 100% air saturated.
- Pressure in the test cell shall be higher than the vapour pressure of water at the steel temperature.
- Diameter of coating holiday: 6 mm.
- Duration: 4 weeks.

Maximum operating steel temperature shall be measured in the steel, 2 mm under the steel/coating interface and the location to be 5 mm into the test area. The diameter of exposed area and sample dimensions must be agreed with the test laboratory. See [Figure C.1](#).

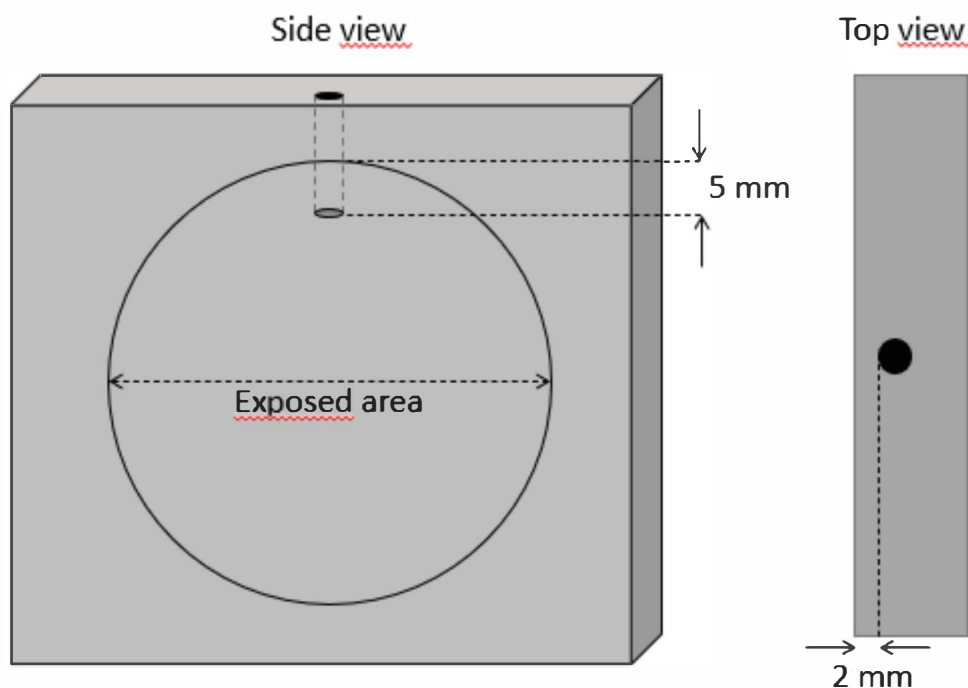


Figure C.1 — Cathodic disbonding test sample

C.2 Test set-up at atmospheric pressure in the electrolyte

Test set-up for the additional cathodic disbonding test at atmospheric pressure in the electrolyte shall be as illustrated in [Figure C.2](#)

The steel temperatures shall be $< +100\text{ }^{\circ}\text{C}$.

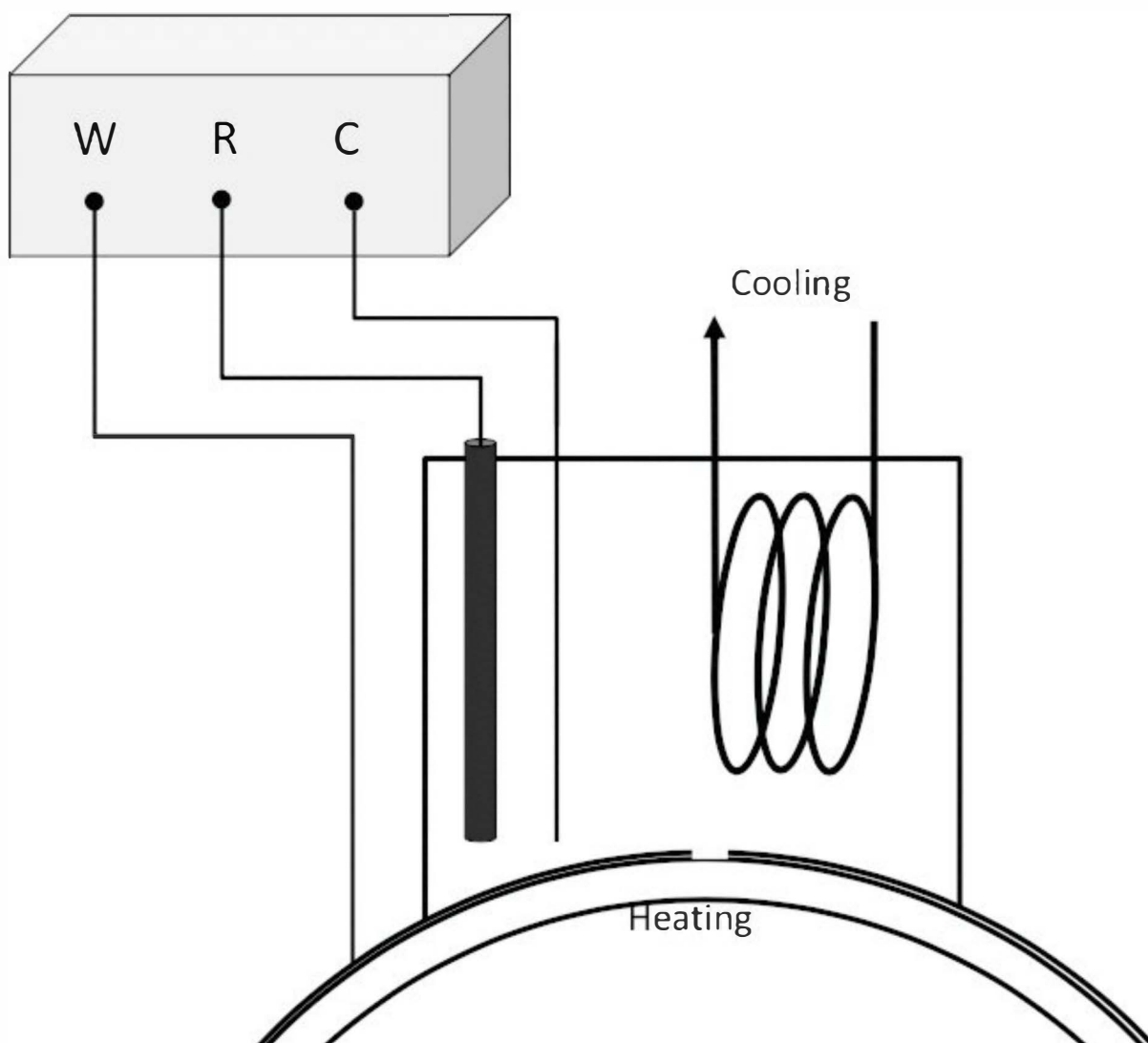


Figure C.2 — Cathodic test set-up at atmospheric pressure in the electrolyte

Annex D
(informative)

Coating report

D.1 Coating reports layout

Coating reports shall after the completed work be presented with a Coating report front page according to the format given in [Table D.1](#), accompanied by Coating results pages as per [Table D.2](#) and for each coat according to [Table D.3](#).

Table D.1 — Coating report front page

COATING REPORT				
Date:				
PO No:		Coating system:		
Coating Manufacturer		Coating Manufactures		
Company:		contact person:		
Coating Manufactures				
internal order no:				
Coating shop:		Coating shops		
		contact person:		
Coating shops				
internal order no:				
Coating inspectors		Coating inspectors		
name:		signature:		
Certification		Certificate level and no:		
organization:				
Painted objects				
No off	Object	Size	Material	Tag no

Table D.2 — Coating inspection results pages

Coating cycle			
First coat:	Nom. thickness, μm :		Thinner:
Second coat:	Nom. thickness, μm :		Thinner:
Third coat:	Nom. thickness, μm :		Thinner:
Fourth coat:	Nom. thickness, μm :		Thinner:
Comments:			
Visual receive control (Steel preparation according to NS-EN ISO 8501-3)			
Date of receive control:		Rust grade:	
Edges rounded:	Major surface defects:	Weld splatters, slivers:	All signs off:
Continually welds:	All welds dressed:	Bolts and nuts protected:	End caps on:
Comments:			
Cleaning			
Date of cleaning:		Method of cleaning:	
Type of detergent:		If machined surfaces; strength of detergent:	
Cleaned with freshwater after use of detergent:		Control of removal of all oil, grease, corrosion inhibitors and salt :	
Comments:			
Abrasive blasting			
Blasting machine:	Blast media control:	Open blasting:	
Abrasive type:		Abrasive size:	
Start blasting, Date:	Time:	End blasting, Date:	Time:
Air temp, $^{\circ}\text{C}$:	Surface temp., $^{\circ}\text{C}$:	Humidity, %:	Dew point, $^{\circ}\text{C}$:
Comments:			
Requirements to cleanliness and roughness			
Requirements to cleanliness:		Requirements to roughness:	
Type of material to be blasted:		Abrasive quality:	
Tested cleanliness and roughness			
Date of test of cleanliness and roughness:			
Test equipment for cleanliness:		Tested cleanliness:	
Test equipment for roughness:		Tested roughness:	
Comments:			
Requirements to salt concentration			
Requirements to max soluble salt concentration: equals 20 mg/m^2 NaCl			
Tested salt concentration			
Date of test of salt concentration:		Salt test equipment:	
Tested salt concentrations:			
Comments:			
Visual inspection after blasting			
Date of visual inspection:		Rust grade:	
All parts blasted without holidays:		Edges:	
Weld spatters and pores in welds:	Major surface defects:	Pores/holes in casting:	
Comments:			

Table D.3 — Each coat

Each coat			
Material name:		Colour, RAL Code:	
Batch no.:		Exp. date:	
Start application:	Time:	End application, date:	Time:
Application method:		Stripe coat applied:	
Max. thinner allowed, %:		Actual thinner added, %:	
Environmental control instrument:			Blotter test:
Air temp., °C:	Surface temp., °C:	Humidity, %:	Dew point, °C:
Comments:			
Requirement to thickness according to CSDS, each coat:			
Average DFT, µm:		Min. DFT, µm:	Max. DFT, µm:
Measured thickness of each coat			
Date of test of coat thickness control:			
Film thickness control instrument:		No. of measures:	
Average DFT, µm:		Min. DFT, µm:	Max. DFT, µm:
Visual inspection after coating			
Date of visual inspection:			
Contamination:	Solvent retention:		Pinholes/popping:
Sagging:	Wrinkling:		Surface defects:
Comments:			
Requirements to adhesion test according to <u>NS-EN ISO 16276-1</u>:			
Absolute minimum accepted adhesion failure (in MPa)		Average adhesion failure during CPT (in MPa)	
Assumed temperature during curing, °C:		Calculated necessary curing time (h):	
Adhesion test results			
Date of gluing dollies to the test panel:		Date of pull-off:	
Temp. during curing, °C:		Adhesion test instrument:	
Film thickness on tested surface, µm:		Is the test performed on the object or on a test panel?:	
If test panel, has it been treated as the object?:			
Diameter of dolly, mm:		Expiry date of glue:	Type of glue:
Adhesion values (MPa) and failure description (% adhesive/cohesive/glue):			
Comments:			
Requirements to adhesion test according to <u>NS-EN ISO 16276-2</u>			
Cross cut test: Acceptance criteria: classification 0-2		X-cut test: Acceptance criteria: Max. level 2	
For adhesion tests according to <u>NS-EN ISO 16276-2</u> and <u>NS-EN ISO 2409</u> : Test locations, test frequency and documentation of the results to be agreed with end user:			
Comments:			
Verification of curing (i.e. MEK-test or curing of phenolic epoxy)			
Requirement to curing			
Measured film thickness, µm:		Allowed range of air humidity, % RH:	

Table D.3 — Each coat *(continued)*

Assumed temperature during curing, °C:		Calculated necessary curing time (h):	
Curing log			
Start curing, date:	Time:	End curing, date:	Time:
Mean temp. during curing, °C:		Actual curing time, hrs.:	
Measured air humidity, % RH:		Curing control method:	
Comments:			
Holiday detection according to <u>NS-EN ISO 29601</u>			
Requirement to holiday test: No holidays			
Detection method:		Test frequency:	
Date of holiday test:		Test instrument:	
Result of holiday test:			
Comments:			

Annex E
(informative)

Test panel for qualification of coating procedure

The CPT test plate shall be minimum 6mm thick and its surface area shall be minimum 1m².

E.1 Examples of test panels

Typical test panel configurations for CPT are shown in [Figure E.1](#) and [Figure E.2](#)

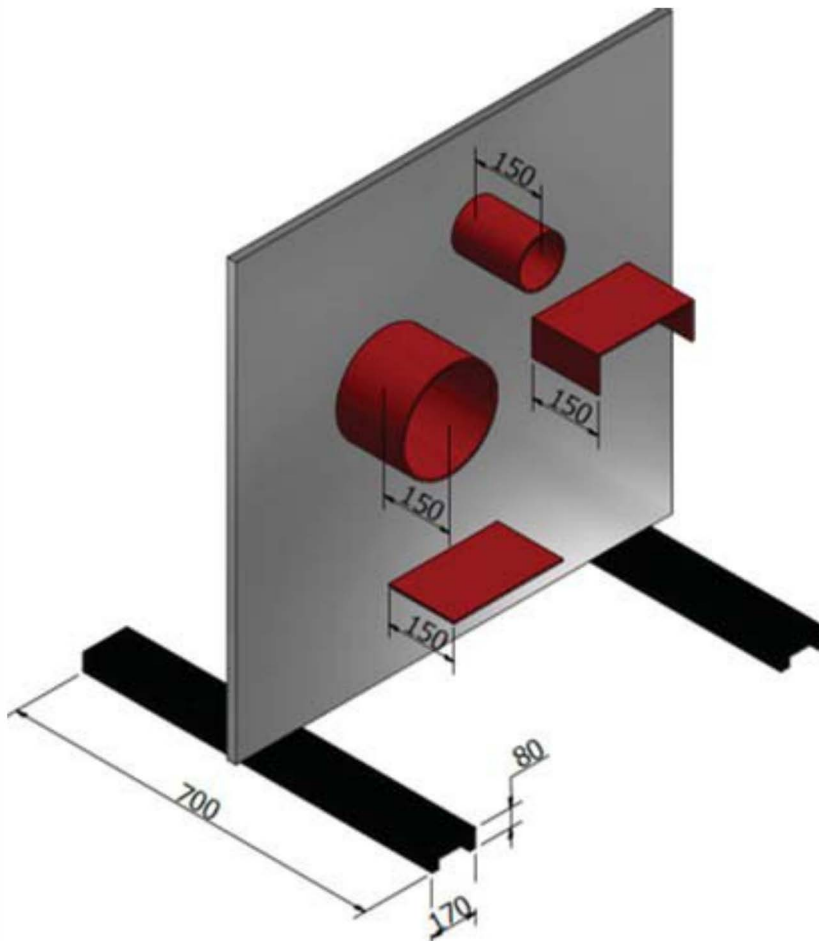


Figure E.1 — Example of test panel 1 m x 1 m for CPT

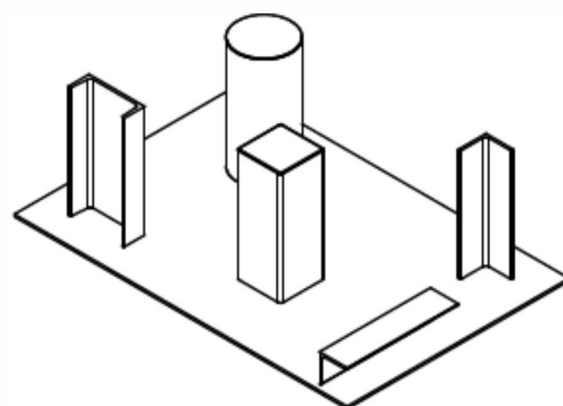
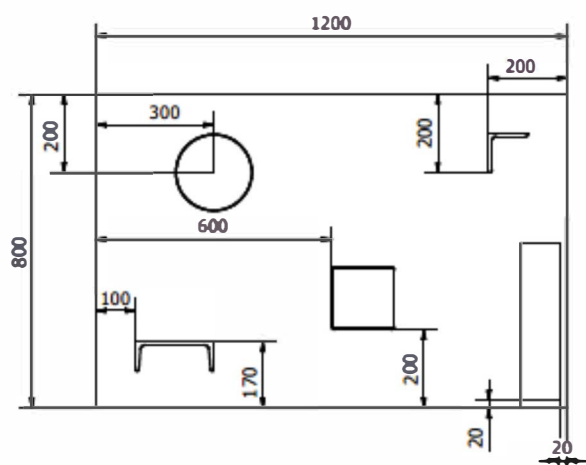


Figure E.2 — Example of test panel 0.8 m x 1,2 m for CPT

Annex F (normative)

Water Uptake for Passive Fire Protection (PFP) Methodology

F.1 Background

Determination of the water uptake is a means to determine the long-term assurance of the PFP system with respect to maintaining the film integrity and functionality. The water uptake results will reveal if the PFP is subject to extraction of components due to weathering.

F.2 Methodology - Test panel details and weight

This methodology shall be used in combination with the panels prepared for testing in accordance with NS-EN ISO 12944-9 (atmospheric cycling tests) and Immersion Freeze Dry Testing described in [Annex G](#) (cyclic splash-zone testing).

The water uptake is expected to be predominantly in the PFP and hence the water uptake from the edging and backing paint can be ignored.

Carbon steel test panels without a scribe shall be used for the water uptake testing. A minimum of 3 panels per test type is required. The test panel dimensions shall be 150x75x6mm.

Weight shall be measured in grams using a calibrated balance with a 0.01g resolution.

The edging paint shall only overlap the exposed face of the PFP by a maximum of 5mm.

The following shall be measured for each panel prior to the environmental exposure testing:

- weight after blasting and prior to any application of coatings ($W_{Pre\ 1}$);
- weight after application of the primer and PFP system. The weight shall be measured after 2 weeks curing/drying at +23 °C and 50% RH ($W_{Pre\ 2}$);
- weight after application of the subsequent edging / backing paint. The weight shall be measured after 2 weeks curing/drying at +23 °C and 50% RH ($W_{Pre\ 3}$).

The weight of the backing and edging paint shall not exceed 10% of the total weight of the coatings applied to limit its impact on the water uptake calculations. The percentage weight of backing and edging paint is calculated using the following equation: $(W_{Pre\ 3} - W_{Pre\ 2}) / W_{Pre\ 3} \times 100$.

The following shall be recorded for each test panel after environmental exposure testing:

- the weight, after wiping away residual surface water, is to be measured immediately after removal from the exposure test ($W_{Post\ 1}$) without removing any coatings;
- the final weight, when no further weight change is measured, when conditioned at +23 °C and 50% RH ($W_{Post\ 2}$). A minimum of 2 weeks conditioning is however required should the final weight be reached prior to this duration.

F.3 Methodology - Water uptake determination

The water uptake shall be expressed as a percentage increase in weight, based on the following calculation steps:

- 1) Weight of wet coatings (W_{wf}) = $W_{Post\ 1} - W_{Pre\ 1}$
- 2) Weight of conditioned coatings (W_{cf}) = $W_{Post\ 2} - W_{Pre\ 1}$
- 3) The water uptake (in %) of PFP at the end of the exposure test ($PFP_{WU\%}$) = $(W_{wf} - W_{cf}) / W_{cf} \times 100$

Annex G (normative)

For Immersion Freeze Dry Testing for Passive Fire Protection (PFP) Methodology

G.1 Background

For areas protected by PFP and exposed to periodic immersion, the properties required to maintain integrity and insulation performance in a fire case are different to that required for atmospheric corrosion testing.

G.2 Methodology - Test details

The cyclic immersion / freeze / dry testing shall be as detailed below:

Table G.1 — Test requirements for cyclic immersion / freeze / dry testing

Description of each test step	Duration of each test step
Water immersion (NS-EN ISO 2812-2)	648 hours
Freezing at -15 ± 2 °C	24 hours
Drying in air at $+23 \pm 2$ °C and $+50 \pm 5\%$ RH	168 hours

The above represents one test cycle of totally 840 hours and shall be carried out 5 times to give an overall duration of 4200 hours.

The test shall be carried out both on representative steel sections and on test panels. The test panel dimensions shall be 75x150x6mm and [Annex H](#) is to be followed for the hollow structural steel section size.

The test specimens and panels shall be fully immersed in 5 weight% NaCl solution at $+40$ °C in accordance with [NS-EN ISO 2812-2](#) and then are subsequently exposed to freeze and dry periods.

The PFP system [CSDS no. 5S](#) shall be prepared without the top-coat for this test. The test panels prepared for water uptake shall be without a scribe. The test panels to evaluate corrosion creep and adhesion/cohesion failure shall have a scribe as described in [NS-EN ISO 12944-9](#).

Acceptance criteria for defects outlined in [NS-EN ISO 4628-1](#), [NS-EN ISO 4628-2](#), [NS-EN ISO 4628-3](#), [NS-EN ISO 4628-4](#) and [NS-EN ISO 4628-5](#), shall follow the requirements in [NS-EN ISO 12944-9](#) and be evaluated immediately after cessation of the test.

Upon completion of 5 cycles, the test specimens shall be conditioned at $+23 \pm 2$ °C for an additional period of 14 days prior to determination of adhesion/cohesion strength, corrosion creep resistance and insulation performance in hydrocarbon fire.

The corrosion at scribe requirements shall not exceed 8 mm.

Pull-off testing shall be according to [NS-EN ISO 4624](#) and meet the acceptance criteria in [Table 1](#). For water uptake testing panels without scribe shall be taken out immediately after the last period of immersion to determine $W_{\text{Post } 1}$, as defined in [Annex F](#). The last freeze and dry period of testing according to this Annex shall be omitted and conditioning undertaken as described in Annex F to determine $W_{\text{Post } 2}$. Fire performance shall be conducted as stated in [Annex H](#) for structural specimens only.

Annex H (normative)

Fire Testing for Passive Fire Protection (PFP) Methodology

H.1 Background

A PFP coating system shall enable personnel to evacuate and to protect assets in the event of fire. Maintaining the integrity of the insulation properties over many years of exposure in offshore and coastal environments is a key requirement for PFP coating system.

Fire testing shall be undertaken following exposure in Immersion Freeze Dry cycling (steel structure), Wet Freeze Dry cycling as described in [UL 2431](#) (steel structure), and [NS-EN ISO 12944-9](#) (test panels) as stated in [Table 1](#).

H.2 Methodology - Test details

Fire testing standard shall comply with [NS-EN 1363-2](#), [BS 476-20:1987](#) appendix D or [UL 1709](#) in relation to the control of the furnace temperature as a function of time.

The method of surface preparation and priming of steel substrates shall be in accordance with [CSDS no. 5A](#) or [CSDS no. 5S](#) depending upon the weathering cycle type being evaluated.

Carbon steel test panels with dimensions 300 x 300 x 10mm shall be used. The PFP thickness to be applied shall be 6mm $\pm$ 10%. Type K thermocouples shall be attached to the non-fire exposed side of the test panels as shown in [Figure H.1](#).

The thermocouples shall be secured using the drilling and peening method described in [ISO 22899-1:2021](#) Annex A.

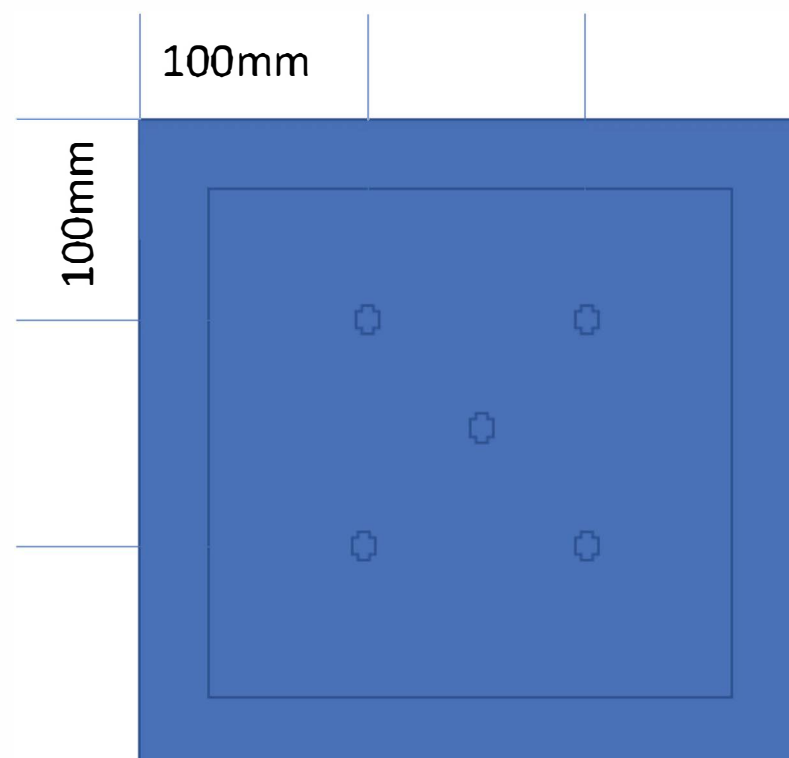


Figure H.1 — Thermocouple arrangement for plate

Each fire test shall include two control panels and two aged panels (from the same ageing test). Each aged and control panel shall be placed diagonally opposite to the other aged and control panel respectively.

The non-fire exposed side shall be covered with vermiculite or calcium silicate boards having a minimum thickness of 50 mm and a maximum bulk density of 500 kg/m³ or with mineral wool (stone wool) having a minimum thickness of 20 mm and a maximum bulk density of 120 kg/m³. The panels are to be fixed vertically to the door of the furnace.

For structural steel specimens, the dimension of hollow or I sections shall be in accordance with UL 2431 or equivalent when evaluating performance after wet freeze dry cycling (UL 2431) and immersion freeze dry testing (Annex G). All steel sections for testing shall be cut from the same length of steel. Type K thermocouples shall be attached to the steel following the requirements of UL 2431. Hollow or I sections as described in UL 2431 shall be tested for UL 2431 wet/ freeze/cyclic and Hollow section for NS-EN ISO 2812-2 cyclic testing.

H.3 Methodology - Assessment

The time and temperature profiles for the controls and the aged panels or structural steel specimens are adjusted for a nominal thickness of 6 mm. using Formula (H.1):

$$t_{corrected} = t_{test} \times 6/D_{test} \quad (H.1)$$

key

t	performance time to reach a specified steel limiting temperature
D _{test}	PFP thickness applied to the steel

In relation to this methodology, the aged panels or structural steel specimen(s) have maintained the required fire performance if the average temperature increase is a maximum 10% higher than that of the control(s). The temperature of the aged/weathered specimens shall be measured when the controls reach +400 °C for offshore applications and +538 °C for onshore applications. For tests containing two aged panels and two controls, the averages of both aged panels and both controls shall be used for this comparison.

Annex I (informative)

Coating Operator Qualification Test (COQT)

I.1 Introduction

This Annex is a guideline prepared to identify an alternative to the Norwegian tradesman education for surface preparation and protective coating application work.

This Annex is designed to enable operators to demonstrate occupational competence as an Abrasive Blast Cleaner and Industrial Coating Applicator, and to ensure that they have the experience, knowledge and professionalism required to meet the requirements in this document.

I.2 Scope

The COQT covers all steps in the surface treatment process. Initially, the candidate shall:

- demonstrate an understanding of the choice and use of proper protective equipment;
- evaluate whether the object to be surface treated is ready for blast cleaning;
- evaluate if a blast cleaned substrate has received the specified cleanliness and roughness;
- explain the importance of correct thinning and mixing of paint components;
- determine the wet film thickness (WFT) necessary to achieve the DFT specified in CADs.

The COQT consists of:

- 1) practical test,
- 2) theoretical discussion.

The qualification for each individual operator is linked to the parts of the COQT that have been completed and passed.

I.3 Assessment 1: Practical test

Duration: Estimated to take 7 to 10 hours, distributed over 3 to 4 days.

The practical test can take place at the employer's premises or at a location designated by the employer. The test panel shall be minimum 2 m² and include the same complexity as shown in [Annex E](#).

The candidate shall blast clean and/or apply the relevant protective coating system(s) to the test panel in accordance with the requirements in this document and the relevant CPS. The candidate shall demonstrate the competence related to:

- identify, use, and maintain personal protective equipment;
- environmental control;
- maintain health, safety, and environmental protection measures;

- prepare and maintain working areas for undertaking work safely and effectively including the safe use and storage of equipment and material;
- use of established procedures related to health, safety and environment and employers work procedure handling techniques to move equipment, material, and waste;
- read and work to according to procedures, specifications and the inspection and test plan;
- achieve the specified standard of work including the use of appropriate quality control devices.

Additional requirements that apply for an abrasive blast cleaner are to:

- demonstrate responsibility for the quality and accuracy of their work including identifying and rectifying surface preparation;
- undertake the specified method of surface preparation of the steel work (e.g. by hand or power tool cleaning, blast cleaning).

Additional requirements that apply for industrial coating applicators are to:

- demonstrate responsibility for the quality and accuracy of their work including identifying and rectifying coating defects;
- undertake the specified method of protective coating application (e.g. by brush, roller, spray), to the required standards.

During the practical test, six questions shall be raised to assess the candidate's underlying knowledge of industrial coatings applicator principles.

Practical test Pass Criteria:

The work shall demonstrate:

- that the quality of the work meets the stated specifications and the relevant CADs;
- appropriate use of quality control devices and test equipment;
- how surface preparation and coatings defects are identified and rectified ([Table 2](#));
- effective communication skills and accurate reporting during the practical test.

The performance shall be verified by a level III inspector.

I.4 Assessment 2: Theroretical discussion

Duration: 60 minutes

A theoretical discussion shall be conducted between the candidate and the person responsible for the test in a controlled environment free from distraction and influence. A selection of subjects to be discussed shall be delivered to the candidate at least one week in advance.

As a part of this discussion, the candidate shall be asked a series of six competency-based questions related to the coating application works, with follow-up questions if required. Topics of relevance are listed below.

If the stated pass standard is not met, the professional discussion will be marked as a fail.

The discussion should include these topics:

- 1) Importance of, and reasons for health, safety, environmental related rules.

Pass criteria: The candidate shall be able to recognize and explain the importance of HSE rules, and local and international legislation and regulations relevant for the coating application industry.

- 2) Preventive measures to avoid personnel injury and to avoid environmental hazards.

Pass criteria: The candidate shall be able to describe various protective measures.

- 3) Common errors and poor techniques related to surface preparation and coating application.

Pass criteria: The candidate shall be able to give correct information when asked about errors and poor techniques and shall demonstrate good knowledge related to how coating defects shall be rectified.

- 4) Working in teams and how to maintain industry best practice.

Pass criteria: The candidate shall be able to discuss how the working team shall cooperate to deliver to the required quality according to the schedule. Candidate shall be able to reflect on how unacceptable behaviour or poor quality of work shall be handled.

In addition to the above, the candidate shall demonstrate knowledge within at least 4 of the following topics:

- identify instances where improvements to the workplace safety have been implemented and explain the importance of these actions;
- describe a range of common fault diagnosis techniques and explain where these are best applied;
- justify why specific techniques are selected to identify and rectify faults;
- provide examples of instances where unsafe/undesirable behaviours have been experienced and explain how these occurrences were handled;
- explain a non-conformance situation and give a description of faults discovered and outline the correct actions that should have been taken to avoid this situation;
- explain how to contribute to the productivity and dynamics of a working team.

I.5 Re-take practical or theoretical test

Candidates who fail one or both assessment methods may be allowed to re-take the test/tests based on an evaluation of the competence shown. Prior to re-take the candidate should get adequate support to be able to prepare properly. The candidate only needs to re-take the failed assessment method.

I.6 Certificate of competence

The result from the practical and theoretical tests shall be evaluated and approved by a FROSIO level III, NACE level III Inspector or ICORR level III inspector that shall also sign the Certificate of competence. Approval by an independent party is not required.

The Certificate of competence shall as a minimum include the following information:

- Certificate for Coating Operator Qualification Test (heading);
- coating Operators name;

- picture of the Coating Operator;
- date of birth;
- date the test is approved;
- where the test has been executed;
- responsible contractor for the test;
- extent of qualification (Abrasive Blast Cleaner or Industrial Coating Applicator or both);
- expire date : valid for five (5) years.

A renewal shall be taken not later than 6 months prior to expiry date. If the renewal is applied at a later date, re-tests are required.

Annex J (normative)

Adhesion/cohesion test

J.1 General requirements

Adhesion/cohesion testing is required during CPT and during production.

When testing shall be conducted on the actual coated object according to NS-EN ISO 16276-1 the following guidelines apply:

- the definition of one measurement is: the average result of 3 test cylinders placed on one spot located minimum 100mm, and maximum 300mm away from each other;
- if not specified in the ITP, the exact location for the test area shall be agreed by the relevant parties and accepted by end user;
- if not otherwise decided, minimum 3 measurement shall be performed per CPT;
- if not otherwise decided in the ITP, minimum 3 measurement shall be performed per item. For items exceeding 250m², 3 measurements shall be performed per 250m²;
- curing of coating prior to test shall be according to “curing time to service” at relevant temperatures including the effect of thinner, thickness and humidity in the CADS;
- test cylinders with central hole are not accepted;
- coating shall be cut down to substrate round the test cylinder;
- any glue failure with values below the minimum requirement shall be considered as a non-valid test. In such cases a new test shall be performed;
- any glue failure with values exceeding the minimum requirement shall be considered as a valid test with respect to the fracture strength properties of the coating. The minimum requirement shall be understood as follows:
 - 1) during CPT: Minimum acceptable value is 15 MPa (Note 8, [Table 2](#));
 - 2) during production: Minimum acceptable values shall be as stated in the relevant CSDS.

When test panels are used, the above apply with the following clarifications:

- the thickness of the test panels shall be minimum 6 mm.;
- the test panel minimum size is 10 cm x 50 cm.;
- the generic material of the test panels shall equal that of the object to be coated;
- the test panels shall be prepared, coated, and cured/dried under the same conditions and in the same way as the object to be coated;
- the test panels shall be traceable to a location on the object to be coated;
- the acceptance criteria during CPT and production shall be according to values stated in the CSDS for the actual coating system.

Minimum values shall be interpreted as follow:

- all measurement series shall reveal values equal to or greater than the minimum specified adhesion;
- within each measurement series the adhesion value of one out of the 3 test cylinders can be up to 40% less than the specified minimum provided the average value for the measurement series is equal to or greater than the minimum specified value.

J.2 Examples on interpretation of readings

Test example when the minimum requirement is 5MPa:

Table J.1 — Example showing acceptable and unacceptable readings

Measurement 1			Measurement 2			Measurement 3			Area size m ²	Test Result
MPa			MPa			MPa				
7	3	5	7	7	5	9	8	7	250	Pass
7	3	5	7	3	5	9	8	7	250	Pass
7	3	5	7	3	5	7	3	5	250	Pass
7	2	5	6	7	5	9	8	7	250	Reject, since reading in the first series results in an average value below the acceptance criteria
7	4	4	6	7	5	9	8	7	250	Reject, since two readings in one series are below the acceptance criteria
5	4	5	6	7	5	9	8	7	250	Reject, since the average reading in the first series is below the acceptance criteria
NOTE Unacceptable readings results are shown in bold letters										

Annex K
(informative)

Overlapping zones

K.1 Description of overlapping zones

The objective of this Annex is to show the preferred overlap sequence in the transition zone between two coating systems. In the case of PFP the working procedures / application guidelines from the specific fire protection material manufacture must be followed.

Some systems have technical / compatibility issues to be considered before overlapping with a different generic coating material. Key issues such as the generic coating chemistry must therefore be considered and verified with the coating manufacture when recoating existing systems new systems.

NOTE Please note that the illustrations in this Annex are made to demonstrate coating system build-up and overlapping between different systems and are not to scale.

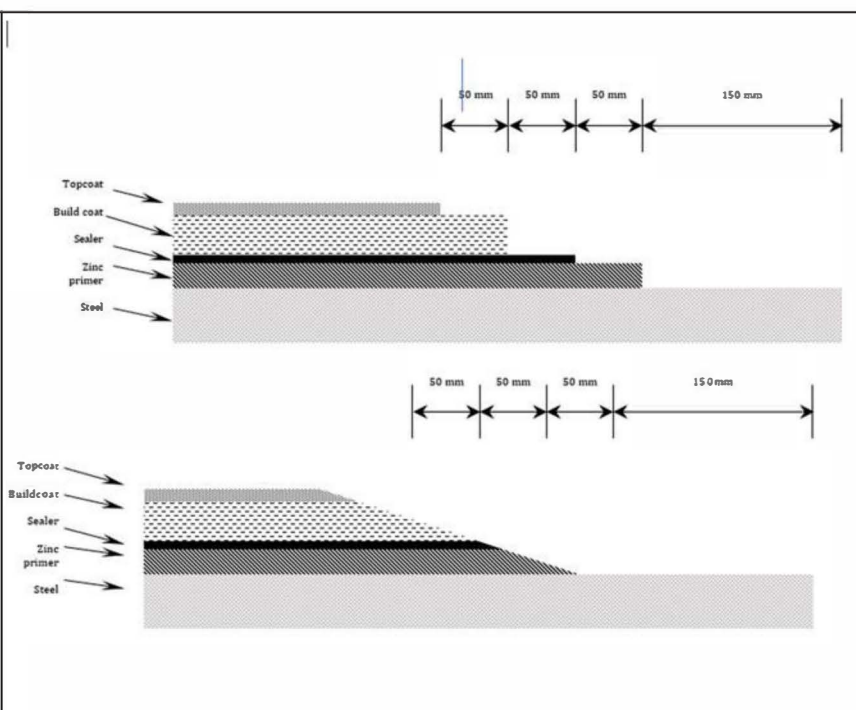
Overlap zones

The termination zone of a coating system should be “stepped” during application. If this is not performed a feathering technique using grinding must be used.

The 50 mm step back is only a recommendation and has to be adjusted depending on the location or geometrics.

All coating systems shall be terminated 150 mm from weld zones or feathered back to 150 mm by low temperature grinding (to avoid HSE issues).

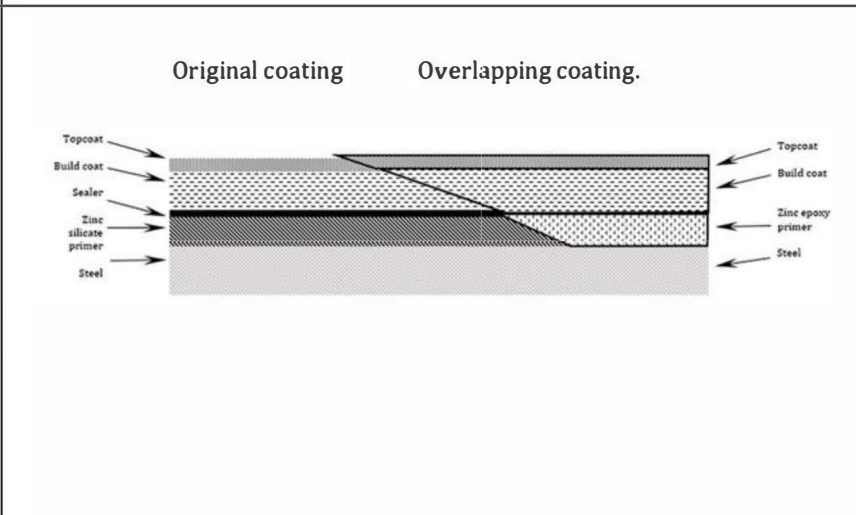
If the termination zone has been stepped, feathering shall be performed before any recoating.



Overlap system 1A and 1B

It is recommended that the zinc silicate is ONLY applied to blasted steel i.e. shall not be applied on top of any other coating. Hence, system 1B to overlap 1A.

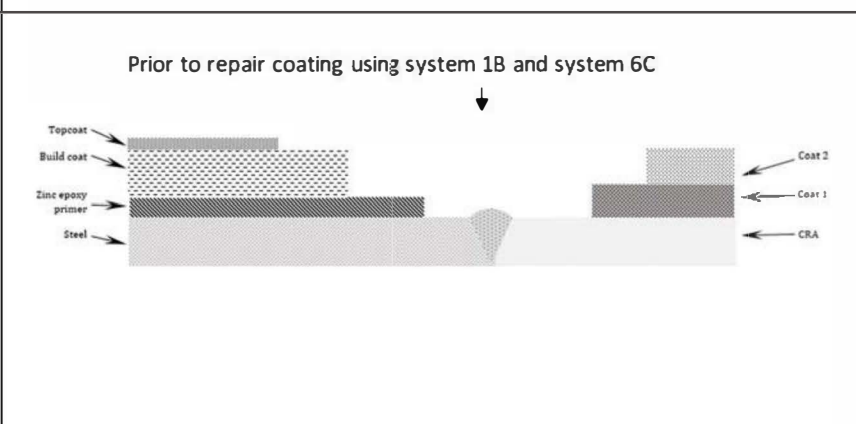
Overlap of the intermediates and topcoat of same generic types are not critical if overcoating intervals are within the limits specified in the CADS. If the overcoating interval has been exceeded light abrasion of the existing underlaying coating is required.



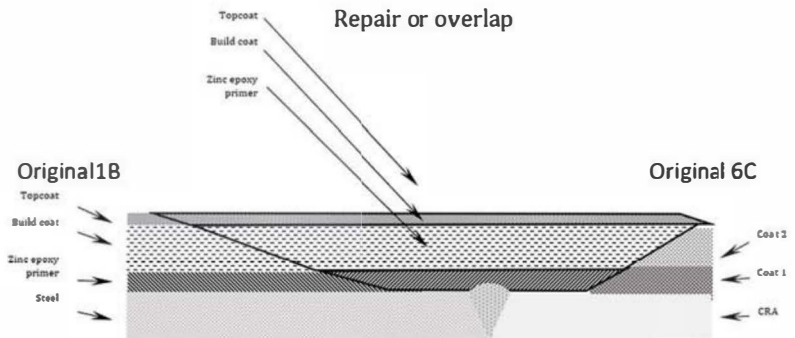
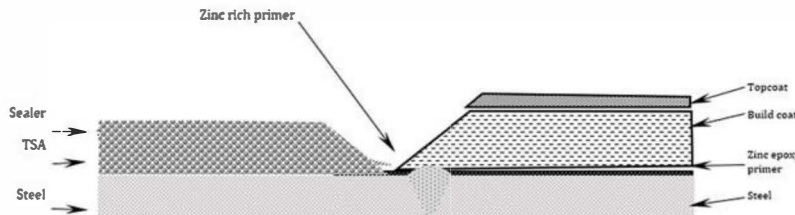
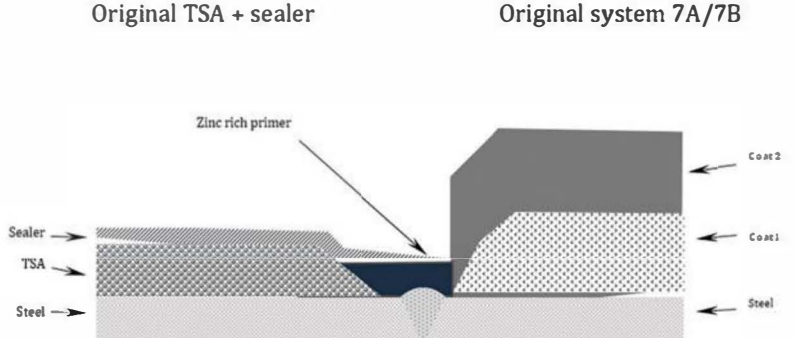
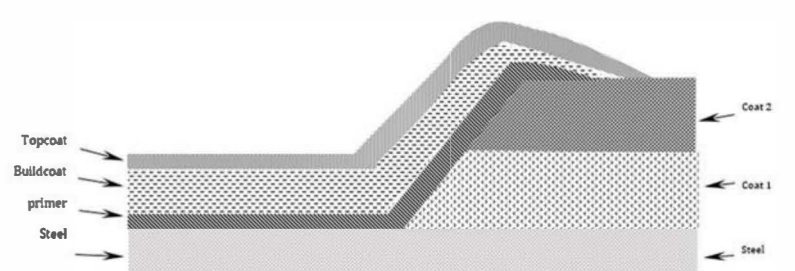
Overlap system 1A/1B and system 6C.

Corrosion Resistant Alloys (CRA) shall always be blasted non-ferrous grit or using nonferrous abrasive equipment (SS wire brushes).

CRA materials/supports must be coated back minimum 50 mm to avoid galvanic corrosion issues when connected to carbon steel.



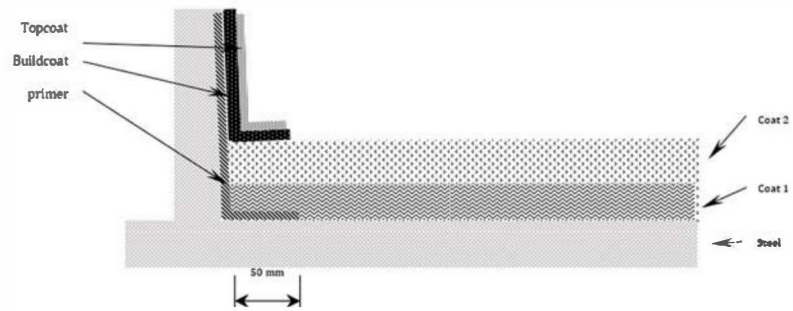
(continued)

The zinc coating shall always overlap the weld but shall not be applied to the CRA if it is a pressure retaining part. The zinc coating can be applied on the CRA if it is a structural item. Overlap can be accepted in both directions once the zinc primer is applied.	 Repair or overlap Original 1B Original 6C Topcoat Build coat Zinc epoxy primer Coat 2 Coat 1 CRA Steel
Overlap system 2A and system 1A/1B No thick epoxy coating or any topcoat shall cover system 2A (TSA). TSA shall only be overlapped with a zinc rich epoxy or zinc ethyl silicate. If the TSA sealer is silicon-based steam/hot water at high pressure is recommended to remove silicone sealer at interface. If sealer is epoxy based it can be overcoated with the selected zinc primer.	 Zinc rich primer Sealer TSA Steel Topcoat Build coat Zinc epoxy primer Steel
Overlap system 2A and system 7A/7B Same as above. Can also apply full system over the zinc rich primer but organic coatings must not overlap TSA.	 Original TSA + sealer Original system 7A/7B Zinc rich primer Sealer TSA Steel Coat 2 Coat 1 Steel
Thick systems to thin systems Example can be thin system like 1A/1B/6A/6C/7B/7C to thick systems such as 1F/4A/5A/7A. The thick system shall be feathered back to allow for a smooth interface and promote adhesion to the overcoating system.	 Topcoat Buildcoat primer Steel Coat 2 Coat 1 Steel

(continued)

In some cases, the primer can be applied as a common primer to both thick and thin system.

Note: When a polyester coating is used it must not be applied on to any zinc rich primer as this will retard the curing.



Annex L
(informative)

Maintenance coating

L.1 General requirements

When to initiate maintenance coating is determined based upon the severity of coating damage, degree of rusting, consequence of rusting, component criticality and its remaining life.

Maintenance coating is an activity that shall be described in the maintenance strategy for each installation/asset. The strategy forms the end user's framework for maintenance plans and consists of both general and area/installation specific requirements.

When the level defined as the start point for maintenance activity is reached for a specific object/area it is recommended that the below parameters are identified, and the relevant necessary actions performed:

- risk of flammable environment;
- health risks related to the removal of existing coating;
- need for access preparations;
- need for protection of adjacent areas;
- need for building habitats;
- need for work permits.

Based on the above a work package is prepared.

The actual content of a work package is determined by the end user and will vary depending on the relevant maintenance strategy.

L.2 Maintenance coating

Maintenance coating is a part of end user maintenance strategy. When to be initiated may vary as the consequence of failure due to coating breakdown will vary.

Coating breakdown causes corrosion/rusting, but its initial cause may be due to mechanical damage, wear and tear, UV- degradation, poorly applied coating or incorrect coating system. The reason(s) behind a coating breakdown will affect the necessary maintenance activities.

Maintenance coating systems shall cover the same structures and equipment as described in this document. The coating systems need to be suitable for application under various conditions being offshore or onshore sites and the procedure should therefore cover all relevant surface preparation methods.

Preferably, the surface preparation for maintenance work shall follow the below steps:

- 1) surface cleaning;
- 2) removal of algae and mould growth using biocides and by mechanical removal is recommended followed by water cleaning;
- 3) removal of oil and grease with water added suitable detergents should be followed by rinsing with clean, fresh water.

L.2.1 Surface examination and preparation

The existing coating should be examined to identify the surface areas that shall be repaired. The areas to be repaired should be clearly marked and documented in the repair report.

The surface preparation shall be carried out to meet end user requirements. The preferred method of surface preparation is grit blasting. The use of abrasive blast cleaning should be enclosed. Alternatively, dust extraction and collection equipment can be used to minimize contamination elsewhere.

If blast cleaning is not allowed/cannot be utilised, power tool cleaning using power wire brushes, power discs, bristle blasters or needle guns are recommendable alternatives. If required, non-sparking tools can be used.

Within areas that cannot be power tool cleaned hand tools like wire brushes, scrapers, chipping hammers, etc. can be used.

The achieved level of cleanliness and roughness shall meet end user requirements.

Wet blasting and water jetting are candidate surface preparation methods when:

- increased safety against sparking applies;
- minimize atmospheric and surface pollution and damage to sensitive control equipment is required;
- surfaces are salt contaminated and wetted;
- only a damaged topcoat shall be removed.

Due to the more rapid flash rusting of surfaces prepared by wet abrasive blasting and water jetting the use of these methods need to be agreed case by case. The water quality for wet blasting needs to be agreed with end user.

L.2.2 Application of maintenance coating

Maintenance coating should be applied in the same manner as for new build with the adjustments advised in the approved procedure.

If it is necessary to control the environmental conditions (temperature and relative humidity), the area may be enclosed during coating application and the critical stages of coating drying and curing. The compatibility between the maintenance coating materials and existing coating materials should be verified with the coating manufacturer. Only coating materials that are suitable for the application conditions as per the coating manufacturer technical data sheet or recommendations should be used.

L.2.3 Quality control

The inspection, testing and acceptance criteria for the applied coating should be in accordance with this document. The acceptance criteria may be adjusted according to the actual site conditions if approved by the end user.

L.2.4 Disposal of waste

Discharge of waste and contaminated water raises environmental concerns and shall be carried out in accordance with the relevant procedures that apply for the installation/asset.

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- [1] FROSIO Guid-CP, *FROSIO guideline for companies providing corrosion protection*
- [2] NIICAP Auditing Standard: AS-1 Program for Accreditation of Field and Shop Coatings Contractor,
- [3] SHOP PAINTING CONTRACTOR CERTIFICATION PROGRAM SSPC QP3 APPLICATION, INSTRUCTIONS, AND PROGRAM RULES,

This NORSOK standard is developed with broad petroleum industry participation by interested parties in the Norwegian petroleum industry and is owned by the Norwegian petroleum industry represented by the Norwegian Oil and Gas Association, the Federation of Norwegian Industries and the Norwegian Shipowners' Association.

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Standards Norway
P.O. Box 242
NO-1326 Lysaker
Norway

Tel. +47 67 83 86 00

petroleum@standard.no

www.standard.no/petroleum

Standard Online AS
P.O. Box 252
NO-1326 Lysaker
Norway

Tel. +47 67 83 87 00

salg@standard.no

Visiting address:

Lilleakerveien 2A
NO-0283 Oslo

