International Association of Oil & Gas Producers

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IOGP S-715J

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Version 1.1

Supplementary Specification to NORSOK M-501 for Surface Preparation and Protective Coatings

NOTE This version (S-715J) of the specification document provides the justification statements for each technical requirement, but is otherwise identical in content to S-715.

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
1.1	May 2024	Issued for Public Review
1.0	July 2020	First Edition

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

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Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

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Introduction

The purpose of the IOGP S-715 specification documents is to define a minimum common set of requirements for surface preparation and the procurement of protective coatings in accordance with NORSOK M-501:2022, Surface Preparation and Protective Coatings, for application in the petroleum and natural gas industries.

The IOGP S-715 specification documents follow a common structure (as shown below) comprising a specification, also known as a technical requirements specification (TRS), a procurement data sheet (PDS), an information requirements specification (IRS) and a quality requirements specification (QRS). These four specification documents, together with the purchase order, define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Requirements Specification (TRS)

This specification is to be applied in conjunction with the supporting PDS, IRS and QRS as follows.

IOGP S-715: Supplementary Specification to NORSOK M-501 for Surface Preparation and Protective Coatings

This specification defines technical requirements for the supply of the equipment and is written as an overlay to NORSOK M-501, following the NORSOK M-501 clause structure. Clauses from NORSOK M-501 not amended by this specification apply as written. Modifications to NORSOK M-501 defined in this specification are introduced by a description that includes the type of modification (i.e. *Add*, *Replace* or *Delete*) and the position of the modification within the clause.

NOTE Lists, notes, tables, figures, equations, examples and warnings are not counted as paragraphs.

IOGP S-715D: Procurement Data Sheet for Surface Preparation and Protective Coatings (NORSOK)

The PDS defines application-specific requirements. The PDS is applied during the procurement cycle only and does not replace the equipment data sheet. The PDS may also include fields for supplier-provided information required as part of the purchaser's technical evaluation. Additional purchaser-supplied documents may also be incorporated or referenced in the PDS to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-715L: Information Requirements for Surface Preparation and Protective Coatings (NORSOK)

The IRS defines information requirements for the scope of supply. The IRS includes information content, format, timing and purpose to be provided by the supplier, and may also define specific conditions that invoke the information requirements.

IOGP S-715Q: Quality Requirements for Surface Preparation and Protective Coatings (NORSOK)

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the PDS or in the purchase order.

The specification documents follow the editorial format of NORSOK M-501 and, where appropriate, the drafting principles and rules of ISO/IEC Directives Part 2.

The PDS and IRS are published as editable documents for the purchaser to specify application-specific requirements. The TRS and QRS are fixed documents.

The order of precedence of documents applicable to the supply of the equipment, with the highest authority listed first, shall be as follows:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser-defined requirements (e.g. PDS, IRS and QRS);

d) this specification;

e) NORSOK M-501.

1 Scope

Add to clause

The scope of this specification includes the following:

— selection of coating and paint systems;

— design of coating systems application;

— surface preparation and cleanliness;

— description of coating systems;

— qualification of coating systems;

— application procedures;

— qualification of coating manufacturers, applicators and inspectors;

— inspection and testing requirements;

— quality management;

— repairs of newly applied coating and paint systems.

This specification is applicable to shop and field-applied coatings for new construction including structures, piping and equipment items.

Justification

This addition clarifies the scope of specification as agreed by the work group and approved by the steering committee.

Add to clause

This specification is applicable to the following environments:

— offshore, marine coastal and subsea (corrosivity categories CX, Im4 and Im3);

— buried and submerged;

— internal coating of tanks and process vessels;

— painting and coating under insulation;

— subsea production systems (subsea hardware) and valves;

— underground piping (excluding pipeline);

— HVAC areas and areas with corrosivity category C1;

— onshore locations and areas with corrosivity categories C2 to C5 (see Annex M);

— areas with operating temperature range from -196 °C to 600 °C.

Justification

This addition clarifies the scope of specification as agreed by the work group and approved by the steering committee.

Add to clause

This specification is not applicable to the following items and applications:

— hull coatings;

— painting and coating systems of non-metallic components;

— pipeline and flowline coatings;

— riser coatings and splash zone sheathings;

— anti-fouling and fouling release coatings;

— building coatings;

— maintenance coating systems;

— fasteners coatings;

— thermoplastic and thermosetting liners;

— elastomeric coatings;

— metallic linings;

— internal coatings of downhole tubing or drill pipes;

— anti-galling coatings;

— thin film coatings not intended for corrosion protection (e.g. polytetrafluoroethylene (PTFE) and other coatings whose main purpose is to reduce friction and temporary storage);

— functional coatings for erosion and abrasion protection (e.g. electroless nickel plating (ENP) coating, hard facing coatings);

— insulation coatings;

— temporary coatings for preservation, transportation and storage;

— coatings of temporary equipment and equipment with a design life shorter than 15 years.

Justification

This addition clarifies the scope of specification as agreed by the work group and approved by the steering committee.

2 Normative references

Add to first paragraph

The following publications are referred to in this document, the PDS (IOGP S-715D) or the IRS (IOGP S-715L) in such a way that some or all of their content constitutes requirements of this specification.

For the purpose of this document, the national version (NS) of EN and EN ISO standards referenced in NORSOK M-501 is equivalent to the corresponding EN and ISO standards.

Add to clause

ASTM A123/A123M, *Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*

ASTM B833, *Standard Specification for Zinc and Zinc Alloy Wire for Thermal Spraying (Metallizing) for the Corrosion Protection of Steel*

ASTM D610, *Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces*

ASTM D714, *Standard Test Method for Evaluating Degree of Blistering of Paints*

ASTM D3359, *Standard Test Methods for Rating Adhesion by Tape Test*

ASTM D4414, *Standard Practice for Measurement of Wet Film Thickness by Notch Gages*

ASTM D4417, *Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel*

ASTM D4541, *Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers*

AWS C2.25/C2.25M, *Specification for Thermal Spray Feedstock—Wire and Rods*

IOGP Report 589, *Paint and surface treatment definitions for the oil and gas industry*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 4618, *Paint and varnishes — Terms and definitions*

ISO 12690, *Metallic and other inorganic coatings — Thermal spray coordination — Tasks and responsibilities*

ISO 12944 (all parts), *Paints and varnishes — Corrosion protection of steel structures by protective paint systems*

ISO 16961, *Petroleum, petrochemical and natural gas industries — Internal coating and lining of steel storage tanks*

ISO 18796-1, *Petroleum, petrochemicals and natural gas industries — Internal coating and lining of carbon steel process vessels — Part 1: Technical requirements*

NACE SP0188, *Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates*

NACE SP0287, *Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape*

NACE AMPP TM0174, *Laboratory Test Methods for the Evaluation of Protective Coatings and Lining Materials on Metallic Substrates in Immersion Service*

SSPC-AB 1, *Mineral and Slag Abrasive*

SSPC-AB 3, *Ferrous Metallic Abrasive*

SSPC-PA 2, *Procedure for Determining Conformance to Dry Coating Thickness Requirements*

SSPC-CS 23, *Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel*

SSPC-SP 1, *Solvent Cleaning*

SSPC-SP 10, *Near-White Metal Blast Cleaning*

SSPC-SP 11, *Power Tool Cleaning to Bare Metal*

SSPC-VIS 1, *Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning*

Delete from clause

NORSOK M-001, *Materials selection*

NORSOK M-121, *Aluminium structural material*

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

3 Terms and definitions

Replace first paragraph with

For the purposes of this document, the terms and definitions given in NORSOK M-501:2022, ISO 4618, ISO 12944 (all parts), IOGP Report 589 and the following apply.

Add new term 3.26

3.26
coating system
layer combined of all coats of the same or multiple coating materials

Add new term 3.27

3.27
lining
coating system that is applied to the internal surfaces of a tank or vessel to serve as a barrier to corrosion

Add new term 3.28

3.28
purchaser
party which purchases a product from a manufacturer

Note 1 to entry: In this specification, the purchaser is an oil company, an engineering contractor or a buyer.

Add new term 3.29

3.29
splash zone
tidal zone
area that is alternately wet and dry because of the influence of tides, winds, waves or ballasting/loading

4 Abbreviations

Add to clause

ACQPA Association for Certification and Qualification of Anticorrosion Paintwork

AMPP Association for Materials Protection and Performance

APS application procedure specification

CAS conformity assessment system

CRA corrosion resistant alloy

CUI corrosion under insulation

ENP electroless nickel plating

FLNG * floating liquefied natural gas

HSSE health, safety, security and environment

ICATS Industrial Coating Applicator Training Scheme

IRS information requirements specification

LNG * liquefied natural gas

NIICAP NACE International Institute Contractor Accreditation Program

PDS procurement data sheet

PPT pre-production trial

PQT procedure qualification trial

PTFE polytetrafluoroethylene

QRS quality requirements specification

SDS supplier data sheet

SSPC Steel Structures Painting Council

TDS technical data sheet

TRS technical requirements specification

* Cited in IOGP S-715J only.

5 General requirements

5.1 General

In fifth list subclause of second paragraph, add after "offshore and coastal"

and onshore

Justification

This addition aligns with the new extended scope of this specification. This scope now also includes onshore facilities exposed to environments with corrosivity categories C5 to C2.

Add new list subclause to second paragraph

— corrosivity categories C5 to C2 apply to environments with reduced aggressiveness compared with corrosivity category CX.

Justification

This requirement aligns with the new extended scope of this specification. This scope now also includes facilities exposed to environments with corrosivity categories C5 to C2.

Add to last paragraph

and, for environments with corrosivity categories C5 to C2, in Annex M

Justification

This addition aligns with the new extended scope of this specification. New Annex M defines the requirements for coatings in environments with corrosivity categories C5 to C2.

5.2 Design and planning

Add to subclause

Field coating of finished items shall be limited to touch-up, repair of damaged coating, field weld areas and complete re-coating work.

Justification

This requirement recognises that a minimal amount of site surface preparation and coating work may be required for installation and hook-up activities. This applies to activities that cannot be completed before installation.

5.4 Ambient conditions

Add to subclause

Unless the ambient conditions are controlled to the requirement of this specification, final blast cleaning and coating shall not be done.

Justification

This requirement includes conditions that are not covered by NORSOK M-501 and that can impair the quality of surface preparation and coating.

Add to subclause

If the ambient conditions fall outside the limits before the paint has cured, surfaces shall be re-blasted and re-coated.

Justification

This requirement includes conditions that are not covered by NORSOK M-501 and that can impair the quality of surface preparation and coating. It also identifies the actions required if the conditions fall outside the specified limits.

5.5 Coating materials and coating systems

Add to second sentence of fourth paragraph

, except for the curing component

Justification

The curing component details are proprietary information that is not normally disclosed by the coating manufacturer.

Add to seventh paragraph after "CSDS no. 5A,"

CSDS no. 5C,

Justification

System 5C (passive fire protection on stainless steel substrate) has been added for completeness as this system also requires pre-qualification to include as a minimum fire testing.

Add to subclause

Materials that have deteriorated (e.g. with change in visual appearance such as colour, with change in viscosity and/or with excessive separation) during storage shall be segregated.

Justification

This requirement indicates how to manage products and product limitations and how to clearly identify product non-conformance.

Add to subclause

Segregated materials shall be rejected unless they are tested and re-certified by the coating manufacturer to confirm usability.

Justification

This requirement indicates how to manage products and product limitations and clearly identify product non-conformance.

Add to subclause

Coating materials, additives and equipment cleaners for each coat and coating system shall be from the same coating manufacturer.

Justification

This requirement indicates how to manage products and product limitations and clearly identifies product non-conformance. It ensures that coating materials are compatible and conform to the qualified coating system.

Add to subclause

When defined in the CSDS for internal coating and lining of process vessels, pre-qualification in accordance with ISO 18796-1 shall be permitted.

Justification

This requirement allows the alternative use of coating pre-qualified in accordance with ISO 18796-1 for lining/internal coating of process vessels in oil and gas since linings qualified to this standard are common for onshore process vessels.

Add to subclause

When defined in the CSDS for internal coating and lining of steel storage tanks, pre-qualification in accordance with ISO 16961 shall be permitted.

Justification

This requirement allows the alternative use of lining/internal coating pre-qualified in accordance with ISO 16961 for steel storage tanks in coastal and onshore facilities.

5.8 Uncoated surfaces

Replace first paragraph (including list) with

Jacketing materials on insulated surfaces shall not be coated.

Justification

Application of coating to specific materials depends on actual environmental and operating/design conditions. Material selection is not in the scope of this specification. Therefore, only the items that do not require coating regardless of the material, operating and design conditions are listed. Moreover, the original requirement is in conflict with Table 3 and Table 4 where coatings are specified for some of the listed materials.

Delete second paragraph

Justification

This requirement has been deleted as it is written to apply to any coating requirement and is in conflict with the coating selection tables where specific coating systems are already prescribed for various items submerged in seawater.

Add new list item to third paragraph

— internal surfaces of piping and equipment items, unless internal coating is applied;

Justification

This list item has been added to clarify other areas, including safety critical areas, that are not to be blasted and coated in addition to the requirements provided in NORSOK M-501. This requirement prevents accidental blasting and coating as this may affect the function of the item and contaminate the process.

Add new list item to third paragraph

— items that cannot be coated due to equipment certification (e.g. ATEX certification).

Justification

This list item has been added to clarify other areas, including safety critical area, that are not to be blasted and coated in addition to the general requirement provided in NORSOK M-501.

In first sentence of fourth paragraph, replace "connected to carbon steel" with

welded directly to carbon steel that is to be coated

Justification

This requirement has been amended to clarify coating requirements for stainless steel / carbon steel welded connections where coating is applied to the carbon steel (e.g. does not apply to internal stainless steel attachments to carbon steel vessels that are not internally coated) vs stainless steel / carbon steel connections that are not welded (e.g. flanged or bolted connections) where the need for coating on the stainless steel part requires separate assessment and may not be necessary.

Add after first sentence of fourth paragraph

Coating requirements for non-welded connections between stainless steel and carbon steel such as flanges shall be evaluated on a case-by-case basis.

Justification

This requirement has been amended to clarify coating requirements for stainless steel / carbon steel welded connections where coating is applied to carbon steel (e.g. does not apply to internal stainless steel attachments to carbon steel vessels that are not internally coated) vs stainless steel / carbon steel connections that are not welded (e.g. flanged or bolted connections) where the need for coating on the stainless steel part requires separate assessment and may not be necessary.

5.11 Hot-dip galvanising

Add to first sentence of first paragraph

or ASTM A123/A123M

Justification

This addition ensures the global use of this specification and includes other common equivalent requirements used in other regions.

Add to start of seventh sentence

If required to remove surface contamination,

Justification

If the blasting process is not necessary, it adds significant and unneeded costs.

5.12 Records and reports

Add to last list item after "the relevant CADSs"

, technical data sheets (TDSs), safety data sheets (SDSs) and batch testing certificates

Justification

This addition aligns with the legal requirements in most jurisdictions.

Add to subclause

The CPS (also known as application procedure specification (APS)) and CPT (also known as procedure qualification trial (PQT)) in accordance with Clause 11 shall be submitted before commencement of the coating work.

Justification

This requirement identifies the information needed to perform the work.

Add to subclause

The approval certificate and test certificates for coating in contact with potable water and jet fuel shall be provided with the coating report.

Justification

This requirement ensures that regulatory certification requirements for specific products are considered and provided.

Add to subclause

Guarantee certificates shall be submitted with the coating report as required.

Justification

It is common among most operators to expect the guarantee on the coating work and certificate to be provided with the final documentation.

5.13 Additional requirements to equipment

Delete first list subclause

Justification

This is a material selection requirement that may conflict with other requirements. Material selection for these items is not within the scope of this specification.

Delete "while parts in stainless steel may be coated after assembly" from third list subclause

Justification

This second part of the sentence has been deleted as it allows coating after assembly and can mislead and may result in incomplete coating application. Surfaces left uncoated (e.g. mating machined surfaces) are addressed in other subclauses of this specification.

Delete third paragraph

Justification

This requirement has been deleted because tack welding is temporary in nature, and it is removed or incorporated into the complete weld before coating if coating is required.

Add to fifth paragraph

, except on the flange face sealing area

Justification

This addition prevents the flange face sealing area from being blasted or coated. Blasting or coating of this area may result in improper sealing, which increases the risk of flange leaking.

Add new subclause

5.15 Stainless steels

Stainless steels under insulation with the exception of HVAC ducting and tubing shall be coated regardless of the temperature.

Justification

This requirement prevents corrosion of stainless steels under insulation.

Add new subclause

5.16 Nickel steel

9 % nickel steel shall not be coated with metallic zinc-based coatings.

Justification

This requirement prevents embrittlement of 9 % Ni steel used in cryogenic service and liquefied natural gas (LNG) storage tanks.

Add new subclause

5.17 Manufacturer standard for off-the-shelf items

The coating system of the equipment manufacturer for off-the-shelf items not listed in Clause 15, when agreed, shall comply with the performance requirements of ISO 12944 (all parts) or ISO 19277 for the environmental corrosivity or CUI classification.

Justification

This requirement specifies how to manage coating on off-the-shelf items and defines minimum performance requirements in accordance with ISO 12944 (corrosion categories C1 to CX and Im1 to Im4) or ISO 19277 (under insulation).

6 Health, safety and environment

Replace second paragraph with

Materials, equipment and plants for surface preparation and coating application shall comply with the applicable health, safety, security and environment (HSSE) laws and regulations.

Justification

The original requirement refers to specific regulations. This replacement is a more generalised requirement to ensure the global use of this specification.

7 Surface preparation

7.1 Pre-blasting preparations

Delete second sentence of second paragraph

Justification

The original requirement allows the supplier to downgrade the surface preparation grade from P3 to P2 for submerged items without consulting the purchaser when, in the vendor's judgement, the coating is applied to limit the current drain to the CP system. However, any coating system applied in combination with CP does reduce current drain to the CP system in addition to, for instance, providing corrosion protection.

In second sentence of fifth paragraph, add after "ISO 12944-4"

or SSPC-SP 1

Justification

The addition of common standards used in other regions ensures the global use of this specification.

Add to subclause

After cleaning and before proceeding with further preparation and coating, surfaces shall be dry.

Justification

This requirement ensures a quality surface preparation and prevents flash rusting.

7.2 Blast cleaning

Add to second sentence of second paragraph

or ASTM D4417 Method C or NACE SP0287

Justification

The addition of common standards used in other regions ensures the global use of this specification.

Delete third sentence of second paragraph

Justification

This requirement has been deleted because as long as the required surface profile and cleanliness are achieved, either grit or shot blasting can be used as permitted by ISO 8504-2.

Delete fourth sentence of second paragraph

Justification

This requirement has been deleted because as long as the required surface profile and cleanliness are achieved, either grit or shot blasting can be used as permitted by ISO 8504-2.

In fifth sentence of second paragraph, replace "and free from chlorides when used on stainless steel and non-ferrous substrates" with

or stainless steel when used on stainless steel

Justification

Limits for chlorides in abrasive materials are established by the reference standard and checked by routine tests. The term "free from" is not defined/measurable, i.e. the chloride limit to be considered "free from" is not defined/measurable and complete removal of chlorides in practice is not achievable.

Add to second paragraph

Non-metallic abrasive shall be used on non-ferrous substrates.

Justification

The use of stainless steel abrasive on stainless steel is an alternative option considered for instance in SSPC-SP 16 and in use by some operators. The restriction to use non-metallic abrasive is applicable only to non-ferrous substrates.

Add to first sentence of third paragraph

or SSPC-AB 3

Justification

The SSPC standard for metallic abrasive is added as an alternative to NS-EN ISO 11124-2 or NS-EN ISO 11124-3 to ensure the global use of this specification.

Add to second sentence of third paragraph

or SSPC-AB 1

Justification

The addition of this common standard used in other regions ensures the global use of this specification. The addition of restriction on crystalline silica is needed for HSSE reasons and to align to ISO 11126 and SSPC-AB 1.

Add to fourth paragraph

A test report or certificate of conformance with the applicable standard shall be supplied with each batch of abrasive.

Justification

This requirement details and standardises the requirement for abrasive medium for blasting as this affects the quality of surface preparation and the final quality of coatings and is not covered in NORSOK M-501. The supply of a test report is optional ("if requested"), i.e. not mandatory in ISO 11124 and ISO 11126. This requirement makes it mandatory to supply a test report for abrasive media to be able to verify compliance.

7.3 Final surface condition

Add to first paragraph

Surface irregularities appearing after surface preparation shall be removed.

Justification

This requirement defines the standard approach to managing non-conformances after surface preparation.

Add to first paragraph

Following removal of surface irregularities, the affected areas shall be re-blasted

Justification

This requirement defines the standard approach to managing non-conformances after surface preparation.

Add to subclause

The equivalent surface preparation grades shall be in accordance with Table 6.

Justification

This requirement defines the equivalent surface preparation grades against ISO, SSPC and NACE to ensure the global use of this specification. Table 6 is also consistent with NACE SP0108.

Add new Table 6

Table 6 — Equivalent surface preparation grades

Cleaning method	ISO 8501-1	SSPC	NACE
White metal abrasive blast cleaning	Sa 3	SP 5	No. 1
Near white abrasive blast cleaning	Sa 2 1/2	SP 10	No. 2

Justification

This table defines equivalent surface preparation grades for ISO, SSPC, NACE to ensure global use of this specification. This table is also consistent with NACE SP0108.

7.4 Stainless steels and non-ferrous substrates

Add to first paragraph

Stainless steel, nickel and copper-based alloys shall be cleaned with dedicated abrasive equipment.

Justification

This requirement prevents cross-contamination of stainless steel which may be difficult to detect and remove and impacts negatively on stainless steel material and coating performance.

Replace second paragraph with

Cleaning and rinsing liquids used for stainless steel shall contain less than 50 mg/l (50 ppm) chlorides.

Justification

This replacement defines the maximum acceptable level of chlorides in the liquid used to clean and rinse stainless steel. A complete halide-free (chloride-free) cleaning solution is not available in practice.

7.4.1 HDG substrates

Replace last sentence with

Defects, breakthrough or crisping of the zinc layer shall not be permitted.

Justification

This replacement defines acceptable criteria and considers the requirement from NACE SP0108 for the global use of this specification.

7.4.2 Aluminium substrates

Add to subclause

The pH of the detergent for cleaning aluminium alloys shall be lower than or equal to 9.

Justification

This requirement prevents corrosion of aluminium substrate and ensures the global use of this specification by inclusion of NACE SP0108.

Add new subclause

7.5 Power tool cleaning

7.5.1

Power tool cleaning shall be permitted only for repair of a single defective area of less than 25 cm^2 (4 in^2).

Justification

This requirement includes the acceptable options permitted by NACE SP0108 and some operators for the global use of this specification and to cover applications where blast cleaning is not feasible or not permitted.

7.5.2

The use of power tools shall be separately qualified in accordance with 11.3.

Justification

This requirement includes the acceptable options permitted by NACE SP0108 and some operators for the global use of this specification and to cover applications where blast cleaning is not feasible or not permitted.

7.5.3

Power tool cleaning shall be in accordance with SSPC-SP 11.

Justification

This requirement includes the acceptable options permitted by NACE SP0108 and some operators for the global use of this specification and to cover applications where blast cleaning is not feasible or not permitted.

7.5.4

Power tools used to clean stainless steel, nickel and copper based alloys shall be made of stainless steel or higher alloyed corrosion-resistant material.

Justification

This requirement includes the acceptable options permitted by NACE SP0108 and some operators for the global use of this specification and to cover applications where blast cleaning is not feasible or not permitted.

8 Coating application

8.1 General

In first sentence of first paragraph, replace "coverage" with

hiding power

Justification

This replacement prevents confusion with area coverage as the requirement is about the hiding power of the subsequent coating layer.

Delete second sentence of second paragraph

Justification

This deletion removes inconsistency with the CSDS requirement and potential conflict.

8.2 Application equipment

Add to subclause

The method of application shall be airless spray or plural component spray.

Justification

This requirement ensures optimal coating durability. The airless spray or plural component spray method provides the best adhesion and performance.

8.3 Application

Add to first paragraph

Surfaces shall be re-blasted if the application of the primer cannot be completed before flash rust appears and within four hours of preparing the surface or within the time recommended by the coating manufacturer, whichever is shorter.

Justification

This is the typical maximum interval allowed by coating manufacturers and some standards (e.g. ISO 2063-2) for application of the first coat on prepared surfaces before rust re-appears in temperate climates. A shorter time may be required in more aggressive climatic conditions.

Add to fourth paragraph

Workmanship visual inspections for defects (e.g. imperfections, blisters and holidays) of each coat shall be performed only until the coating system application has been completed.

Justification

This requirement ensures visual inspections for workmanship. Even in tank linings, the test for holidays is not performed until all coats have been applied.

Add to fifth paragraph

After removal of contamination, the coating shall be repaired.

Justification

This requirement defines the remedial action if the contamination is found to be unacceptable during inspection.

Add after second sentence of sixth paragraph

If the coating system applies to temperatures less than 80 °C (or up to 120 °C, if qualified), the repair can be done by using epoxy zinc rich primer over inorganic zinc primer.

Justification

This requirement allows the use of zinc rich epoxy coats for repair of inorganic zinc primer as permitted in CSDS no. 1A.

Add to second sentence of eighth paragraph

in accordance with ISO 2808 Method 1A or ASTM D4414

Justification

This addition covers the gap by defining applicable methods to both ISO and ASTM.

Delete second sentence of fourteenth paragraph

Justification

These requirements direct the pressure vessel manufacturer to use a specific manufacturing sequence, which is not appropriate for a coating specification. The pressure vessel manufacturer is responsible for selecting the method to achieve a satisfactory internal coating.

Delete third sentence of fourteenth paragraph

Justification

These requirements direct the pressure vessel manufacturer to use a specific manufacturing sequence, which is not appropriate for a coating specification. The pressure vessel manufacturer is responsible for selecting the method to achieve a satisfactory internal coating.

Delete fourth sentence of fourteenth paragraph

Justification

These requirements direct the pressure vessel manufacturer to use a specific manufacturing sequence, which is not appropriate for a coating specification. The pressure vessel manufacturer is responsible for selecting the method to achieve a satisfactory internal coating.

Replace fifth, sixth and seventh sentences of fourteenth paragraph with

Areas adjacent to the manholes and areas at risk of coating damage shall be inspected in accordance with Table 2, after installation of internals and after dismantling of internal scaffolding.

Justification

The inspection activities are listed in Table 2, however the "coating integrity check" is not listed there. The three clauses have been combined into one requirement consistent with the inspection activities listed in Table 2.

9 Thermally sprayed metallic coatings

9.1 General

Delete "pressure retaining" from first sentence of second paragraph

Justification

The risk of liquid metal embrittlement by molten zinc in the event of a fire is equally applicable to stainless steel structural parts (e.g. stainless steel frames for small packages, stainless steel pipe supports and stainless steel anchor bolts) that are not pressure retaining but may be primary or secondary structures and whose failure can have severe consequences.

Delete "if exposed to cathodic protection system based on aluminium anodes" from second sentence of second paragraph

Justification

Experience shows accelerated corrosion and poor performance of TSZ in such applications particularly in splash and tidal zones, regardless of the application of cathodic protection. Moreover, the details of the type of CP system and sacrificial anode cathodic protection anodes are in most cases unknown to the contractor.

Add to subclause

If the minimum DFT is in accordance with ISO 2063-1, Table C.1, the sealer shall not be applied on TSA coating for immersion service (Im4), buried service (Im3) or under insulation.

Justification

Application of the sealer in the listed environment can impair the coating performance. This requirement standardises the sealer application on TSA.

9.2 Metallic coating materials

Add to first sentence of first paragraph

and Table 7

Justification

NORSOK M-501 allows the use any of the listed ISO wires for both TSA and TSZ, which may lead to incorrect wire selection (e.g. a Zn wire could be selected instead of an Al wire when TSA is specified). The current list is limiting for zinc given all of the options available. The addition of acceptable AWS and ASTM wires ensures the global use of this specification.

Add new Table 7

Table 7 — Metallic materials for thermally sprayed coating

Thermal spray coating	Standard	Classification (UNS no.)
TSZ	ISO 14919	2.1 / Zn 99.99
	ISO 14919	2.2 / Zn 99
	AWS C2.25/C2.25M	W-Zn-1 (Z13001)
	AWS C2.25/C2.25M	W-Zn-2 (Z15001)
	AWS C2.25/C2.25M	W-ZnAl-2 (Z30700)
	ASTM B833	99.99 Zinc (Z13005)
	ASTM B833	99.9 Zinc (Z15005)
	ASTM B833	99.995 Zinc (Z12004)
	ASTM B833	99.95 Zinc (Z14004)
	ASTM B833	99 Zinc (Z17000)
	AWS C2.25/C2.25M	W-ZnAl-1 (Z30401)
TSA	ISO 14919	3.2 / Al99.5
	ISO 14919	3.3 / AlMg5
	AWS C2.25/C2.25M	W-Al-1100 (A91100)
	AWS C2.25/C2.25M	W-Al-1350 (A91350)

Justification

NORSOK M-501 allows the use any of the listed ISO wires for both TSA and TSZ, which may lead to incorrect wire selection (e.g. a Zn wire could be selected instead of an Al wire when TSA is specified). The addition of acceptable AWS and ASTM wires ensures the global use of this specification.

Delete first paragraph (including list)

Justification

This requirement is now included in Table 7.

Replace fourth sentence of fifth paragraph with

The sealer shall not be applied for immersed (Im4) service, buried (Im3) service or insulated services.

Justification

This replacement aligns with ISO 2063 (all parts), NACE SP0108 and SSPC-CS 23 where the sealer may not be necessary or may have negative effects under insulation.

Delete first sentence of sixth paragraph

Justification

There are no criteria defined for inspection of pinholes after application of sealer. This may lead to unnecessary repair and increased cost. The coating integrity is not compromised by the appearance of pinholes in the sealer.

In second sentence of sixth paragraph, replace "sealer" with

tie coat

Justification

A tie coat instead of a sealer is required for "duplex" systems on top of TSZ.

9.3 Application of thermally sprayed coating

Delete first sentence of fourth paragraph

Justification

This requirement is in conflict with CSDS no. 2A, NOTE 7. There should not be a measurable overlay of sealer on the metallic coating after application.

Delete NOTE

Justification

With the deletion of the first sentence of the fourth paragraph, this note is no longer required.

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

Delete second sentence of fifth paragraph

Justification

This deletion prevents unnecessary costs to conventional blast cleaning operation. It is hardly possible to remove "any" silicon sealer that penetrated the pores in the metallic spray coating "prior to blasting" the coat, and it adds an additional costly and time-consuming stage to conventional surface preparation.

Delete fifth sentence of sixth paragraph

Justification

The original requirement has been deleted as it is not achievable in practice to remove "any" sealer that has penetrated the pores in the metallic spray coating without blasting the coat.

10 Passive fire protection coatings

10.1 General

In first sentence of first paragraph, add before "spray applied"

intumescent type

Justification

This addition clarifies that cement-based fire protection is not included in this specification, consistently with CSDS no. 5A, CSDS no. 5B and CSDS no. 5C.

10.2 The PFP coating systems

In second sentence of second paragraph, replace "AISI 316L" with

stainless steel

Justification

The reference to AISI restricts the selection to a specific national grade while any 316L would be acceptable. The 304L mesh is also commonly used and acceptable as it is embedded in the PFP layer and protected from the environment.

Replace third sentence of second paragraph with

Stainless steel studs shall be used for stainless steel substrates.

Justification

The reference to AISI restricts the selection to a specific national grade while any 316L would be acceptable. The size and material of the welded stud are up to the PFP manufacturer's recommendation and need to be compatible with the equipment/piping material, with stainless steel to be used on stainless steel substrate. Copper coated carbon steel studs are used for capacitive discharge stud welding. Other stud welding methods are applicable, and the selection of the fixing method is outside the scope of this specification.

Delete fourth sentence of third paragraph

Justification

This requirement states that pre-qualification is required only for systems 5A and 5S creates circular reference with the requirement in CSDS no. 5C.

Delete first sentence of fourth paragraph

Justification

This requirement has been deleted as alternative primers not qualified as part of the PFP system can only be used if approved by the PFP manufacturer. Alternative primers, even if approved by the end-user, may not guarantee the fire protection properties of the system if an alternative coat is used.

Delete second sentence of fourth paragraph

Justification

This requirement has been deleted as alternative primers not qualified as part of the PFP system can only be used if approved by the PFP manufacturer. Alternative primers, even if approved by the end-user, may not guarantee the fire protection properties of the system if an alternative coat is used.

Delete third sentence of fourth paragraph

Justification

This requirement has been deleted as it cannot be verified. The tie-coat qualification, tests and acceptance criteria required for approval are undefined.

Add new list item to second sentence of sixth paragraph

— exposed to cryogenic temperatures or cryogenic spills.

Justification

This addition covers important applications in cryogenic service including LNG, floating liquefied natural gas (FLNG) and coastal facilities (e.g. regasification, process plants) which may require additional specific testing.

10.3 Application

Delete second sentence of third paragraph

Justification

This requirement has been deleted as it directs the supplier to a specific course of action which is the engineering design contractor's decision. Verification of structural fire integrity is outside the scope of a coating specification.

Delete first sentence of fourth paragraph

Justification

This requirement has been deleted as it is a construction detail that has implications for the fire safety of the structure. It is not part of a coating specification.

Delete second sentence of fourth paragraph

Justification

This requirement has been deleted as it is a construction detail that has implications for the fire safety of the structure. It is not part of a coating specification.

Delete fifth paragraph

Justification

This requirement has been deleted as it is in conflict with 10.2.

11 Qualification requirements

11.1 Pre-qualification of materials

Replace first sentence of second paragraph with

The laboratory performing pre-qualification of coating material shall be certified to ISO/IEC 17025 for the required tests and assessment methods.

Justification

This replacement provides clarity on the testing laboratory accreditation while removing the limitation of the original requirement where only testing to ISO standards is considered.

Delete "by a 3rd party inspector accepted by the testing laboratory" from second sentence of second paragraph

Justification

This deletion provides clarity on the requirement to witnessing pre-qualification testing and removes the limitation that the witnessing party shall be accepted, i.e. selected, by the testing laboratory. Coating pre-qualification including selection of testing laboratory and witnessing party is the responsibility of the coating manufacturer as stated in the first paragraph of 11.1. The coating manufacturer can elect to use a third-party inspector to witness the preparation of the test panel or may agree with the end-user alternative witnessing.

Add to subclause

Lining materials for process vessels and tanks shall have 5 years of documented performance in the specific service and fluid.

Justification

This requirement defines the criteria for re-qualification of coating systems as this is not considered in NORSOK M-501. It also provides alignment with ISO 12944-9 and NACE SP0108.

Add to subclause

Pre-qualified coating systems shall be re-qualified if the formulation of individual coats is changed.

Justification

This requirement defines the criteria for re-qualification of coating systems as this is not considered in NORSOK M-501. It also provides alignment with ISO 12944-9 and NACE SP0108.

Add to subclause

Pre-qualified coating systems shall be re-qualified if the coating manufacturer is changed.

Justification

This requirement defines the criteria for re-qualification of coating systems as this is not considered in NORSOK M-501. It also provides alignment with ISO 12944-9 and NACE SP0108.

Add to subclause

Unless permitted in the CSDS, pre-qualified coating systems shall be re-qualified if the substrate material is changed.

Justification

This requirement defines the criteria for re-qualification of coating systems as this is not considered in NORSOK M-501. It also provides alignment with ISO 12944-9 and NACE SP0108.

Add to subclause

Coating systems shall be re-qualified if the surface preparation is changed.

Justification

This requirement defines the criteria for re-qualification of coating systems as this is not considered in NORSOK M-501. It also provides alignment with ISO 12944-9 and NACE SP0108.

Add to subclause

Coating systems shall be re-qualified if the DFT range of an individual coat is changed.

Justification

This requirement defines the criteria for re-qualification of coating systems as this is not considered in NORSOK M-501. It also provides alignment with ISO 12944-9 and NACE SP0108.

Add to subclause

Coating systems shall be re-qualified if the total DFT range is changed.

Justification

This requirement defines the criteria for re-qualification of coating systems as this is not considered in NORSOK M-501. It also provides alignment with ISO 12944-9 and NACE SP0108.

Add to subclause

Equipment used for pull-off testing shall apply an automatically centered pulling force.

Justification

This requirement has been moved from Table 1, NOTE 2 to this subclause while NOTE 2 has been deleted.

Add to subclause

Pull-off adhesion testing on systems CSDS no. 4A and CSDS no. 4B shall be without skid aggregates.

Justification

This requirement has been moved from Table 1, NOTE 2 to this subclause while NOTE 2 has been deleted.

Add to subclause

The thickness for pre-qualification tests of the PFP material in systems CSDS no. 5A, CSDS no. 5C and CSDS no. 5S shall be the thickness certified by the fire protection testing.

Justification

This requirement ensures that the thickness tested for fire testing is the target thickness.

Add to subclause

Corrosion tests, pull-off tests and fire tests on PFP systems shall be performed on the certified scheme with respect to mesh requirements.

Justification

This requirement ensures that PFP qualification tests are representative of the actual PFP system with or without mesh.

Add to subclause

PFP systems where the mesh is optional shall be tested with and without mesh.

Justification

Where a PFP system can be applied both with and without mesh, this requirement ensures that qualification tests are representative of both PFP options.

Add to subclause

Qualification of system CSDS no. 7 on carbon steel substrate shall qualify stainless steel substrate.

Justification

This requirement clarifies that qualification done on carbon steel also qualifies stainless steel, but at the same time, qualification on stainless steel is also acceptable.

Add to subclause

Qualification of linings for multi-phase service shall test each of area exposed to different phases (e.g. oil, produced water and vapour phases).

Justification

This requirement clarifies that for lining the testing at all phases is mandatory.

Table 1 — Pre-qualification tests for coating materials

Replace Table 1 with

Activity No.	Activity description	Verification method	Acceptance criteria	Remarks
11.1A	Cyclic ageing test	ISO 12944-9, Annex B	ISO 12944-9 and supplementary requirements: • Chalking to ISO 4628-6, maximum rating 2 for system 1A and 1B. • Pull-off test to ISO 4624 or ASTMD4541. ◦ Adhesion failure: Minimum 5,0 MPa (725 psi), maximum 50 % reduction from the value measured before ageing.	Applicable for CSDS no. 1A, CSDS no. 1B, CSDS no. 1G Note 1, CSDS no. 1H Note 1, CSDS no. 4A, CSDS no. 4B
11.1B	PFP system verification tests after ageing resistance according to ISO 12944-9, Annex B, cyclic aging test	ISO 12944-9, Annex B and supplementary requirements: Water uptake after exposure testing, Annex F. Fire test.	• Pull-off test to ISO 4624 or ASTM D4541. ◦ Adhesion failure ≥ 5 MPa. ◦ Cohesive failure ≥ 2 MPa for systems 5A and 5S. • Water uptake < 2 % for systems 5A and 5S. • Fire test, according to regulatory requirements or Annex H for systems 5A, 5C and 5S.	Applicable for CSDS no. 5A, CSDS no. 5C, CSDS no. 5S
11.3	PFP system ageing resistance	UL 2431 Wet Freeze Dry Cycle or equivalent	ISO 12944-9 and supplementary requirements: • Fire test verification to Regulatory requirement or Annex H.	Applicable for CSDS no. 5A, CSDS no. 5C, CSDS no. 5S
11.4	Cathodic disbonding test	ISO 12944-9	ISO 12944-9	Applicable for CSDS no. 1F, CSDS no. 3C, CSDS no. 5S, CSDS no. 7A, CSDS no. 7B, CSDS no. 7C
11.5	High temperature cathodic disbonding test for operating temperature > 50 °C (122 °F)	ISO 12944-9 and supplementary requirements: • Steel temperature to be the maximum operating temperature. • Electrolyte to contain 3,5 % NaCl. • Electrolyte bulk temperature to be maintained at +30 °C (86 °F). • Cathodic protection potential to be -1200 mV (SCE). • Oxygen concentration of the test solution to be maintained at its saturation value at the electrolyte bulk temperature. • Duration 4 weeks.	ISO 12944-9	Applicable for CSDS no. 7A, CSDS no. 7B, CSDS no. 7C Refer to Annex C for typical test set-up. Cathodic disbonding tests for operating temperature above 100 °C (212 °F) to be done under pressure to prevent boiling of the solution on the steel surface.

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

Activity No.	Activity description	Verification method	Acceptance criteria	Remarks
11.6	CUI testing	ISO 19277 for category CUI-3, excluding multiphase CUI cyclic corrosion test. For CSDS no. 1D and CSDS no. 10A both tests are required. For CSDS no. 6C and CSDS no. 10B, only thermal cyclic testing is required.	ISO 19277	Applicable for CSDS no. 1D, CSDS no. 10A, CSDS no. 6C and CSDS no. 10B. For insulated cryogenic service, see 11.18.
11.7	CUI vertical pipe test	ISO 19277 vertical pipe test for category CUI-3. Temperature measured 100 mm above the hotplate to be ≥ 200 °C during testing.	ISO 19277	Applicable for CSDS no. 1D and CSDS no. 10A and CSDS no. 10B
11.8	Static high temperature 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. Testing as per ISO 19277.	Blistering, cracking, flaking and pre- and post-test adhesion as per ISO 19277.	Applicable for CSDS no. 1D, CSDS no. 6C, CSDS no. 10A and CSDS no. 10B
11.9	Water immersion test	ISO 2812-2	• Adhesion failure (see ISO 4624 or ASTM D4541): Maximum 30 % reduction from original value, but never below 10 MPa • Visual evaluation as per ISO 4628-2, ISO 4628-3, ISO 4628-4 and ISO 4628-5. Nil (0 %) regarding blistering, rusting, cracking and flaking.	Applicable for CSDS no. 3A
11.10	Seawater tank test to IMO	IMO PSPC.MSC.215(82) Appendix 1	Acceptance criteria for epoxy-based systems applied according to Table 1 of the IMO resolution. Pre-qualification at MDFT 320 µm is acceptable.	Applicable for seawater ballast tanks and CSDS no. 3B
11.11	Cargo oil tank testo to IMO	IMO PSPC MSC.288(87), Appendix 1 and 2	IMO PSPC MSC.288(87). Pre- qualification at MDFT 320 µm is acceptable.	Applicable for offshore and cargo oil tank and CSDS no.3C
11.12	Thermal cycling test	NACE TM0404 section 9	NACE TM0404 section 9. Visual evaluation as per ISO 4628-4 and ISO 4628-5: Nil (0 %) regarding cracking and flaking.	Applicable for CSDS no. 3A, CSDS no. 3D, CSDS no. 3E and CSDS no. 3F
11.13	Immersion testing	ISO 2812-1	ISO 2812-1 and supplementary requirements: • Adhesion per ISO 16276-2 or ISO 2409, classification: 0-2 or ASTM D3359 Method B classification 3B. • Nil (0 %) regarding blistering, rusting, cracking and flaking to ISO 4628-2, ISO 4628-3, ISO 4628-4 and ISO 4628-5.	Applicable for CSDS no. 3G

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

Activity No.	Activity description	Verification method	Acceptance criteria	Remarks
11.14	Elevated temperature and pressure testing	NACE TM0174, Method A (6 months)	ISO 4628-2 or ASTM D714, no blisters. ISO 4628-3 or ASTM D610, 9 or better.	Applicable for CSDS no. 3D, CSDS no. 3E and CSDS no. 3F
11.15	Cathodic disbonding	ASTM G42:11, +80 °C	ASTM G42:11 and supplementary requirements: • Equivalent circuit diameter < 20 mm.	Applicable for CSDS no. 1F
11.16	Buried pipe coating test	ISO 12944-9, for category Im4	ISO 12944-9 and supplementary requirements: • Average 6,0 mm corrosion at scribe. • Pull off testing adhesion failure: ≥ 5 MPa and maximum 50 % reduction from original value.	Applicable for CSDS no. 1F
11.17	Impact testing	ASTM G14, Three specimens and 20 impact readings	ASTM G14, 5.6 J (50 in-lbf)	Applicable for CSDS no. 1F and CSDS no. 7A
11.18	CUI cryogenic testing	ISO 19277, CUI-3-Cryo	ISO 19277	Applicable for CSDS no. 9
11.19	Process vessels lining test	ISO 18796-1	ISO 18796-1 and as per CSDS	Alternative internal coating and lining of process vessels to ISO 18796-1. Qualification of linings to sample all phases (e.g. oil, produced water and vapour phases) of multi-phase systems. When specified, applicable for CSDS no. 3D, CSDS no. 3E, CSDS no. 3F, CSDS no. 3G
11.20	Storage tank lining test	ISO 16961	ISO 16961	Alternative internal coating and lining of above ground welded steel atmospheric storage tanks handling stabilized crude oil, hydrocarbons and water. When specified, applicable for CSDS no. 3B, CSDS no. 3C
NOTE 1 Testing for System 1G and 1H according to the CSDS at the maximum operating temperature of 120 °C.				

Justification

This table has been modified to align with the changes in the technical requirements.

11.2 Qualification of applicator contractors and personnel

11.2.2 Qualification of coating operators

Replace first paragraph (including list) with

Operators shall be certified to NACE, SSPC, ACQPA, ICATS or an equivalent certification accepted by the purchaser.

Justification

This replacement ensures the global use of this specification by removing the specific reference to Norway and the potential conflict with the minimum requirement compass and free trade agreements.

Delete first sentence of second paragraph

Justification

This deletion prevents the use of alternative qualification in Annex I without prior purchaser's (end user's) acceptance.

11.2.3 Qualification of metal spray operators

In first sentence of first paragraph, replace "Annex A.2" with

and Table 2

Justification

ISO 14918 defines the principles of qualification testing of sprayer and provides a basis for mutual recognition by examining Bodies for qualification relating to thermal sprayer. It defines the range of qualification, qualification scope, examination and testing requirements, re-test and period of validity. NORSOK M-501 has more stringent acceptance criteria for adhesion testing than ISO 14918 and ISO 2063 (all parts) and these have been included in Table 2. The use of more severe tests is permitted by ISO 14918 when required by the relevant application standard.

Replace second sentence of first paragraph with

The thermal sprayer practical test shall be demonstrated on test panels or components in accordance with 11.3.2.

Justification

This replacement clarifies that the operator qualification requirements are covered in 11.2.3. It also defines the practical test.

Add after first paragraph

The thermal spray coating shall be applied in accordance with the CPS.

Justification

It is essential to follow a CPS as the acceptance criteria for the qualification of the thermal spray operator are as defined in Table 2 and qualification ranges are as per ISO 14918 (including spray process, application method and consumable).

Replace first sentence of second paragraph with

The thermal sprayer qualification tests shall be in accordance with the procedure qualification tests in Table 2.

Justification

The original requirement has been replaced as it does not fully define the required tests and potentially conflicts with other requirements. Table 2 includes both tests to qualify the CPS using a CPT/PPT and tests to monitor coating application during production. Not all tests in Table 2 require three measurement "series". It is not clear whether the acceptance criteria are the average of three series of measurement, a single value, the CPT value or the production value. The original requirement deviates from both ISO 4624 and ISO 16276-1 and differs from Table 2.

Add to second paragraph

The adhesion test for thermal sprayer qualification shall use three sets of three dollies (i.e. nine dollies in total).

Justification

Table 2 includes both tests to qualify the CPS using a CPT/PPT and tests to monitor coating application during production. Not all tests in Table 2 require three measurement "series". It is not clear whether the acceptance criteria are the average of three series of measurement, a single value, the CPT value or the production value. The original requirement deviates from both ISO 4624 and ISO 16276-1 and differs from Table 2.

Delete fifth paragraph

Justification

This requirement has been deleted as it allows the use of alternative qualification in Annex I without prior purchaser's (end user's) acceptance.

11.2.4 Qualification of passive fire protection operators

Delete second paragraph

Justification

This requirement for qualification of welders and welding procedures including for stud welding is addressed in the relevant welding codes and specifications and is beyond the scope of a coating specification.

Delete third paragraph

Justification

This requirement for renewal of qualification of welders is addressed in relevant welding codes and specifications, and is beyond the scope of a coating specification.

11.2.5 Qualification of supervisors, foremen and Quality Control personnel

Add to first sentence of first paragraph

, SSPC PCI Level 3 or AMPP Senior Certified Coating Inspector

Justification

This addition ensures the global use of this specification by addition of missing qualification and new qualification by AMPP .

Add to second sentence of first paragraph after "level II"

or SSPC PCI Level 2 or AMPP Certified Coating Inspector

Justification

This addition ensures the global use of this specification use by addition of missing qualification and new qualification by AMPP.

Add to second paragraph

SSPC PCI Level 2, or to an equivalent level by an organisation specified by the purchaser.

Justification

This addition generalises local requirements to ensure the global use of this specification.

Add to subclause

Qualification of personnel supervising and coordinating thermal spraying activities shall be in accordance with ISO 12690.

Justification

This addition ensures alignment with ISO 2063 (all parts) and ISO 12690 for thermal spray specialist qualification.

11.3 Qualification of procedures

11.3.1 Coating procedure specification (CPS)

Replace fourth list item of first paragraph with

— SDSs for blasting media, coating materials, and solvents;

Justification

TDSs (PDSs) and SDSs do not contain the same information. SDSs are required for all products used during coating application, including for blasting media, solvents, cleaning fluids, not only for the coating material.

Delete fifth list item of first paragraph

Justification

The ITP is supplied as a separate deliverable together with the quality plan as it is project and item specific. It is not part of the CPS, which may cover multiple items (e.g. structures, equipment items, packages). These two documents are also prepared and submitted at different stages in a project.

Add new list item to first paragraph

— performance (pre-qualification) test report.

Justification

Pre-qualification testing is required for some coating systems as per 11.1. NORSOK M-501 does not detail how to verify that the required tests have been performed and that pre-qualification has been successfully carried out.

Replace first list item of fifth paragraph with

— modifications, reformulations or substitution of approved individual coats and coating systems;

Justification

What is identified a "change" of coating material is undefined. This clarifies what the changes in the coating material requiring re-qualification of the CPS are and align the content of 11.3.1 with 11.1, noting that not all changes require re-qualification.

Add new list item to fifth paragraph

— unless permitted in the CSDS, a change of the substrate material from ferrous to non-ferrous.

Justification

The substrate material is an essential variable for coating procedure qualification.

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

In first sentence of second paragraph, replace "can" with

shall

Justification

This replacement ensures a mandatory requirement, rather than a possible alternative to other optional test panels. Without this replacement, it has little benefit as the applicator could use any other test plate preparation and this is particularly important for the shape test on TSA/TSZ coat.

In first sentence of third paragraph, replace "can" with

shall

Justification

This replacement ensures a mandatory requirement rather than a possible alternative to other options.

Delete third sentence of third paragraph

Justification

This deletion prevents conflict with 11.3.2 which defines test panel size of "minimum 1 m^2, typically 0.8 m x 1.2 m or 1 m x 1 m. There is also a conflict between 11.3.2, Annex E and Annex J. Annex J requires 3 x 3 dollies and in practice, all dollies cannot fit on the panel size proposed. Additionally, all required tests can only be performed if multiple test panels are used.

Replace second list item of fourth paragraph with

— inspection and test results in accordance with Table 2;

Justification

Table 2 includes inspection, tests and acceptance criteria applicable to CPT.

Replace second sentence of ninth paragraph with

Extension of the CPT beyond 3 years shall be maximum 1 year with conditions remaining unchanged.

Justification

This replacement clarifies and ensures the correct reading of this paragraph by removing the ambiguity as to whether the intent is to extend the validity of the CPT beyond three years or further restrict it to less than a year.

Delete third sentence of ninth paragraph

Justification

This deletion clarifies and ensures the correct reading of this paragraph by removing the ambiguity as to whether the intent is to extend the validity of the CPT beyond three years and not to further restrict it to less than a year. Additionally, this deletion prevents a potential conflict with 11.3.2.

12 Inspection and testing

Table 2 — Inspection and testing

Replace Table 2 with

Activity No.	Activity description	Verification method	Frequency	Acceptance criteria	Management of non-conformance
Activities prior to surface preparation					
12.1	Substrate reception control	ISO 8501-1 or SSPC-VIS 1	100 % of all surfaces	Rust Grade B or Condition B	Remediation of surface or object.
12.2	Visual examination of substrate preparation	ISO 8501-3	100 % of all surfaces	As per CSDS	Defects to be removed or repaired.
Environmental conditions					
12.3	Environmental conditions recording during surface preparation and coating	ISO 8502-4	Before the start of each shift and twice per shift	In accordance with 5.4	No blasting nor coating.
Surface preparation					
12.4	Surface contamination testing	ASTM F22	One test for each batch of components, at least once per 100 m² of prepared surface with a minimum of three checks per day	Free from contamination, no water pearls	Re-clean as specified in 7.1 until criterion is met.
12.5	Compressed air quality	ASTM D4285	At the start of each shift	Free from any contamination	Clean and service air delivery system. Clean and re-blast contaminated components since last acceptable test.
12.6	Testing of blasting medium (salt and oil contamination)	ASTM D7393	Once per batch of blasting medium	No oil	Change blasting media. Re-wash and re-blast of surface prepared with contaminated medium.
		ASTM D4940		150 µS/cm (150 µmho/cm)	
12.7	Surface cleanliness after blasting carbon steel	ISO 8501-1 or SSPC VIS 1	100 % visual of all surfaces	In accordance with specified requirements in CSDS and equivalent surface preparation in Table 6.	Re-blasting and re-testing.
		ISO 8502-3	One test for each batch of components, at least once per 100 m² (1076 ft²) of prepared surface with a minimum of three checks per day	Maximum quantity rating 2 and size rating 2	Re-cleaning and retesting of non-conforming area until acceptable.

Table 2 — Inspection and testing *(continued)*

Activity No.	Activity description	Verification method	Frequency	Acceptance criteria	Management of non-conformance
12.8	Surface cleanliness after sweep blasting HDG steel, stainless steel and non-ferrous metal	SSPC-SP 16	100 % visual of all surfaces	In accordance with specified requirements in CSDS and equivalent surface preparation in Table 6.	Re-blasting and re-testing.
		ISO 8502-3	One test for each batch of components, at least once per 100 m² (1076 ft²) of prepared surface with a minimum of three checks per day	Maximum quantity rating 2 and size rating 2	Re-cleaning and retesting of non-conforming area until acceptable.
12.9	Salt test of blasted surface	ISO 8502-6 and ISO 8502-9	One test for each batch of components , at least one test per 100 m² (1076 ft²), with minimum three checks per day	As per CSDS	Wash of non-conforming area with potable water and retesting until acceptable followed by re-blasting.
12.10	Surface profile	ISO 8503-1, ISO 8503-2 with grit comparator, ISO 5803-4, or ISO 8503-5 or ASTM D4417 Method C or NACE SP0287	One test for each batch of components, at least one test per 10 m² (108 ft²)	As per CSDS	Re-blasting non-conforming area with abrasive of suitable grade to achieve desired surface profile.
Coating application					
12.11	Curing test (for Zn silicate)	ASTM D4752	Each batch of components, at least once per 100 m² (1076 ft²)	Level 4 to 5	Allow to cure.
12.12	Visual examination of coating	Visual examination to determine curing, contamination, solvent retention, pinholes/popping, sagging and surface defects.	100 % of surface after each coat	No defects	Repair defects.
Coating test after curing					
12.13	Dry film thickness (individual coat and complete system)	ISO 19840 or SSPC PA 2	ISO 19840	ISO 19840 and as per CSDS	Repair, additional coats or re-coating.

Table 2 — Inspection and testing *(continued)*

Activity No.	Activity description	Verification method	Frequency	Acceptance criteria	Management of non-conformance
12.14	Holiday detection (applicator contractor)	ISO 29601 or NACE SP0188 (high voltage spark test when the average DFT is 500 µm or higher).	100 % of lined surfaces, splash and tidal zone coating, buried coating or as per CSDS 100 % of welds of submerged equipment items Under insulation piping and equipment (if organic coating system is used): 100 % of coated area	No holidays	Repair and retesting.
12.15A	Adhesion or cohesion by pull-off test	ISO 16276-1 or ASTM D4541, and Annex. During CPT, tests exhibiting 20 % or more in glue failure to be repeated	As agreed on ITP. Frequency of inspection/testing may be increased as required by the coating inspector if any of the spot check does not comply with the acceptance requirement. The average value from 3 dollies represents one measurement.	• TSA coating: CPT 9,0 MPa (1300 psi), production 7,0 MPa (1015 psi), minimum single. Testing of TSA without sealer. • For systems CSDS no. 3A, CSDS no. 3C, CSDS no. 3D, CSDS no. 3E and CSDS no. 3F, maximum 30 % reduction from CPT value, minimum single 5,0 MPa (725 psi). • Other coating systems and TSZ: maximum 50 % average reduction from CPT, 5,0 MPa (725 psi) minimum single. • For sprayed on and hand applied PFP during application, adhesion and cohesion value according to ISO 16276-1 and ISO 16276-2 ≥ 5,0 MPa (725 psi) regardless of mesh inclusion.	Coating applied since last acceptable test to be rejected. Re-blast and re-coat.
12.15B	Adhesion by cross-cut or X-cut test	ISO 16276-2 or ASTM D3359 Method B or ISO 2409	As agreed on ITP. Frequency of inspection/testing may be increased as required by the coating inspector if any of the spot check does not comply with the acceptance requirement	ISO 16276-2 Classification 0-2 ASTM D3359 Classification 3B For DFTs exceeding 250 µm, X-cut test to be performed with acceptance criteria ISO 16276-2 level 2	Coating applied since last acceptable test to be rejected. Re-blast and re-coat.

Table 2 — Inspection and testing *(continued)*

Activity No.	Activity description	Verification method	Frequency	Acceptance criteria	Management of non-conformance
12.16	Visual examination of metal sprayed coating	Examine all CPT test panels and production items for surface defects such as lumps, bubbles, uncoated spots, loose metal powder and ash.	100 % of surface	No defects	Repair and re-coat.
12.17	Visual examination after sealer application on metal spray coating	Examine at 10X magnification.	All CPT test panels at 10X magnification. For production testing, as agreed on ITP. Frequency of inspection/testing may be increased as required by the coating inspector if any of the spot check does not comply with the acceptance requirement	No open pores	Add sealer and re-examine until no open pores are detected.
12.18	Bend test - TSA (not required on TSZ)	ISO 2063-2:2017, Annex G or AWS C2.23/NACE 12/ SSPC S 23:2016, Appendix A 13 mm (0,5 in) mandrel	Before start of each shift	AWS C2.23/NACE 12/ SSPC CS-23. For TSA, minor cracks accepted but no lifting or spalling of the coating	Verify and adjust application parameters. Repeat the test to confirm acceptance.

Justification

This table has been modified to align with the changes in the technical requirements.

13 Repair of coating

13.1 General

Add to first sentence of second paragraph

or ASTM A123/A123M

Justification

The addition of ASTM A123/A123M ensures the global use of this specification as it is an alternative standard used globally for HDG items.

13.3 Removal of coating damage

Add to first sentence of second paragraph

, except when the use of alternative cleaning methods is permitted in 7.5.1

Justification

Under the specific conditions defined in 7.5.1, power tools are permitted for minor repairs.

15 Selection of a NORSOK system

Table 3 — Coating selection table for structural items

Replace Table 3 with

Substrate Material	Application or Item	Operating Environment	Coating System (CSDS no.)	
			Default [a]	Alternative [b]
Carbon steel	Structures and structural components (general), including frames, base plates, enclosures, permanent lifting beams and lugs	Offshore and coastal areas	1A	-
		HVAC	8	Manufacturer's standard coating
		Splash zone and tidal zone, and up to and including underside of cellar deck or other deck directly exposed above sea	7A	-
		Submerged ≤ 50 °C (122 °F)	7B	-
		Submerged > 50 °C (122 °F)	7C	-
		Buried steel structures, piles	1F	-
	Bridges, crane boom, A-frames, lifeboat stations and rescue areas	Offshore and coastal	1A	-
	Exhaust stack, flare stack and boom	Offshore and coastal	2A	-
	Escape routes and walkways, deck areas, lay down	Offshore and coastal	4A	-
	Deck, normal and light duty areas	Offshore and coastal	4A	4B
	Caisson	External surface, all zones	7A	-
	Caisson	Internal surface	7B	-
Stainless steel	Structure and structural components, outfitting	Offshore and coastal	- [c]	6A
		Splash zone/tidal zone and submerged	- [c]	7D
	Lifeboat stations / rescue areas	Offshore and coastal	- [c]	6A
	Caisson	External surface, all zones	- [c]	7E
	Caisson	Internal surface	- [c]	7E
Carbon steel HDG	Handrails and ladders	Offshore and coastal	- [d]	6B
	Frames, foundations, structures	Offshore and coastal	6B	-
Aluminium	Structures and structural components (general)	Offshore and coastal areas	- [c]	6D
		HVAC	N/R	-
Any material with PFP	Item requiring passive fire protection	Offshore and coastal areas	5A	-
		Splash zone and tidal zone, and up to and including underside of cellar deck or other deck directly exposed above sea	5S	-
Stainless steel with PFP	Item requiring passive fire protection	Offshore and coastal areas	5C	-

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

Substrate Material	Application or Item	Operating Environment	Coating System (CSDS no.)	
			Default [a]	Alternative [b]
KEY N/R not required - not specified NOTE The table is to be read in conjunction with the CSDS in Annex A which includes additional restrictions on operating conditions for each coating systems. [a] The default system is the minimum requirement to meet the high durability range in ISO 12944-1. [b] The alternative coating system replaces the default system when specified in the data sheet. [c] Coating depends on material grade and project requirements. If coating is specified, the alternative coating system is the default. [d] Coating depends on project requirements. If coating is specified, the alternative coating system is the default.				

Justification

This table defines the standard generic coating systems proposed for specific equipment items and applications on offshore and coastal facilities, starting from the coating systems already specified in NORSOK M-501 and considering the coating systems proposed in operating companies' specifications. This ensures a wider adoption while allowing for an alternative system supplied as standard by package manufacturers who can achieve the required minimal performance.

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

Replace Table 4 with

Substrate Material	Application or Item	Operating Environment	Coating System (CSDS no.)		Remarks
			Default [a]	Alternative [b]	
Carbon steel	Pressure vessels, equipment, piping and valves, pumps	Offshore and coastal areas, non-insulated ≤ 80 °C (176 °F)	1A	-	CSDS no. 1G is also qualified as CSDS no. 1A, but not vice-versa.
		Offshore and coastal areas, non-insulated, T ≤ +120 °C	1G	1H	For maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
		Offshore and coastal areas, non-insulated > 80 °C (176 °F) to 595 °C (1100 °F)	10A	2A	CSDS no. 2A to be preferred for very high durability or when maintenance is not feasible.
		Offshore and coastal areas, non-insulated > 400 °C (752 °F)	10A	2A	CSDS no. 2A to be preferred for very high durability or when maintenance is not feasible. System to be suitable for corrosion protection during planned down time.
		Offshore and coastal areas, insulated ≤ 200 °C (392 °F)	2A	1D	Coating system to be selected as for un-insulated surfaces when perforated guards or sheets are used for personnel protection. System CSDS no. 1D is an acceptable alternative when pre-qualified to the required maximum operating temperature.
		Offshore and coastal areas, insulated 200 °C (392 °F) to 595 °C (1100 °F)	10A	2A	
		Buried piping	1F	-	For maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
		Splash zone and tidal zone	7A	-	For maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
		Above splash zone and up to and including underside of cellar deck or other deck directly exposed above sea	7A	2A	For 7A, for maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
		Submerged ≤ 50 °C (122 °F), insulated and non-insulated	7B	7C	
		Submerged > 50 °C (122 °F) up to 150 °C, insulated and non-insulated	7C	-	For maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
		HVAC	8	Manufacturer's standard coating	For maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
		Low temperature and cryogenic service	9	-	Minimum operating temperature colder than -50 °C (-58 °F).

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

Substrate Material	Application or Item	Operating Environment	Coating System (CSDS no.)		Remarks
			Default [a]	Alternative [b]	
Carbon steel *(continued)*	Actuator, gear box	Offshore and coastal areas	1A	1B	For maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
		Offshore and coastal areas, insulated T ≤ +200 °C	1D	-	
	Electric generators, motors, transformers, engines, turbines, compressors	Offshore and coastal areas	1A	2B, 1B, 1G	For maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
Stainless steel	Pressure vessels, equipment, piping and valves, pumps	Offshore and coastal areas, non-insulated	- [c]	6A, 10B, 2C	Coating selection for stainless steels to consider the risk of corrosion and stress corrosion cracking
		Non-insulated, splash zone T ≤ +50 °C	7D	-	
		Submerged ≤ 50 °C (122 °F), insulated and non-insulated	7E	7C, 7A	
		Submerged > 50 °C (122 °F) up to 150 °C, insulated and non-insulated	7F		For maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
		Insulated, Offshore and coastal areas	2C	6C	Coating system to be selected as for un-insulated surfaces when perforated guards or sheets are used for personnel protection. For system 6C and maximum operating temperatures above 80 °C, testing to be agreed with the coating manufacturer.
		Low temperature and Cryogenic service T< -50 °C	9	-	
		HVAC	N/R [c]	6A [c]	
	Actuator, gear box	Offshore and coastal areas non-insulated	N/R [c]	6A [c]	
		Atmospheric zone, insulated	6C	-	
	Instruments and instrument tubing (NPS ≤ 2 or DN ≤ 50)	Offshore and coastal areas	N/R [c]	6A [c], 6C [c]	6A is the default for non-insulated items, 6C is the default for insulated items
Aluminium	Actuator and other equipment items	Offshore and coastal areas	N/R [e]	6D [e]	

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

Substrate Material	Application or Item	Operating Environment	Coating System (CSDS no.)		Remarks
			Default [a]	Alternative [b]	
Carbon steel HDG	Miscellaneous equipment items, electrical equipment	Offshore and coastal areas	- [d]	6B [d]	
Any material with PFP	Item requiring passive fire protection	Offshore and coastal areas	5A	-	
Stainless steel with PFP	Item requiring passive fire protection	Offshore and coastal areas	5C	-	

KEY

N/R not required

- not specified

NOTE The table is to be read in conjunction with the CSDS in Annex A which includes additional restrictions on operating conditions for each coating systems.

[a] The default system is the minimum requirement to meet the high durability range in ISO 12944-1.

[b] The alternative coating system replaces the default system when specified in the data sheet.

[c] Coating depends on material grade and project requirements. If coating is specified, the alternative coating system is the default.

[d] Coating depends on project requirements. If coating is required, the alternative coating system is the default.

[e] Coating depends on aluminium material grade and project requirements. If coating is required, the alternative coating system is the default.

Justification

This table defines the standard generic coating systems proposed for specific equipment items and applications on offshore and coastal facilities, starting from the coating systems already specified in NORSOK M-501 and considering the coating systems proposed in operating companies' specifications. This ensures a wider adoption while allowing for an alternative system supplied as standard by package manufacturers who can achieve the required minimal performance.

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

Replace Table 5 with

Substrate Material	Application or Item	Operating Environment (internal)	Coating System (CSDS no.)	
			Default	Alternative [a]
Carbon steel	Storage tanks	Potable water	3A	-
		Ballast water, seawater, firewater, slops, oily water, open drain, closed drain, service water	3B	Lining qualified to ISO 16961
		Demineralized water, hydrocarbons, un-stabilized crude, produced water, fuel, aviation fuels, sewage	3D	Lining qualified to ISO 18796-1
		Diesel, condensate, stabilized crude	3C	Lining qualified to ISO 16961
		Methanol, ethanol, MEG, TEG	3G	Lining qualified to ISO 18796-1
	Process vessels	Hydrocarbon liquids mixed with vapour, produced water, seawater Operating pressure ≤ 0,3 MPa (44 psi) Operating temperature -20 °C (-4 °F) to 75 °C (167 °F)	3D	3E, 3F, Lining qualified to ISO 18796-1
		Hydrocarbon liquids mixed with vapour, produced water, seawater Operating pressure ≤ 7 MPa (1015 psi) Operating temperature -20 °C (-4 °F) to 80 °C (176 °F)	3E	3F, Lining qualified to ISO 18796-1
		Hydrocarbon liquids mixed with vapour, produced water, seawater Operating pressure ≤ 3 MPa (435 psi) Operating temperature -20 °C (-4 °F) to 130 °C (266 °F)	3F	Lining qualified to ISO 18796-1

NOTE 1 The table is to be read in conjunction with the CSDS in Annex A which includes additional restrictions on operating conditions for each coating systems.

NOTE 2 External coating to be in accordance with the requirement in Table 3 and Table 4.

[a] Alternative coating systems replace the default system when specified in the data sheet.

Justification

This table defines the standard generic coating systems proposed for specific equipment items and applications on offshore and coastal facilities, starting from the coating systems already specified in NORSOK M-501 and considering the coating systems proposed in operating companies' specifications. This ensures a wider adoption while allowing for an alternative system supplied as standard by package manufacturers who can achieve the required minimal performance.

Annex A
(normative)

Coating systems data sheet

Table A.1 — Coating systems data sheet overview

Add new rows "CSDS no. 1G" and "CSDS no. 1H" after row "CSDS no. 1F"

CSDS	Substrate	Service/exposure conditions	Comments
CSDS no. 1G	Carbon steel	Offshore and coastal environment, non-insulated, -50 °C to +120 °C	
CSDS no. 1H	Carbon steel	Offshore and coastal environment, non-insulated, -50 °C to +120 °C	When agreed with end user

In row "CSDS no. 9", column "Substrate", add to "Stainless steel"

and carbon steel

Justification

These updates align the table with the changes made to CSDS no. 1G (added) and CSDS no. 9 (including low temperature steel).

CSDS no. 1A

In row "Operating temperature range", after "+80 °C", add "Note 6" reference

In section "Generic description of coating system", delete row "Coat number 2:"

In section "Generic description of coating system", row "Coat number 4: (Topcoat)", replace "UV resistant topcoat" with

Polyurethane or polysiloxane Note 7

In row "Pre-qualification tests", replace "11.1" with

11.1A

Delete NOTE 5 from NOTES section

Add new NOTE 6 to NOTES section

NOTE 6 For continuous operating temperature below -35 °C, additional testing at low temperature is required.

Add new NOTE 7 to NOTES section

NOTE 7 HSSE restrictions may apply in some countries on the use of polyurethane due to the presence of free isocyanate.

Justification

This CSDS has been updated to align with the changes in technical requirements. The sealer coat and associated NOTE 5 have been removed as a sealer coat is not required. NOTE 6 has been added to cover for

additional testing required for temperatures below -35 °C. The generic term “UV-resistant topcoat” has been replaced with two specific options. NOTE 7 has been added for clarity.

CSDS no. 1B

In row "Operating temperature range", after "+80 °C", add "Note 5" reference

In row "Generic description of coating system", row "Coat number 1: (Primer)", column "Generic type", after "Note 3" reference, delete "and [Note] 4" reference

In section "Generic description of coating system", row "Coat number 3: (Topcoat)", column "Generic type", replace "UV resistant topcoat" with

Polyurethane or polysiloxane Note 6

In row “Pre-qualification tests”, replace “11.1” with

11.1A

Delete NOTE 4 from NOTES section

Add new NOTE 5 to NOTES section

NOTE 5 For continuous operating temperature below -35 °C, additional testing at low temperature is required.

Add new NOTE 6 to NOTES section

NOTE 6 HSSE restrictions may apply in some countries on the use of polyurethane due to the presence of free isocyanate.

Justification

This CSDS has been modified to align with the changes in technical requirements. NOTE 4 on tie-coat has been removed as it is not required. NOTE 5 has been added to cover for additional testing required for temperatures below -35 °C. The generic term “UV-resistant topcoat” has been replaced with two specific options. NOTE 6 has been added for clarity. Pre-qualification test activity has been updated from 11.1 to 11.1A.

CSDS no. 1D

In section "Generic description of coating system", replace column header "DTF" with

MDTF

Justification

This CSDS has been updated to align with the changes in technical requirements. DTF has been updated to MDTF (minimum DFT) for consistency.

CSDS no. 1F

In row "Surface roughness", add after "and / or"

NS-EN ISO 8503-5

In section "Generic description of coating system", replace column header "DTF" with

MDTF

In section "Generic description of coating system", column "Generic type", rows "Coat number 1: (Primer) " and "Coat number 2: (Topcoat) ", replace "Epoxy or polyester" with

Glass flake epoxy

In row "Pre-qualification tests", replace "11.7" with

11.17

In NOTE 1, replace "may" with

shall

In NOTES section, delete "to increase chemical resistance and to avoid chalking" from NOTE 1

Justification

This CSDS has been updated to align with the changes in technical requirements. Missing reference to NS-EN ISO 8503-5 has been added. DTF has been updated to MDTF (minimum DFT) for consistency. Glass flake epoxy has been added as it ensures greater mechanical resistance against abrasion in soil and it is also preferred on the UG/AG transitions. The pre-qualification test activity has been updated from 11.7 (CUI testing) to 11.17 (impact testing). NOTE 1 has been modified as this is not sufficient to define coating on UG/AG areas.

Add new CSDS no. 1G

CSDS no. 1G

Coating System Data Sheet		CSDS no. 1G [Note 1]	Rev. 02
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 +120 °C [Note 6]			
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 2 ½ , ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 35 µm to 50 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
3:	Epoxy [Note 5]	DFTs shall be as per the qualified system	
4: (Topcoat)	Polysiloxane topcoat [Note 5]		
Total MDFT		300 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1, activity: 11.1A [Note 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, 12.11, 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 50 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 Qualification testing at +120 °C.

NOTE 6 For continuous operating temperature below -35 °C, additional testing at low temperature is required.

Justification

This new CSDS has been added for system 1 based on inorganic zinc silicate primer for temperature up to 120 °C and to differentiate from system 1A which is limited to 80 °C. The maximum surface roughness has been reduced to 50 µm to be below the primer thickness to prevent corrosion spots due to protrusion of the steel profile above the primer coating.

Add new CSDS no. 1H

CSDS no. 1H

Coating System Data Sheet		CSDS no. 1H 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 +120 °C Note 6			
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 2 ½ , ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3			
Surface roughness: 35 µm to 50 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 rich epoxy Note 4	60 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
3:	Epoxy Note 5	DFTs shall be as per the qualified system	
4: (Topcoat)	Polysiloxane topcoat Note 5		
Total MDFT		300 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: Table 1, activity: 11.1A Note 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 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. ISO 12944-1) can be achieved.

NOTE 2 For castings steel preparations, grade P2 is permitted.

NOTE 3 If the actual surface roughness exceeds 50 µm, a corresponding DFT increase is required as per the correction value of NS-ISO 19840

NOTE 4 Zinc rich 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 Qualification testing at +120 °C.

NOTE 6 For continuous operating temperature below -35 °C, additional testing at low temperature is required.

Justification

This new CSDS has been added for system 1 based on Zn-rich epoxy primer as an alternative to inorganic zinc primer for temperatures up to 120 °C and to differentiate from system 1A which is limited to 80 °C. The maximum surface roughness has been reduced to 50 µm to be below the primer thickness to prevent corrosion spots due to protrusion of the steel profile above the primer coating.

CSDS no. 2A

In row "Surface cleanliness", add after "NS-EN ISO 8501-1"

or SSPC-SP 10

In section "Generic description of coating system", row "Coat number 1: (TSA coat)", column "MDTF", replace "200 µm" with

250 µm

In section "Generic description of coating system", row "Total MDFT", column "MDTF", replace "200 µm" with

250 µm Note 8

In NOTE 6, replace "if the minimum DFT is in accordance with NS-EN ISO 2063-1, Table C.1 and CP is provided" with

and insulated service

Add new NOTE 8 to NOTES section

NOTE 8 No individual reading below 250 µm is acceptable.

Justification

This CSDS has been modified to align with the changes in technical requirements. A reference to the corresponding SSPC-SP 10 has been added. The MDFT has been increased to 250 µm to account for negative operators' experience with lower TSA thicknesses. NOTE 6 has been modified to add insulated service that also does not require application of the sealer coat. NOTE 8 has been added to prevent the risk of corrosion due to insufficient thickness.

CSDS no. 2B

In row "Operating temperature range", after "+80 °C", add "Note 7" reference

In section "Generic description of coating system", row "Coat number 4: (Topcoat)", column "Generic type", replace "UV resistant topcoat" with

Polyurethane or polysiloxane Note 8

Add new NOTE 7 to NOTES section

NOTE 7 For continuous operating temperature below -35 °C, additional testing at low temperature is required for topcoat and sealer coat.

Add new NOTE 8 to NOTES section

NOTE 8 HSSE restrictions may apply in some countries on the use of polyurethane due to the presence of free isocyanate.

Justification

This CSDS has been modified to align with the changes in technical requirements. The generic term "UV-resistant topcoat" has been replaced with two specific options. NOTE 7 has been added to cover for additional testing required for temperatures below -35 °C. NOTE 8 has been added for clarity.

CSDS no. 2C

In section "Generic description of coating system", row "Coat number 1: (TSA coat)", column "MDTF", replace "200 µm" with

250 µm

In section "Generic description of coating system", row "Total MDFT", column "MDTF", replace "200 µm" with

250 µm Note 9

Delete "metallic and chloride free" from NOTE 3

In NOTE 7, replace "if the minimum MDFT is in accordance with NS-EN ISO 2063-1, Table C.1 and CP is provided" with

and insulated service

Add new NOTE 9 to NOTES section

NOTE 9 No individual reading below 250 µm is acceptable. Measurements may be carried out on a carbon steel test plate.

Justification

This CSDS has been modified to align with the changes in technical requirements. MDFT increased to 250 µm to account for operators' negative experience with lower TSA thicknesses. NOTE 7 has been modified to add insulated service that also does not require application of the sealer coat. NOTE 9 has been added to prevent the risk of corrosion due to insufficient thickness. NOTE 3 has been modified to allow the use of non-ferrous metallic as chloride free abrasive is not achievable (refer to Table 2 Activity 12.6 for the chloride content limit of abrasive).

CSDS no. 3B

In row "Pre-qualification tests", after "11.10 ", add "Note 3" reference

Add new NOTE 3 to NOTES section

NOTE 3 Alternative coating pre-qualified according to Table 1 activity 11.20 (ISO 16961) may be used.

Justification

This CSDS has been modified to align with the changes in technical requirements. NOTE 3 has been added to cover tank linings that are not under IMO regulation (i.e. all tanks in coastal facilities) and that are commonly qualified to ISO 16961.

CSDS no. 3C

In section "Generic description of coating system", row "Total MDFT", column "MDTF", add after "300 µm"

or as qualified by the coating manufacturer

In row "Pre-qualification tests", after "11.11", add "Note 4" reference

Add new NOTE 4 to NOTES section

NOTE 4 Alternative coating pre-qualified according to Table 1 activity 11.20 (ISO 16961) may be used.

Justification

This CSDS has been modified to align with the changes in technical requirements and to allow the MDTF to be qualified by the coating manufacturer. NOTE 4 has been added to cover tank linings that are not under IMO regulation (i.e. all tanks in coastal facilities) and that are commonly qualified to ISO 16961/18796-1.

CSDS no. 3D

In row "Surface cleanliness", replace "2½" with

3

In section "Generic description of coating system", header row, after "Generic type", delete "Note 3" reference

In row "Pre-qualification tests", after "Note 5" reference, delete "and [Note] 6" reference

Delete NOTE 3 from NOTES section

In NOTES section, replace NOTE 5 with

NOTE 5 Alternative coating pre-qualified according to Table 1 activity 11.19 (ISO 18796-1) may be used.

Delete NOTE 6 from NOTES section

Justification

This CSDS has been modified to align with the changes in technical requirements. Sa has been increased to 3 for better surface preparation. NOTE 3 has been deleted as coating should be cured in accordance with the manufacturer's data sheet. NOTE 5 has been replaced. NOTE 6 has been deleted to allow for the option to use lining qualified to ISO18796-1 and to be consistent with Table 1 activities 11.14 and 11.19.

CSDS no. 3E

In row "Surface cleanliness", replace "2½" with

3

In section "Generic description of coating system", header row, after "Generic type", delete "Note 2" reference

In row "Pre-qualification tests", after "Note 4" reference, delete "and [Note] 5" reference

Delete NOTE 2 from NOTES section

In NOTES section, replace NOTE 4 with

NOTE 4 Alternative coating pre-qualified according to Table 1 activity 11.19 (ISO 18796-1) may be used.

Delete NOTE 5 from NOTES section

Justification

This CSDS has been modified to align with the changes in technical requirements. Sa has been increased to 3 for better surface preparation. NOTE 2 has been deleted as coating should be cured in accordance with the manufacturer's data sheet. NOTE 4 has been replaced to allow for the option to use linings qualified to ISO18796-1.

CSDS no. 3F

In row "Surface cleanliness", replace "2½" with

3

In section "Generic description of coating system", header row, after "Generic type", delete "Note 2" reference

In section "Generic description of coating system", rows "Coat number 1: (Primer)" and "Coat number 2: (Topcoat)", after "ester", add "Note 6" reference

In row "Pre-qualification tests", after "Note 4" reference, delete "and [Note] 5" reference

Delete NOTE 2 from NOTES section

In NOTES section, replace NOTE 4 with

NOTE 4 Alternative coating pre-qualified according to Table 1 activity 11.19 (ISO 18796-1) may be used with cathodic disbondment test done at 95 °C for temperature exceeding 95 °C.

Delete NOTE 5 from NOTES section

Add new NOTE 6 to NOTES section

NOTE 6 Vinyl ester coating shall not be used at temperature exceeding 90 °C.

Justification

This CSDS has been modified to align with the changes in technical requirements. Sa has been increased to 3 for better surface preparation. NOTE 2 has been deleted as coating should be cured in accordance with the manufacturer's data sheet. NOTE 4 has been replaced to allow for the option to use linings qualified to ISO 18796-1. NOTE 6 has been added to restrict the use of vinyl ester above 90 °C.

CSDS no. 3G

In row "Surface cleanliness", replace "2½" with

3

In row "Surface roughness", replace "50 µm to 85 µm" with

40 µm to 50 µm

In row "Pre-qualification tests", after "Note 3" reference, add ", Note 4" reference

Add new NOTE 4 to NOTES section

NOTE 4 Alternative coating pre-qualified according to Table 1 activity 11.19 (ISO 18796-1) may be used.

Justification

This CSDS has been modified to align with the changes in technical requirements. Sa has been increased to 3 and roughness has been reduced for better surface preparation. NOTE 4 has been added to allow for the option to use linings qualified to ISO 18796-1 and to be consistent with amended Table 1 Activity 11.19.

CSDS no. 4A

In section "Generic description of coating system", row "Coat number, As the pre-qualification", replace "Non-skid epoxy" with

Solvent-free high-build epoxy non-skid

In row "Pre-qualification tests", replace "11.1" with

11.1A

In NOTES section, delete second and third sentences from NOTE 1

In NOTES section, add to NOTE 3

on helideck

Justification

This CSDS has been modified to align with the changes in technical requirements and to define the minimum coat required for the application removing the option for "other generic materials" in NOTE 1. Pre-qualification test activity details have been corrected from 11.1 to 11.1A. NOTE 3 has been expanded for clarity.

CSDS no. 4B

In section "Generic description of coating system", row "Coat number, As the pre-qualification", replace "Non-skid epoxy" with

Solvent-free high-build epoxy non-skid

In row "Pre-qualification tests", replace "11.1" with

11.1A

In NOTES section, delete second and third sentences from NOTE 1

Justification

This CSDS has been modified to align with the changes in technical requirements and to define the minimum coat required for the application removing the option for "other generic materials" in NOTE 1. Pre-qualification test activity details have been updated from 11.1 to 11.1A.

CSDS no. 5A

In section "Generic description of coating system", row "Coat number 5: (Topcoat)", replace "UV resistant topcoat" with

Polyurethane or polysiloxane

In row "Pre-qualification tests", replace "11.1" with

11.1B

Justification

This CSDS has been modified to align with the changes in technical requirements. The generic term "UV-resistant topcoat" has been replaced with two specific options. Pre-qualification test activity details have been updated from 11.1 to 11.1B.

CSDS no. 5C

In section "Generic description of coating system", row "Coat number 4: (Topcoat)", replace "UV resistant topcoat" with

Polyurethane or polysiloxane

In row "Pre-qualification tests", add before "As stated in 10.2 for 5A and 5S."

Table 1, activities: 11.1B and 11.3.

Justification

This CSDS has been modified to align with the changes in technical requirements. The generic term "UV-resistant topcoat" has been replaced with two specific options. Pre-qualification test activity details have been updated to be consistent with the CSDS applicable to CX environment only.

CSDS no. 5S

In section "Generic description of coating system", row "Coat number 4: (Topcoat)", replace "UV resistant topcoat" with

Polyurethane or polysiloxane

In row "Pre-qualification tests", replace "11.1" with

11.1B

In row "Pre-qualification tests", replace "11.2" with

11.3

Justification

This CSDS has been modified to align with the changes in technical requirements. The generic term "UV-resistant topcoat" has been replaced with two specific options. Pre-qualification test activity details have been updated.

CSDS no. 6A

In section "Generic description of coating system", header row, replace "NDTF" with

MDTF

In section "Generic description of coating system", row "Coat number 3: (Topcoat)", replace "UV resistant topcoat" with

Polyurethane or polysiloxane

In NOTES section, NOTE 2, replace "non-metallic and chloride free" with

non-ferrous

Justification

This CSDS has been modified to align with the changes in technical requirements. "DTF" has been updated to "MDTF" (minimum DFT) for consistency. The generic term "UV-resistant topcoat" has been replaced with two specific options. NOTE 2 has been modified to allow the use of non-ferrous metallic as chloride free abrasive is not achievable (refer to Table 2 Activity 12.6 for the chloride content limit of abrasive).

CSDS no. 6B

In row "Surface roughness", before "19 µm", delete "min."

In row "Surface roughness", after "19 µm", add "Note 4" reference

In section "Generic description of coating system", header row, replace "NDTF" with

MDTF

In section "Generic description of coating system", row "Coat number 3: (Topcoat)", replace "UV resistant topcoat" with

Polyurethane or polysiloxane

Add new NOTE 4 to NOTES section

NOTE 4 The thickness of the galvanized coating remaining after blasting shall comply with 5.11.

Justification

This CSDS has been modified to align with the changes in technical requirements. "DTF" has been updated to "MDTF" (minimum DFT) for consistency. The generic term "UV-resistant topcoat" has been replaced with two specific options. The surface roughness has been supplemented with NOTE 4 to ensure that after sweep blasting, the HDG is not reduced below the thickness specified in 5.11.

CSDS no. 6C

In section "Generic description of coating system", header row, replace "NDTF" with

MDTF

In NOTES section, NOTE, 3 replace "non-metallic and chloride free" with

non-ferrous

Justification

This CSDS has been modified to align with the changes in technical requirements. "DTF" has been updated to "MDTF" (minimum DFT) for consistency. NOTE 3 has been modified to allow the use of non-ferrous metallic as chloride free abrasive is not achievable (refer to Table 2 activity 12.6 for the chloride content limit of abrasive).

CSDS no. 6D

In section "Generic description of coating system", header row, replace "NDTF" with

MDTF

In section "Generic description of coating system", row "Coat number 3: (Topcoat)", replace "UV resistant topcoat" with

Polyurethane or polysiloxane

Justification

This CSDS has been modified to align with the changes in technical requirements. The generic term "UV-resistant topcoat" has been replaced with two specific options. NOTE 7 has been added for clarity.

CSDS no. 7D

In section "Generic description of coating system", header row, replace "DTF" with

MDTF

In row "Pre-qualification test", replace "NA, ref. Table 1 note 7" with

Table 1, activities 11. 1, 11.4, 11. 5 and 11.17 Note 7

Add new NOTE 7 to NOTES section

NOTE 7 Qualification of system CSDS no. 7 on carbon steel substrate also qualifies stainless steel substrate.

Justification

This CSDS has been modified to align with the changes in technical requirements. Pre-qualification requirements have been updated. NOTE 7 has been added to address the applicability of the qualification done on stainless steel if this has not been previously done on carbon steel.

CSDS no. 7E

In row "Pre-qualification test", replace "NA, ref. Table 1 note 7" with

Table 1, activity 11.4 Note 6

Add new NOTE 6 to NOTES section

NOTE 6 Qualification of system CSDS no. 7 on carbon steel substrate also qualifies stainless steel substrate.

Justification

This CSDS has been modified to align with the changes in technical requirements. Pre-qualification requirements have been updated. NOTE 7 has been added to address the applicability of the qualification done on stainless steel if this has not been previously done on carbon steel.

CSDS no. 7F

In row "Pre-qualification test", replace "NA, ref. Table 1 note 7" with

Table 1, activities 11.4 and 11.5 Note 6

Add new NOTE 6 to NOTES section

NOTE 6 Qualification of system CSDS no. 7 on carbon steel substrate also qualifies stainless steel substrate.

Justification

This CSDS has been modified to align with the changes in technical requirements. Pre-qualification requirements have been updated. NOTE 7 has been added to address the applicability of the qualification done on stainless steel if this has not been previously done on carbon steel.

CSDS no. 9

In row "Substrate material", add after "metals"

, Low temperature steel

In row "Surface cleanliness", add before "Sweep"

Stainless steel and non-ferrous:

In row "Surface cleanliness", add new paragraph

Low temperature steel: Sa 2 ½, ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3 or SSPC-SP 10

In row "Surface roughness", add before "25 µm"

Stainless steel and non-ferrous:

In row "Surface roughness", add new paragraph

Low temperature steel: 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

Justification

This CSDS has been modified to align with the changes in technical requirements and to include requirements for low alloy and low temperature steels (e.g. Ni- steels). These low temperature steels are extensively used in cryogenic service such as LNG.

Annex C
(informative)

High temperature cathodic disbonding testing

C.1 Test procedures

Add new NOTE after first sentence of first paragraph

NOTE Alternative testing to ASTM G42 may be used.

Justification

The CP disbonding test at high temperature can also be conducted in accordance with ASTM G42 which is similar to ISO 15711.

Annex H
(normative)

Fire Testing for Passive Fire Protection (PFP) Methodology

H.1 Background

In first sentence of second paragraph, add after "shall be undertaken"

in accordance with NS-EN 1363-2, BS 476-20:1987 appendix D or UL 1709

Justification

This addition specifies the fire testing standard.

Annex J
(normative)

Adhesion/cohesion test

J.1 General requirements

In list subclause 1) of ninth list subclause of second paragraph, replace "Minimum acceptable value is 15 MPa (Note 8, Table 2)" with

refer to Note 8, Table 2

Justification

The original requirement conflicts with Table 2, Notes 4, 5, 6, 7 and 8, i.e. even if the fracture strength during CPT exceeds the values required for the specific coating system in Notes 4, 5, 6 and 7 (e.g. 9 MPa for TSA) and Note 8 (fracture exhibiting 80 % glue failure), if there is any glue failure, the test is not be acceptable unless the fracture strength is > 15 MPa. This may not be achievable for all listed coating systems.

Replace second list subclause of fourth paragraph

If a single adhesion measurement is below the minimum value, the test may be repeated only once.

Justification

No values are allowed to be below the minimum specified value as this would compromise the integrity of the coating system. However, repeating the test once is permitted to account for possible errors in the execution of the test.

Add new Annex M

Annex M
(normative)

Coatings for corrosivity categories C2, C3, C4 and C5

M.1 Scope

This annex defines the requirements for high durability coatings exposed to environments with corrosivity categories C2 to C5 as defined in ISO 12944-2.

Justification

This defines the scope of this new annex.

The scope and exclusions defined in Clause 1 apply also to this annex.

Justification

This defines the scope and exclusions of this new annex.

M.2 General requirements

M.2.1 Coating for corrosivity categories C4 and C5

Coating systems qualified for corrosivity categories CX in accordance with this specification shall be used in environments with corrosivity categories C4 (high corrosivity) and C5 (very high corrosivity).

Justification

For environments with high corrosivity and very high corrosivity, this requirement achieves a higher performance life and may make asset protection more economical while reducing the number of coating options (standardisation) for environments with corrosivity categories C4, C5 and CX.

NOTE Coating systems qualified for corrosivity category CX in accordance with this specification may be used in environments with corrosivity categories C2 to CX, within the limitations stated in the CSDS.

Justification

This note clarifies that the specification allows the user to select a single coating system qualified for corrosivity category CX and to use it for all corrosivity categories, although this may not be the most economical coating for corrosivity <C4.

M.2.2 Coatings for corrosivity categories C2 and C3

M.2.2.1

For corrosivity categories C2 and C3, the general requirements defined in 5.2 through to 5.17 shall apply with the concessions defined in M.2.2.2 to M.2.2.4.

Justification

This requirement defines the specific requirements for coating in environments with corrosivity categories C2 and C3 when this deviates from the main part of the specification.

M.2.2.2

The coating systems defined in M.14 shall be used as the default systems in environments with corrosivity categories C2 and C3.

Justification

This requirement indicates the specific coating system to be used as the default system in in environments with corrosivity categories C2 and C3. These systems are listed in M.11.

M.2.2.3

Shop primer or weld-through primer are permitted to remain and form part of the final coating system in environments with corrosivity categories C2 and C3, provided that the conditions in M.2.2.4 through M.2.2.7 are fulfilled.

Justification

This requirement allows the use of shop primer and weld through primer in environments with corrosivity categories C2 and C3 provided that certain conditions are met. This may provide cost saving during execution of work on large equipment such as storage tanks.

M.2.2.4

The shop primer or weld through primer shall be qualified as part of the full coating system.

Justification

This requirement ensures that the whole system including the shop primer is qualified to meet the required performance.

M.2.2.5

Weld-through primers shall have no detrimental effects on the welds.

Justification

This requirement ensures that when weld through primer is used, this has not impact on the weld quality and does not increase the risk of weld defects.

M.2.2.6

The application of successive coating on the remaining shop primer or weld through primer shall be in accordance with Clause 8.

Justification

This requirement ensures that the appropriate quality and performance is achieved in the final coating.

M.2.2.7

The shop or weld through primer shall be removed and re-blasted prior to application of the full coating system if the following occurs:

— the shop or weld through primer does not comply with the requirements in M.2.2.3 to M.2.2.6;

— the primer is visibly degraded; or

— rust appears.

Justification

This requirement ensures that the finished coat meet the required performance.

M.2.2.8

Pre-qualification of the coating systems defined in M.15 shall be in accordance with M.8.

Justification

This requirement defines the pre-qualification requirement for coating qualified for environments with corrosivity categories C2 and C3 as these corrosivity categories do not require the full set of testing required to qualify systems for environments with corrosivity categories CX, C5 and C4.

M.2.3 Stainless steel coatings and hot-dip galvanising (HDG) for corrosivity categories C2 and C3

M.2.3.1

Additional coating shall not be required for corrosion protection of HDG steel in environments with corrosivity categories C2 and C3.

Justification

Coating on HDG items is not necessary for less aggressive environments with corrosivity categories C2 and C3. This relaxes the requirement in Table 3 and Table 4 where for environments with corrosivity categories CX, C5 and C4, coating is required on HDG items in some specific applications.

M.2.3.2

Coating shall not be required for corrosion protection of uninsulated stainless steel exposed to environments with corrosivity categories C2 and C3.

Justification

Unlike in environments with corrosivity categories CX, C5 and C4, the risk of external chloride SCC and external corrosion of stainless steel is minimal in environments with corrosivity categories C2 and C3.

M.2.4 Coatings under insulation for environments with corrosivity categories C2 and C3

Coating system 2A shall not be mandatory under insulation for environments with corrosivity categories C2 and C3.

Justification

Unlike proposed in Table 4, TSA is not required under insulation due to the reduced risk of CUI in environments with corrosivity categories C2 and C3 and other more economical coating systems are preferred.

M.3 Health, safety and environment (HSE)

HSE requirements for materials and coating application work shall comply with Clause 6 for all environmental corrosivity categories.

Justification

The HSE requirements defined in Clause 6 do not depend on the environmental category and apply equally to coating in environments with corrosivity categories C2 to C5.

M.4 Surface preparation

Surface preparation shall comply with Clause 7 for all environmental corrosivity categories.

Justification

The surface preparation requirement defined in Clause 6 equally apply to coating in environments with corrosivity categories C2 to C5 to ensure that the required high durability is achieved.

M.5 Coating application

Coating applications shall be in accordance with Clause 8 for all environmental corrosivity categories.

Justification

The application requirements defined in Clause 8 equally apply equally to coating in environments with corrosivity categories C2 to C5 to ensure that the required high durability is achieved.

M.6 Thermally sprayed metallic coatings

If thermal spray coating is required for environments with corrosivity categories C2 and C3, materials and application of TSA and TSZ shall be in accordance with Clause 9.

Justification

Application of TSA in environments with corrosivity categories C2 and C3 is not mandatory. However, if applied to ensure a quality coating and meet the high durability, TSA materials and application have to be in accordance with Clause 9.

M.7 Passive fire protection (PFP) coatings

PFP coating systems qualified in accordance with Clause 10 may be used in environments with corrosivity categories C2 and C3.

Justification

PFP coating in accordance with Clause 10 is also suitable for use in environments with corrosivity categories C2 and C3.

M.8 Pre-qualification of coating systems

M.8.1

Pre-qualification testing of coating systems for corrosivity categories C4 and C5 shall be in accordance with Table 1.

Justification

This requirement ensures a high durability coating in environments with high (C4) and very high (C5) corrosivity.

M.8.2

Pre-qualification testing for corrosivity categories C2 and C3 shall be in accordance with ISO 12944-6 corrosivity category C3 or higher and with durability very high, with the supplementary requirements in M.8.3 through M.8.7.

Justification

This requirement defines the pre-qualification testing for environments with corrosivity category C2 and C3, amending the requirement in ISO 12944-6 to ensure the high durability performance is achieved consistently, while reducing the number of test options. To bridge some gaps in ISO 12944-6, additional requirements are added.

M.8.3

Three pull-off dollies shall be tested on each test panel.

Justification

This requirement defines the minimum number of dollies to be tested on each panel as this is not defined in ISO 12944-6 which requires 3 panels minimum, i.e. minimum 9 dollies in total are tested.

M.8.4

Scored samples shall be used for pull-off testing.

Justification

This requirement ensures that a consistent testing methodology is used.

M.8.5

Individual pull-off strength values measured in accordance with ISO 4624 or ASTM D4541 shall be 5 MPa or higher on all test panels.

Justification

This requirement achieves the required coating performance for high durability.

M.8.6

The average pull-off strength measured in accordance with ISO 4624 or ASTM D4541 after ageing shall be greater than or equal to 50 % of the average pull-off value measured before ageing.

Justification

This requirement ensures a consistent performance of the applied coating.

M.8.7

If cross-cut testing is applied in accordance with ISO 16276-2, ASTM D3359 Method B or ISO 2409 to multipolymeric matrix or silicone coatings, the acceptance criteria shall be ISO 16276-2 classification 0-2 or ASTM D3359 classification 3B.

Justification

This requirement supports alternative testing by cross-cut testing of thin (< 200 microns) silicone and multipolymeric coating systems.

M.9 Qualification of companies and personnel

M.9.1

Applicator contractors, coating operators, supervisors and quality control personnel shall be qualified in accordance with 11.2.

Justification

This requirement ensures appropriate QC of the coating work, qualification of personnel defined in 11.2 are independent of the corrosivity category and are also adopted for environments with corrosivity categories C2 to C5, with the exception noted below for inspector environments with corrosivity categories C2 and C3 where conditions are less corrosive.

M.9.2

For environments with corrosivity categories C2 and C3, inspectors certified Level I in accordance with FROSIO, NACE, SSPC or ICorr shall carry out the inspection work under the supervision of an inspector level II.

Justification

This requirement ensures a minimum level of quality assurance while recognising that inspectors with level III are not normally employed by vendors and contractors executing coating work in environments with lower corrosivity categories, i.e. C2 and C3.

M.10 Qualification of procedures

Qualification of procedures shall be in accordance with 11.3, with pull-off testing amended in accordance with M.11 for coating in environments with corrosivity categories C2 and C3.

Justification

This requirement ensures that the material quality and quality of application for high and very high corrosivity environments pre-qualification is in accordance with 11.3. For environments with lower corrosivity, i.e.C2 and C3, the requirements are reduced to account for the lower probability of coating failure.

M.11 Inspection and testing

M.11.1

Inspection and testing shall be carried out in accordance with Table 2 with the concession in M.11 for coating in environments with corrosivity categories C2 and C3.

Justification

Inspection and test requirements for applied coating requirements in Table 2 are reduced for environments with corrosivity categories C2 and C3 due to the lower risk of coating failure compared to environments with corrosivity categories C4, C5 and CX for which the criteria in Table 2 apply.

M.11.2

For coating in environments with corrosivity categories C2 and C3, three pull-off dollies shall be tested on each test panel, except for PFP, TSA and TSZ coatings.

Justification

This requirement defines the minimum pull-off testing required for environments with lower corrosivity, i.e. C2 and C3. It does not apply to PFP, TSA and TSZ coating.

M.11.3

Scored samples shall be used for pull-off testing.

Justification

This requirement ensures that a consistent testing methodology is used.

M.11.4

Individual pull-off strength values measured in accordance with ISO 4624 or ASTM D4541 shall be 5 MPa or higher for coating in environments with corrosivity categories C2 and C3.

Justification

This requirement achieves the required coating performance for high durability.

M.11.5

During production, the minimum pull-off strength for coating in environments with corrosivity categories C2 and C3 shall be 5MPa or ≥ 50 % of the average pull-off value obtained during CPT.

Justification

This defines the requirement for acceptance of production pull-off strength for environments with corrosivity categories C2 and C3.

M.11.6

If cross-cut testing is applied in accordance with ISO 16276-2,ASTM D3359 Method B or ISO 2409 to multipolymeric matrix or silicone coatings for environments with corrosivity categories C2 and C3, the acceptance criteria shall be ISO 16276-2 classification 0-2 or ASTM D3359 classification 3B.

Justification

This requirement ensures the quality of the finished painted item and achieves high durability.

M.12 Coating repair

Repair of damaged coating shall be performed in accordance with Clause 13.

Justification

This requirement ensures proper repair of coating damage regardless of the corrosivity category.

M.13 Quality management and performance assurance

Coating manufacturers and applicator contractors shall have a quality management system in accordance with Clause 14.

Justification

The quality requirements defined in Clause 14 apply to C2, C3, C4 and C5 remain unchanged to ensure consistent coating quality.

M.14 Coating systems for corrosivity categories C2, C3, C4 and C5

M.14.1

The coating systems defined in Annex A for corrosivity category CX shall be accepted in environments with corrosivity category C5 and lower.

Justification

This requirement clarifies that coating qualified for environments with corrosivity category CX may be used in environments with lower corrosivity as the expected performance life will be higher and some systems may have lower life cycle cost of protection for very high durability.

M.14.2

The default coating systems for generic applications in environments with corrosivity categories C2, C3, C4 and C5 shall be in accordance with Table M.1 and Table M.2.

Justification

This requirement defines the coating system applicable for onshore use in environments with corrosivity categories C2 to C5.

Add new Table M.1

Table M.1 — Coating selection table for structural items in environments with corrosivity categories C2 to C5

Substrate material	Item to be coated	Environmental corrosivity to ISO 12944-2 [a]		
		C2	C3	C4, C5
Carbon steel	Structures and structural components including frames, base plates, enclosures, permanent lifting beams and lugs	CSDS no. 11A	CSDS no. 1B	CSDS no. 1A
	Exhaust stack, flare stack	CSDS no. 1B (T ≤ +80 °C), CSDS no. 12 (T > +80 °C)	CSDS no. 1B (T ≤ +80 °C), CSDS no. 12 (T > +80 °C)	CSDS no. 1A (T ≤ +80 °C), CSDS no. 2A
	Escape routes, walkways	CSDS no. 4B	CSDS no. 4B	CSDS no. 4A [b]
Stainless steel	Structures and structural components and outfitting	N/R	N/R	[c]
HDG carbon steel	Handrails and ladders	N/R [d]	N/R [d]	[d]
	Foundations, frames and structures	N/R	N/R	CSDS no. 6B
Aluminium	Structures and structural components	N/R [e]	N/R [e]	[f]
Carbon steel under PFP	Any item requiring passive fire protection	[g]	[g]	CSDS no. 5A
Stainless steel under PFP	Any item requiring passive fire protection	[g]	[g]	CSDS no. 5C

KEY

N/R not required

NOTE Refer to the CSDSs in M.15 and Annex A for additional restrictions on the coating systems.

[a] The CSDSs listed under each environmental corrosivity represent the minimum requirement to meet the high durability range as defined in ISO 12944-1. Where multiple systems are listed for an item under specific exposure conditions, the first listed system is the default one.

[b] System CSDS no. 4B can be used for light duty areas.

[c] Coating requirements depends on the stainless steel material grade. When coating is required, system CSDS no. 6A is the default.

[d] When coating is required, system CSDS no. 6B is the default.

[e] Coating requirements depends on aluminium grade. When coating is required, system CSDS no. 6F is the default.

[f] Coating requirements depends on aluminium grade. When coating is required, system CSDS no. 6D is the default.

[g] Coating under PFP to follow the PFP manufacturer's recommendations.

Justification

This table defines the defaults coating systems to be used in environments with corrosivity categories C2, C3, C4 and C5.

Add new Table M.2

Table M.2 — Coating selection table for pressure vessels, equipment, piping and valves in environments with corrosivity categories C2 to C5

Substrate material	Item to be coated	Exposure conditions	Environmental corrosivity to ISO 12944-2 [a]		
			C2	C3	C4, C5
Carbon steel	Pressure vessels, equipment, piping and valves, pumps	Non-insulated, T ≤ +80 °C	CSDS no. 11A	CSDS no. 1A, CSDS no. 1B	CSDS no. 1A
		Non-insulated, T ≤ +120 °C	CSDS no. 11B [b]	CSDS no. 1H [b]	CSDS no. 1G [b, c]
		Non-insulated, +120 °C < T < +400 °C	CSDS no. 12	CSDS no. 12	CSDS no. 10A, CSDS no. 2A [d]
		Non-insulated, T > +400 °C	CSDS no. 10A	CSDS no. 10A	CSDS no. 10A, CSDS no. 2A [d]
		Insulated [e], T ≤ +200 °C	CSDS no. 1D [f]	CSDS no. 1D [f]	CSDS no. 2A, CSDS no. 1D [f]
		Insulated, +200 °C < T< +595°C	CSDS no. 10A	CSDS no. 10A	CSDS no. 2A, CSDS no. 10A
		Low temperature and cryogenic service T < -50°C	CSDS no. 9	CSDS no. 9	CSDS no. 9
	Actuator, gear box	Non-insulated	CSDS no. 11A (T ≤ +80 °C), CSDS no. 11B (T > +80 °C)	CSDS no. 1A, CSDS no. 1B	CSDS no. 1A [b], CSDS no. 1B [b]
		Insulated T ≤ +200 °C	CSDS no. 1D [f]	CSDS no. 1D [f]	CSDS no. 1D [f]
	Generators, motors, engines, turbines, transformers, compressors	-	CSDS no. 11A (T ≤ +80 °C), CSDS no. 11B (T > +80 °C)	CSDS no. 1B, CSDS no. 1A	CSDS no. 1A [b], CSDS no. 2B [b], CSDS no. 1B [b], CSDS no. 1G [b]
Stainless steel	Pressure vessels, equipment, piping and valves, pumps	Non-insulated [g]	N/R [g]	N/R [g]	CSDS no. 6A, CSDS no. 10B, CSDS no. 2C [d]
		Insulated [e]	CSDS no. 6C [h]	CSDS no. 6C [h]	CSDS no. 6C, CSDS no. 2C
		Low temperature and cryogenic service, T < -50 °C	CSDS no. 9	CSDS no. 9	CSDS no. 9
	Actuator, gear box	Non-insulated	N/R	N/R	N/R
		Insulated [c]	N/R [h]	N/R [h]	CSDS no. 6C
HDG carbon steel	Misc. equipment	-	N/R [i]	N/R [i]	[i]
Aluminium	Misc. equipment	-	N/R [j]	N/R [j]	[k]
Carbon steel under PFP	Any item requiring passive fire protection	-	[l]	[l]	CSDS no. 5A

Table M.2 — Coating selection table for pressure vessels, equipment, piping and valves in environments with corrosivity categories C2 to C5 *(continued)*

Substrate material	Item to be coated	Exposure conditions	Environmental corrosivity to ISO 12944-2 [a]		
			C2	C3	C4, C5
Stainless steel under PFP	Any item requiring passive fire protection	-	[l]	[l]	CSDS no. 5C
Stainless steel	Instruments and instrument tubing (NPS ≤ 2 or DN ≤ 50)	Insulated and non-insulated	N/R [h]	N/R [h]	N/R [h]

KEY

N/R not required

NOTE Refer to the CSDSs in M.15 and Annex A for additional restrictions on the coating systems.

[a] The CSDSs listed under each environmental corrosivity represent the minimum requirement to meet the high durability range as defined in ISO 12944-1. Where multiple systems are listed for an item under specific exposure conditions, the first listed system is the default one.

[b] For maximum operating temperatures above +80 °C, testing shall be agreed with the coating manufacturer.

[c] CSDS no. 1G is also qualified as CSDS no. 1A, but not vice versa.

[d] CSDS no. 2A or CSDS no. 2C shall be preferred for very high durability (ISO 12944-2) or when maintenance is not feasible.

[e] The coating system can be selected as for un-insulated surfaces when perforated guards or sheets are used for personnel protection.

[f] System CSDS no. 1D is acceptable when pre-qualified to the required maximum operating temperature.

[g] Coating requirements depend on the stainless steel material grade and risk of corrosion (refer to ISO 21457). When coating is required, system CSDS no. 6A is the default.

[h] Coating requirements depend on the stainless steel material grade and risk of corrosion (refer to ISO 21457). When coating is required, system CSDS no. 6A is the default for non-insulated items and CSDS no. 6C is the default for insulated items.

[i] When coating is required, system CSDS no. 6B is the default.

[j] Coating requirements depend on aluminium grade. When coating is required, system CSDS no. 6F is the default.

[k] Coating requirements depend on aluminium grade. When coating is required, system CSDS no. 6D is the default.

[l] Coating under PFP shall follow the PFP manufacturer's recommendations.

Justification

This table defines the default coating systems to be used in environments with corrosivity categories C2, C3, C4 and C5.

M.15 Additional coating system datasheet for C2 and C3 atmospheric corrosivity

Add new CSDS no. 11A

CSDS no. 11A

Coating System Data Sheet		**CSDS no. 11A**	**Rev. 01**
Substrate material: Carbon steel		**Corrosivity category:** C2, ref. ISO 12944-2	
Items to be coated: Structures, structural components, frames, base plates, enclosures, permanent lifting beams and lugs, A-frames, equipment items, piping and valves			
Service: Environment with low corrosivity C2 or lower, 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 2 ½ , ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3, SSPC-SP 10			
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 2	**MAX DFT**
1: (Primer)	Epoxy	100 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Polyurethane or Poly-siloxane	80 µm	
Total MDFT		180 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: M.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 12.15B			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa.			
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 Qualification testing at 120 °C.			

Justification

System 11A is selected as cost-effective alternative for C2 environment based on system C2.06 ISO 12944-5.

Add new CSDS no. 11B

CSDS no. 11B

Coating System Data Sheet		CSDS no. 11B	Rev. 01
Substrate material: Carbon steel		**Corrosivity category:** C2, ref. ISO 12944-2	
Items to be coated: Structures, structural components, frames, base plates, enclosures, permanent lifting beams and lugs, A-frames, equipment items, piping and valves			
Service: Environment with low corrosivity C2 or lower, non-insulated			
Operating temperature range: –50 °C Note 3 to +120 °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 2 ½ , ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3, SSPC-SP 10			
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 2	**MAX DFT**
1: (Primer)	Epoxy Note 2	100 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Polyurethane or Poly-siloxane Note 2	80 µm	
Total MDFT		180 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: M.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 12.15B			
Adhesion: Max. 50 % reduction of value from the CPT during production, but any measurement shall be min. 5 MPa.			
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 Qualification testing at 120 °C. NOTE 3 For continuous operating temperature below -35 °C, additional testing at low temperature is required.			

Justification

System 11B is selected as a cost-effective alternative for C2 environment, amended from system C2.06 ISO 12944-5 and system 1G.

Add new CSDS no. 12

CSDS no. 12

Coating System Data Sheet		CSDS no. 12	Rev. 01
Substrate material: Carbon steel		**Corrosivity category:** C3, ref. ISO 12944-2	
Items to be coated: Structures, structural components, frames, base plates, enclosures, permanent lifting beams and lugs, A-frames, equipment items, piping and valves			
Service: Environment with medium corrosivity C3 or lower, non-insulated			
Operating temperature range: + 120 °C to +400 °C Note 5,6			
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 2 ½ , ref. NS-EN ISO 8501-1 Dust level max quantity and rating 2, ref. NS-EN ISO 8502-3, SSPC-SP 10			
Surface roughness: 35 µm to 50 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 2**	**MAX DFT**
1: (Primer)	Zinc silicate Note 3	60 µm	The maximum DFT for each coat shall be within the limits given in the relevant CADS
2: (Topcoat)	Silicone Note 4	20 µm	
Total MDFT		80 µm	
Pre-qualifications, procedure qualifications and inspection requirements			
Pre-qualification tests: M.8 and Table 1 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, 12.11, 12.12, 12.13 and 12.15B			
Adhesion: Cross-cut test on the complete system, ISO 16276-2 classification 0-2 or ASTM D3359 classification 3B			
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 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 4 A mist coat shall be applied according to the coating manufacturer's recommendations to minimise bubbling. When mist coat is used, the extent of thinning shall be covered in the CPS in accordance with the guidelines from the coating manufacturer.

Justification

System 12 is selected as a cost-effective alternative for C3 environment.

Bibliography

Add to start of Bibliography

The following documents are informatively cited in the text of this document, NORSOK M-501, the PDS (IOGP S-715D) or the IRS (IOGP S-715L).

Add to Bibliography

[4] API Specification Q2, *Specification for Quality Management System Requirements for Service Supply Organizations for the Petroleum and Natural Gas Industries*

[5] ISO 9001, *Quality management systems — Requirements*

[6] ISO 10005, *Quality management — Guidelines for quality plans*

[7] ISO 14921, *Thermal spraying — Procedures for the application of thermally sprayed coatings for engineering components*

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

[9] ISO/IEC Directives, Part 2, *Principles and rules for the structure and drafting of ISO and IEC documents*

[10] NACE SP0108 *, *Corrosion control of offshore structures by protective coatings*

* Cited in IOGP S-715J only.

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