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Petroleum, petrochemical and natural gas industries — External corrosion protection of risers by coatings and linings —

Part 2: Maintenance and field repair coatings for riser pipes

Industries du pétrole, de la pétrochimie et du gaz naturel — Protection de la corrosion externe des tubes de production par revêtements et doublures —

Partie 2: Entretien et réparation in situ des tubes de production

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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A list of all parts in the ISO 18797 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document has been developed in response to worldwide demand for minimum specifications for field applied maintenance and repair coatings for riser pipes. ISO 18797-1 specifies the shop applied coatings for risers. Coated offshore risers are intermittently exposed to varying conditions. These include – but are not limited to – sunlight, rain, snow, hail, water spray, salt spray, high humidity, fluctuating ambient temperatures (varying from sub-zero to high temperature), water currents, and impacts from waves, drifting debris and marine growth. Exposure to such conditions can cause severe coating deterioration in time, resulting in ineffective corrosion prevention of the steel riser pipe.

Users of this document are advised that further or differing requirements can be utilized for individual applications. This document can also be used for the maintenance and repair of coatings on other types of structures in the offshore splash zone, such as jetty piles and platform legs. This document does not limit the contractor or the manufacturer from proposing, or from accepting, alternative engineering solutions for the individual application. This can be particularly applicable where there is innovative or developing technology. Where an alternative is proposed, the specification issuer is expected to identify any deviations from this document and provide details.

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Petroleum, petrochemical and natural gas industries — External corrosion protection of risers by coatings and linings —

Part 2: Maintenance and field repair coatings for riser pipes

1 Scope

This document specifies the selection criteria and minimum requirements for protective coating systems for maintenance and field repair of risers exposed to conditions in the splash zone. It is applicable for maintenance requirements and field repairs of riser coatings.

This document does not apply to the selection of techniques and materials used to restore integrity of the risers to be coated, nor does it apply to the selection of additional mechanical protective materials that are not part of the coating systems described in this document.

New construction shop applied riser coatings are covered in ISO 18797-1. Compatible maintenance and repair coating systems specified in ISO 18797-1 are covered in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 34-1, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 48-2, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 527-3, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets*

ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method*

ISO 1431-1, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static and dynamic strain testing*

ISO 1523, *Determination of flash point — Closed cup equilibrium method*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

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ISO 2781, *Rubber, vulcanized or thermoplastic — Determination of density*

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

ISO 2811-1, *Paints and varnishes — Determination of density — Part 1: Pycnometer method*

ISO 3233-1, *Paints and varnishes — Determination of percentage volume of non-volatile matter — Part 1: Method using a coated test panel to determine non-volatile matter and to determine dry-film density by the Archimedes' principle*

ISO 3251, *Paints, varnishes and plastics — Determination of non-volatile-matter content*

ISO 3801, *Textiles — Woven fabrics — Determination of mass per unit length and mass per unit area*

ISO 4591, *Plastics — Film and sheeting — Determination of average thickness of a sample, and average thickness and yield of a roll, by gravimetric techniques (gravimetric thickness)*

ISO 4593, *Plastics — Film and sheeting — Determination of thickness by mechanical scanning*

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

ISO 4628-2, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering*

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

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

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

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

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 6502-2, *Rubber — Measurement of vulcanization characteristics using curemeters — Part 2: Oscillating disc curemeter*

ISO 6964, *Polyolefin pipes and fittings — Determination of carbon black content by calcination and pyrolysis — Test method*

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

ISO 8501-4, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 4: Initial surface conditions, preparation grades and flash rust grades in connection with high-pressure water jetting*

ISO 8502-3, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)*

ISO 8502-4, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 4: Guidance on the estimation of the probability of condensation prior to paint application*

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

ISO 8502-9, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 9: Field method for the conductometric determination of water-soluble salts*

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

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

ISO 10474, *Steel and steel products — Inspection documents*

ISO 11357-1, *Plastics — Differential scanning calorimetry (DSC) — Part 1: General principles*

ISO 11357-2, *Plastics — Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature and step height*

ISO 11357-3, *Plastics — Differential scanning calorimetry (DSC) — Part 3: Determination of temperature and enthalpy of melting and crystallization*

ISO 12944-9:2018, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures*

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

ISO 18797-1, *Petroleum, petrochemical and natural gas industries — External corrosion protection of risers by coatings and linings — Part 1: Elastomeric coating systems-polychloroprene or EPDM*

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

ISO 21809-3:2016, *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems — Part 3: Field joint coatings*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

ISO 80000-1:2009, *Quantities and units — Part 1: General*

ASTM D149, *Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies*

ASTM D991, *Standard Test Method for Rubber Property — Volume Resistivity Of Electrically Conductive and Antistatic Products*

ASTM D1141, *Standard Practice for the Preparation of Substitute Ocean Water*

ASTM D5894, *Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)*

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

NACE SP0274, *High-Voltage Electrical Inspection of Pipeline Coatings*

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3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
application procedure specification
APS
document describing procedures, methods, equipment and tools used for coating application

3.2
applicator
contractor (3.6) or subcontractor having the technical capability, knowledge, equipment and qualified personnel that is approved by the *client* (3.4) for the coating process

3.3
atmospheric zone
external *surface* (3.26) of a *riser* (3.19) that extends upward from the *splash zone* (3.22) up to the top decks of the platform which are exposed to sun, wind, sprays and rains

3.4
client
organization for which professional services are rendered or person that receives a product

3.5
complete coating
installed coating ready for commissioning comprising all individual parts of the coating material

3.6
contractor
organization that agrees to furnish materials and/or perform specific services to the *client* (3.4)

3.7
dry film thickness
DFT
thickness of a coating remaining over the peaks of a rough *surface* (3.26) when the coating has hardened

[SOURCE: ISO 19840:2012, 3.1]

3.8
failure mechanism
process that leads to failure

Note 1 to entry: ISO 14224:2016, B.2.2 and Table B.2, define failure causes for all equipment classes.

3.9
failure mode
manner in which failure occurs

Note 1 to entry: ISO 14224:2016, B.2.6, contains tables with relevant failure modes defining failure modes to be used for each equipment class.

3.10
holiday
coating discontinuity that exhibits electrical conductivity when exposed to a specific voltage

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3.11
inspection and testing plan
ITP
document providing an overview of the sequence of inspections and tests, including standard references, recommended apparatuses (tools) and testing procedures

3.12
maintenance and repair of a coating
activities dedicated to retaining or restoring the integrity of the existing coating in order to reach a level of protection against corrosion that enables a metallic structure to continue in service operation safely and economically for a determinate period

Note 1 to entry: Maintenance of a coating can refer to the activities to restore either the damages that are localized on small areas and do not require the complete removal of existing coating, or damage over larger areas that require the complete removal of existing coating and installation of field repair coating.

Note 2 to entry: For the purposes of this document, all types of coating used for maintenance and repair of riser coatings are designated as "repair coating".

Note 3 to entry: In ISO 14224:2016, 3.49, "maintenance" is defined as a combination of all technical and management actions intended to retain an item in, or restore it to, a state in which it can perform as required.

Note 4 to entry: In ISO 14224:2016, 3.8, "corrective maintenance" is defined as maintenance carried out after fault detection to effect restoration.

Note 5 to entry: "Repair" is a type of maintenance activity as defined in ISO 14224:2016, Table B.5.

3.13
manufacturer
organization responsible for the manufacture of coating material(s)

3.14
nominal dry film thickness
NDFT
dry film thickness (3.7) specified for each coat or for the whole paint system to achieve the required durability

[SOURCE: ISO 19840:2012, 3.6]

3.15
nominal strain at break
elongation at break
nominal strain at the last recorded data point before the stress is reduced to less than or equal to 10 % of the strength if the break occurs after yielding

Note 1 to entry: Nominal strain is the representation of strain calculated from grip displacement and the gripping distance.

[SOURCE: ISO 527-1:2019, 3.8 and 3.8.1]

3.16
nominal thickness
dimension as specified by the *manufacturer* (3.13)

Note 1 to entry: The nominal thickness of the complete coating is the calculated sum of the nominal thicknesses of all the layers of the coating before application.

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3.17
pre-production trial
PPT
application of coating and subsequent inspection and testing of its properties, to confirm that the *application procedure specification* (3.1) contains all necessary instructions to install the coatings in conformity with specific minimum requirements, carried out at the job site immediately prior to production

3.18
procedure qualification trial
PQT
application of coating and subsequent inspection and testing of its properties, to confirm that the *application procedure specification* (3.1) contains all necessary instructions to install the coatings in conformity with minimum requirements, carried out at the premises of the *contractor* (3.6) or another agreed location

3.19
riser
section of pipeline carrying crude oil or gas between the ocean floor and the upper decks of the platform on offshore structures

Note 1 to entry: In ISO 14224:2016, "riser" is a specific equipment class as per ISO 14224:2016, Table A.4 (level 6) and "coating" is a "maintainable item" for risers, as per ISO 14224:2016, Table A.93.

3.20
self-healing
ability of a coating to restore its original film thickness (leaving no *holidays* (3.10) as a result), after a 6 mm diameter defect is made down to bare metal

3.21
shift
time period when a crew of workers is at work

3.22
splash zone
external *surface* (3.26) of a *riser* (3.19) area above and below the mean water level that is periodically wet and dry due to the influence of the astronomical tides, winds and waves

Note 1 to entry: The limits are as defined by the contract specifications.

3.23
strain at break
strain at the last recorded data point before the stress is reduced to less than or equal to 10 % of the strength if the break occurs prior to yielding

[SOURCE: ISO 527-1:2019, 3.7.2, modified — Note 2 to entry has been deleted.]

3.24
stress at break
stress at which the specimen breaks

Note 1 to entry: Expressed in megapascals (MPa).

[SOURCE: ISO 527-1:2019, 3.6.4, modified — Note 2 to entry has been deleted.]

3.25
submerged zone
external *surface* (3.26) of a *riser* (3.19) below the water level

3.26
surface
interface between *substrate* (3.28) and environment where coating is applied

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3.27
surface preparation
method of preparing a *surface* (3.26) for coating application

Note 1 to entry: ISO 12944-4:2017, Clause 6, contains a comprehensive overview of suitable methods for surface preparation.

3.28
substrate
material from which the *riser* (3.19) is made

3.29
technical assessment
TA
application of coating and subsequent inspection and testing of its properties to confirm that the coatings are meeting the minimum requirements

Note 1 to entry: Technical assessment is usually carried out under controlled laboratory conditions.

3.30
weld cap
outermost *surface* (3.26) of the weld

4 Symbols and abbreviated terms

4.1 Symbols

T_{max}	maximum service temperature of coating
ε_b	strain at break
ε_{tb}	nominal strain at break
σ_b	stress at break

4.2 Abbreviated terms

HDPE	high-density polyethylene
HSE	health, safety and environment
NACE	NACE International—The Corrosion Society (formerly: National Association of Corrosion Engineers). NACE has merged with SSPC to form the Association for Materials Protection and Performance AMPP
SDS	safety data sheet
SSPC	the Society for Protective Coatings (formerly: the Steel Structures Painting Council)

5 Coating types

The coating types covered by this document are listed in Table 1. Clauses 6 to 9 provide requirements that apply to all coating types. Clauses 10 to 13 provide coating-specific requirements.

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