DRAFT INTERNATIONAL STANDARD

ISO/DIS 18797-2

ISO/TC **67**

Secretariat: **NEN**

Voting begins on:
2020-07-03

Voting terminates on:
2020-09-25

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

ICS: 75.180.10

This document is circulated as received from the committee secretariat.

ISO/CEN PARALLEL PROCESSING

Reference number
ISO/DIS 18797-2:2020(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*.

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.

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. This includes – but is 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 and 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 does not limit the contractor and/or manufacturer from proposing, or the client 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.

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 field maintenance and repair of risers exposed to conditions in the splash zone.

This document does not cover the selection of techniques and materials used to restore integrity of the risers to be coated. This document neither covers the selection of additional mechanical protective materials that are not part of the described coating systems included in this document.

This document is applicable for maintenance requirements and field repairs of risers. New construction riser coatings and repair of damaged applied coatings before installation are covered in ISO 18797-1.

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*

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*[1)]

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*

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)*

1) ISO 6502-2 replaces ISO 3417, which has been withdrawn.

ISO 8502-9, *Preparation of steel substrate 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 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 F22, *Standard Test Method for Hydrophobic Surface Films by the Water-Break Test*

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

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
document describing procedures, methods, equipment and tools used for coating application

3.2
applicator
organization appointed by the contractor to perform application of coatings/linings on riser pipes as per project procedures prepared in accordance with this document

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

Note 1 to entry: Other definitions can be found in e.g. DNV-OS-C101 and NACE SP0176.

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

Note 1 to entry: For the purpose of this document the client is also considered as end user

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

3.6
contractor
organization appointed by the client to perform the works in accordance with this document

Note 1 to entry: For the purpose of this document, the contractor is also considered as applicator.

Note 2 to entry: For the purpose of this document, the contractor is also considered as purchaser.

3.7
end user

company (companies) that own(s) and/or operate(s) risers

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

3.11
maintenance and repair of a coating
activities dedicated to retain or restore 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 either coating repair which means the activities to restore damages that are localized on small areas and do not require the complete removal of existing coating, or coating rehabilitation which means the activities to restore damages over larger areas that require the complete removal of existing coating and installation of new coating.

Note 2 to entry: For the purpose 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 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.

3.12
manufacturer
organization responsible for the manufacture of coating material(s)

3.13
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

[SOURCE: ISO 527-1, 3.8.1]

3.14
pre-production trial
application of coating and subsequent inspection and testing of its properties, to confirm that the APS contains all necessary instructions to install the coatings in conformance with minimum requirements as stated in this document, carried out at job site immediate prior to production

3.15
procedure qualification trial
application of coating and subsequent inspection and testing of its properties, to confirm that the APS contains all necessary instructions to install the coatings in conformance with minimum requirements as stated in this document, carried out at the premises of the contractor or other agreed location

3.16
purchaser
party responsible for providing the purchase order requirements

3.17
riser
section of pipeline carrying crude oil or gas between ocean floor and upper decks of platform on offshore structures

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

3.18
self-healing of coating
ability of a coating to restore its original film thickness (leaving no holidays as a result), after a 6 mm diameter defect is made down to bare metal

3.19
shift
time period when a crew of workers is at work

3.20
splash zone
external surface of a riser that is periodically wet and dry by the influence of the astronomical tides, winds and waves

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

Note 2 to entry: Other definitions can be found in e.g. DNV-OS-C101 and NACE SP0176.

3.21
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, 3.7.2]

3.22
stress at break
stress at which the specimen breaks, expressed in megapascals (MPa)

[SOURCE: ISO 527-1, 3.6.4]

3.23
submerged zone
external surface of a riser below the water level

Note 1 to entry: Other definitions can be found in e.g. DNV-OS-C101 and NACE SP0176.

3.24
surface
interface between substrate and environment where coating has to be applied

3.25
surface preparation
method of preparing a surface for coating application

Note 1 to entry: ISO 12944-4:2018, Clause 6 contains a comprehensive overview of suiTable methods for surface preparation.

3.26
substrate
material where riser is made of

3.27
technical assessment
application of coating and subsequent inspection and testing of its properties, to confirm that the coatings are in conformance with minimum requirements as stated in this document, carried out under controlled laboratory conditions

3.28
weld cap
outermost surface 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

APS application procedure specification

DFT dry film thickness

HDPE high density polyethylene

HSE health, safety and environment

ITP inspection and testing plan

PDS product data sheet

PPT pre-production trial

PQT procedure qualification trial

SDS safety data sheet

TA technical assessment

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.

Table 1 — Coating types

Type of coating	Clause	Code	Substrate
Non-crystalline low-viscosity polyolefin based coating with polymeric tape outer wrap, applied under dry conditions	10	10A	Dry
Non-crystalline low-viscosity polyolefin based coating with outer wrap like polymeric tape or moisture curing composite wrap material, applied under wet or immersed conditions		10B	Wet
Petrolatum tape wrap systems	11	11A	Dry and wet
Wax-based tape wrap systems		11B	Dry and wet
Polychloroprene based elastomeric coating	12	12	Dry
Liquid-applied epoxy coatings	13	13	Dry and wet

6 General requirements

6.1 Responsibility of the client

The client shall be responsible for making or approving the appropriate selection of the repair or rehabilitation coating, in accordance with the expected working, environmental and service conditions. The client shall validate the information supplied by the purchaser as listed in Clause 7.

6.2 Rounding

Unless otherwise stated in this document, to determine conformance with the specified requirements, observed or calculated values shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with ISO 80000-1:2009, Annex B, Rule A.