
**Petroleum, petrochemicals and
natural gas industries — Internal
coating and lining of carbon steel
process vessels —**

**Part 1:
Technical requirements**

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*Industries du pétrole, de la pétrochimie et du gaz naturel —
Revêtement de protection interne et doublure des récipients de
production en acier au carbone —*

ISO 18796-1:2018

Partie 1: Exigences techniques

<https://standards.iteh.ai/catalog/standards/siso/7fac2004-8fab-4e37-b014-91bbe55825dc/iso-18796-1-2018>



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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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 ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*.

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A list of all parts in the ISO 18796 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

The objective of this document is to define the minimum technical requirements for the corrosion protection by coating/lining of internal surfaces of carbon steel process vessels used in the oil and gas industry and subject to marked pressure/temperature changes and/or acidic or other aggressive chemicals. In addition, this document provides technical guidance for developing project specifications and helps to ensure compliance in coating/lining material selection and performance with contract requirements.

Further or differing requirements can be specified for individual applications. This document does not limit the contractor and/or manufacturer from proposing, or the company from accepting, alternative engineering solutions for the individual application. This can particularly be applicable where there is an innovative or emerging technology. Where an alternative is proposed, the specification issuer will need to identify any deviation from this document and provide details.

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Petroleum, petrochemicals and natural gas industries — Internal coating and lining of carbon steel process vessels —

Part 1: Technical requirements

1 Scope

This document specifies the minimum technical requirements for surface preparation, materials, application, inspection and testing of internal coating and lining systems that are intended to be applied on internal surfaces of process vessels that are subject to marked pressure/temperature changes and/or potentially corrosive conditions or processes and aggressive chemicals, used in the oil and gas industry.

This document covers both new construction and maintenance works of process vessels as well as the repair of defective and deteriorated coating and lining systems.

This document also provides the minimum requirements for the coated and lined samples and the criteria for their approval.

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2 Normative references

ISO 18796-1:2018

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 2812 (all parts), *Paints and varnishes — Determination of resistance to liquids*

ISO 3233 (all parts), *Paints and varnishes — Determination of the percentage volume of non-volatile matter*

ISO 4624¹⁾, *Paints and varnishes — Pull-off test for adhesion*

ISO 7027, *Water quality — Determination of turbidity*

ISO 7619-1, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 1: Durometer method (Shore hardness)*

ISO 8501-1²⁾, *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 8501-3, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 3: Preparation grades of welds, edges and other areas with surface imperfections*

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)*

1) ASTM D4541 is equivalent to this document.

2) SSPC-SP5/NACE No. 1 is equivalent to this document.

ISO 18796-1:2018(E)

ISO 8502-6³⁾, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 6: Extraction of soluble contaminants for analysis — The Bresle method*

ISO 8502-9⁴⁾, *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 10474⁵⁾, *Steel and steel products — Inspection documents*

ISO 11124 (all parts), *Preparation of steel substrates before application of paints and related products — Specifications for metallic blast-cleaning abrasives*

ISO 11125 (all parts), *Preparation of steel substrates before application of paints and related products — Test methods for metallic blast-cleaning abrasives*

ISO 11126 (all parts), *Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives*

ISO 11127-6, *Preparation of steel substrates before application of paints and related products — Test methods for non-metallic blast-cleaning abrasives — Part 6: Determination of water-soluble contaminants by conductivity measurement*

ISO 16276 (all parts)⁶⁾, *Corrosion protection of steel structures by protective paint systems — Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating*

ISO 19840⁷⁾, *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 21809-3:2016⁸⁾, *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems — Part 3: Field joint coatings*

ISO 29601⁹⁾, *Paints and varnishes — Corrosion protection by protective paint systems — Assessment of porosity in a dry film*

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

ASTM D522, *Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings*

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 D2583, *Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor*

ASTM D4060, *Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser*

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

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

3) SSPC-Guide 15 is equivalent to this document (together with ISO 8502-9).

4) SSPC-Guide 15 is equivalent to this document (together with ISO 8502-6).

5) EN 10204 is equivalent to this document.

6) ASTM D4541 is equivalent to this document.

7) SSPC-PA2 is equivalent to this document.

8) ASMT G42 is equivalent to this document.

9) NACE SP0188 is equivalent to this document.

ASTM F21, *Standard Test Method for Hydrophobic Surface Films by the Atomizer Test*

NACE/TM 0174, *Standard Test Method — Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials on Metallic Substrates in Immersion Service*

SSPC-SP1, *Steel Structure Painting Council Surface Preparation Specifications — Solvent Cleaning*

3 Terms, definitions and abbreviated terms

3.1 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/>

3.1.1

abrasive blast cleaning

surface preparation method that uses an abrasive propelled by air pressure, centrifugal force, or water pressure to clean and usually to profile a surface

3.1.2

application procedure specification

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

3.1.3

applicator

contractor or subcontractor having the technical capability, knowledge, equipment, qualified personnel that is approved by the client for the coating processes as required by this document

3.1.4

coat

one layer of protective coating or paint applied to the surface in a single application to form an evenly distributed film when dry

3.1.5

contractor

vendor or company that agrees to furnish materials and/or perform specific project/services to the client

3.1.6

curing

chemical process of developing the intended properties of a coating/polymerized product in the lining system, generally due to a reaction between two or more chemicals (e.g. resin and curative)

3.1.7

client

entity for which professional services are rendered or person that receives a product

3.1.8

dew-point

temperature of a given air/water vapour mixture at which condensation starts, because its maximum water content saturation is reached at that temperature

3.1.9

dry film thickness

thickness of a coat of paint, layer of tape or coating system in its fully cured condition

3.1.10

epoxy

resin containing functional epoxy groups that allow for curing by polymerization with a variety of curatives

3.1.11

grit abrasive

angular or irregularly shaped particles of abrasives

3.1.12

holiday

discontinuity in a lining or contamination in the coating film that significantly lowers the performance of a coating

Note 1 to entry: Examples of discontinuity in a lining are pinhole, void, crack, thin spot, and inclusion of foreign material.

3.1.13

lining

internal coating

Note 1 to entry: The term 'coating' is also used for the purposes of this document.

Note 2 to entry: Internal coating can be applied to the internal surfaces of a tank vessel to serve as a barrier to corrosion and/or product contamination, for example.

3.1.14

novolac

phenol-formaldehyde resin with formaldehyde to phenol molar ratio of less than 1

3.1.15

phenolic

resin of the phenol-formaldehyde type

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3.1.16

pinhole

small film defect characterized by small pore like flaws in the lining that would permit corrosion of the substrate under the conditions for which the lining is designed

Note 1 to entry: A pinhole can extend entirely through the film and lead to a holiday.

3.1.17

surface profile

micro-roughness of a surface, generally expressed as the average height of the major peaks relative to the major valleys

3.2 Abbreviated terms

APS	application procedure specification
ASTM	American Society for Testing and Materials
BGAS	British Gas
BS	British Standard
CV	curriculum vitae
DFT	dry film thickness
GRUP	glass reinforced unsaturated polyester

GRVE	glass reinforced vinyl ester
GSO	Gulf Standardization Organization
HBE	high build epoxy
HSE	health, safety and environment
ISO	International Organization for Standardization
ITP	inspection and testing plan
MSDS	materials safety data sheet
NACE	National Association of Corrosion Engineers
NTU	nephelometric turbidity units
OSHA	Occupational Safety and Health Administration
PPT	pre-production trial
PQT	procedure qualification trial
QA/QC	quality assurance/quality control
QP	qualification procedure
RH	relative humidity
RP	recommended practice
SSPC	Society for Protecting Coatings
WFT	wet film thickness

4 Conformance

4.1 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.

NOTE For the purpose of this provision, the rounding method of ASTM E29-08 is equivalent to ISO 80000-1:2009, Annex B, Rule A.

4.2 Conformance to this document

Management systems based on ISO 9001 and ISO 14001 and good laboratory practice should be applied to assist conformance with the requirements of this document. ISO/TS 29001 gives sector-specific guidance on quality management systems.

The applicator shall be responsible for conforming to all of the applicable requirements of this document.

5 Pre-work requirements

5.1 General

5.1.1 All necessary HSE procedures shall be followed to protect personnel and the surrounding environment during on-site/field works.

5.1.2 The contractor/supplier shall submit their HSE manual for client's approval. The approved recommended procedures for safe lining processes shall be strictly followed.

5.1.3 All relevant requirements for fire safety, client's safety regulations for contractors and lifting equipment regulations shall be followed while performing work within the operation areas.

5.1.4 An MSDS shall be submitted as required.

5.1.5 All wastes resulting from supply and installation shall be contained, collected and properly disposed of in accordance with local HSE protection standards or regulations.

5.2 Safety precautions in flammable atmosphere

5.2.1 Where there is a risk of a flammable atmosphere being present in a particular vessel, the client may, with relevant safety authority, impose restrictions on methods of surface preparation based on area classification for plant design and construction/maintenance projects.

5.2.2 The contractor shall submit to the client, for approval, all necessary data for the proposed coating/lining systems, solvents and coating procedures in order to permit area classification to be determined for the duration of coating work.

5.2.3 All equipment used in surface preparation, coating/lining application and inspection, including floodlights or spotlights, shall be explosion-proof and spark-proof.

5.2.4 Prior to surface preparation, all scales shall be removed from the vessel and shall be properly weathered prior to disposal. The flammable atmosphere inside the vessel shall be monitored.

5.3 Safety precautions in confined space

The procedures for performing safe work in confined spaces shall be in accordance with the client's identified HSE regulations.

5.4 Safety precautions for blasting and coating works

5.4.1 The abrasive blast nozzle shall be bonded (grounded) to the work metal in order to prevent the build-up of electrostatic charges, which could cause a spark discharge.

5.4.2 Nozzle blast operators shall wear goggles and an approved helmet and shall be connected to a source of clean air. All other persons exposed to the blast dust and chemical fumes shall wear air-supplied respirators.

5.4.3 Any surface laps, scabs, or seams exposed by abrasive blasting shall be reported immediately to the client so they can take appropriate action.

5.4.4 Adequate fresh air ventilation shall be provided during all lining work.