SLOVENSKI STANDARD
oSIST prEN ISO 12736-1:2022

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Industrija za predelavo nafte in zemeljskega plina - Mokre toplotne izolacijske prevleke za naftovode in podvodno opremo - 1. del: Validacija materialov in izolacijskih sistemov (ISO/DIS 12736-1:2021)

Petroleum and natural gas industries - Wet thermal insulation systems for pipelines and subsea equipment - Part 1: Validation of materials and insulation systems (ISO/DIS 12736-1:2021)

Erdöl- und Erdgasindustrie - Wärmedämmschicht für Rohrleitungen und Unterwasseranlagen - Teil 1: Validierung von Materialien und Isoliersystemen (ISO/DIS 12736-1:2021)

Industries du pétrole et du gaz naturel - Revêtements pour isolation thermique humide de canalisations, lignes d'écoulement et structures sous-marines - Partie 1: Validation des matériaux et des systèmes d'isolation (ISO/DIS 12736-1:2021)

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ICS:

25.220.20	Površinska obdelava	Surface treatment
75.180.10	Oprema za raziskovanje, vrtanje in odkopavanje	Exploratory, drilling and extraction equipment

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Petroleum and natural gas industries — Wet thermal insulation systems for pipelines and subsea equipment —

Part 1:
Validation of materials and insulation systems

ICS: 25.220.20; 75.180.10

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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 Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

This second edition partly cancels and replaces the first edition (ISO 12736:2014), which has been technically revised and split into three parts.

The main changes compared to the previous edition are as follows:

— clearer delineation between validation and projects;

— introduction of material classes;

— modification of material property testing requirements, including detailed thermal conductivity testing requirements;

— introduction of additional long-term testing requirements;

— introduction of additional system testing requirements, including system interfaces;

— removal of project specific testing requirements;

— addition of requirement for risk-based analysis of the system long-term performance;

— modifications of the format and content requirements of the final validation dossier;

— addition of informative annex with guidelines for using this document.

A list of all parts in the ISO 12736 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

Users of this document are advised that further or differing requirements can be required for individual applications. This document is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This can be particularly applicable where there is innovative or developing technology. Where an alternative is offered, it is the responsibility of the vendor to identify any variations from this document and provide details. Annex A further clarifies the intended use of this document.

Petroleum and natural gas industries — Wet thermal insulation systems for pipelines and subsea equipment —

Part 1: Validation of materials and insulation systems

1 Scope

This document defines the minimum requirements for validation of wet thermal insulation systems applied to pipelines and subsea equipment in the petroleum and natural gas industries.

This document is applicable to wet thermal insulation systems submerged in seawater.

This document is not applicable to:

— maintenance works on existing installed wet thermal insulation systems;

— qualification for anti-corrosion coating;

— thermal insulation in the annulus of a steel pipe-in-pipe system.

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 (all parts), *Rubber, vulcanized or thermoplastic — Determination of tear strength*

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

ISO 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

ISO 527 (all parts), *Plastics — Determination of tensile properties*

ISO 604, *Plastics — Determination of compressive properties*

ISO 844, *Rigid cellular plastics — Determination of compression properties*

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

ISO 1183 (all parts), *Plastics — Methods for determining the density of non-cellular plastics*

ISO 6721-1, *Plastics — Determination of dynamic mechanical properties — Part 1: General principles*

ISO 8301, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Heat flow meter apparatus*

ISO 8302, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Guarded hot plate apparatus*

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

ISO 11357-4, *Plastics — Differential scanning calorimetry (DSC) — Part 4: Determination of specific heat capacity*

ISO 11359-2, *Plastics — Thermomechanical analysis (TMA) — Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*

ISO 12736-2, *Petroleum and natural gas industries — Wet thermal insulation systems for pipelines and subsea equipment — Part 2: Qualification processes for production and application procedures*

ISO 12736-3, *Petroleum and natural gas industries — Wet thermal insulation systems for pipelines and subsea equipment — Part 3: Interfaces between systems, field joint systems, field repairs, and pre-fabricated insulation*

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

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

ASTM D575, *Standard Test Methods for Rubber Properties in Compression*

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 https://www.electropedia.org/

3.1
application procedure specification
quality specification document, or group of specifications, describing procedures, method, equipment, tools, etc. used for *system* (3.34) application

3.2
batch
quantity of *material* (3.17) produced in a continuous manufacturing operation using raw materials of the same source or grade

3.3
blown foam
insulation *material* (3.17) formed by incorporating a gas phase into a polymer matrix

3.4
certificate of analysis
document provided by the manufacturer which indicates results of specific tests or analysis, including test methodology, performed on a defined lot of the manufacturer's product and corresponding conformity ranges

3.5
construction joint
interface (3.12) where both *systems* (3.34) are identical

3.6
cutback
length of item left uncoated at each end for joining purposes

Note 1 to entry: Joining purposes are welding, for example.

3.7
field joint
uncoated area that results when two pipe sections, or a pipe section and a *fitting* (3.8), with *cutbacks* (3.6) are assembled by welding or other methods

3.8
fitting
receptacle on a piece of *subsea equipment* (3.32), which interfaces to a *pipeline* (3.21)

3.9
high molecular weight precursor thermoset
material (3.17), which is a polymeric compound that remains malleable until application of sufficient heat to cause network formation and then does not flow upon reheating

EXAMPLE Butyl rubber.

3.10
inorganic syntactic foam
insulation *material* (3.17) formed by dispersing inorganic hollow particles within a polymer matrix

3.11
inspection and test plan
document providing an overview of the sequence of inspections and tests, including appropriate resources and procedures

3.12
interface
location where two *systems* (3.34) meet and affect each other.

Note 1 to entry: A field joint system has two interfaces.

Note 2 to entry: In the case of multilayer systems, interfaces can be made up of multiple sub-interfaces.

3.13
jumper
short section of *pipeline* (3.21) that transfers fluid between two pieces of *subsea equipment* (3.32)

3.14
liquid precursor elastomeric thermoset
material (3.17), which is a polymeric compound with its glass transition below ambient temperature, that is produced via combination of one or more components that can be pumped and flow as liquids and which react to create a crosslinked polymer that does not flow upon reheating

EXAMPLE Liquid precursor silicone rubber.

3.15
liquid precursor non-elastomeric thermoset
material (3.17), which is a polymeric compound with its glass transition above ambient temperature, that is produced via combination of one or more components that can be pumped and flow as liquids and which react to create a crosslinked polymer that does not flow upon reheating

EXAMPLE Liquid epoxy,.

3.16
mainline
portion of a *pipeline* (3.21) which is not a *field joint* (3.7)

3.17
material
polymeric compound applied to the surface to be protected/insulated in units of discrete thickness (layers) to build up a *system* (3.34)

3.18
material manufacturer
legal entity responsible for the manufacture of one or more *materials* (3.17) utilized in a *system* (3.34)

3.19
material maximum and minimum rated temperature
maximum and minimum temperature to which a particular *material* (3.17) can be continuously exposed, as per *system provider* (3.36) recommendation, during storage or in service as part of a *system* (3.34)

Note 1 to entry: For multi-layer systems, the material maximum rated temperature can be less than the *system maximum rated temperature* (3.35).

3.20
maximum rated pressure
maximum hydrostatic pressure to which the *system* (3.34) can be exposed, according to the *system provider* (3.36)

3.21
pipeline
flowline
tubular piping used to convey fluids

Note 1 to entry: Pipeline includes *jumpers* (3.13), *risers* (3.27) and *field joints* (3.7).

3.22
pre-fabricated insulation
section of stand-alone insulative *material* (3.17), which is factory manufactured into its final form and then installed in the field by mechanically fastening or bonding to a corrosion protected structure

3.23
pre-production trial
series of tests performed immediately before the start of production, designed to demonstrate that the requirements of the validated *system* (3.34) and/or *procedure qualification trial* (3.24) are achieved, as outlined in this document and as agreed

3.24
procedure qualification trial
series of tests designed to demonstrate that the *materials* (3.17), *system provider* (3.36), equipment and procedures can produce the *system* (3.34) in accordance with the *validation dossier* (3.43) and meet the specific project requirements as outlined in this document and as agreed

3.25
project
scope of work agreed upon contractually between *system purchaser* (3.37) and *system provider* (3.36)

3.26
R-lay
reel-lay
method of *pipeline* (3.21) installation in which long *stalks* (3.31) of pre-insulated pipes are pre-assembled by welding and application of *field joint* (3.7) system onshore before being spooled onto large reels onboard the installation vessel, which then lays the pipes by unspooling the reel offshore

3.27
riser
vertical portion of a *pipeline* (3.21), including the bottom bend, arriving on or departing from an offshore surface installation

3.28
safety data sheet
DEPRACATED: material safety data sheet
form intended to provide workers and emergency personnel with procedures for handling and working with a *material* (3.17) utilized in the manufacture of the *system* (3.34) in a safe manner including physical data

Note 1 to entry: Physical data can include flash point, toxicity and first aid.

3.29
service life
specified period of use for a *system* (3.34) in service

3.30
solid/solid filled
insulation *material* (3.17) which systematically does not contain voids, bubbles, or hollow particles

3.31
stalk
continuous string of welded and *field joint* (3.7) coated pipe, which is prepared in readiness for pipe spooling onto a *reel-lay* (3.26) barge

Note 1 to entry: Note1 to entry: A number of stalks will normally be required to make up a *pipeline* (3.21).

3.32
subsea equipment
components from a subsea production system, including subsea processing items and structures, meant to control hydrocarbons, not including *pipelines* (3.21)

EXAMPLE Valve, connector, manifold, christmas tree, flowline end termination.

3.33
substrate
surface to which a *material* (3.17) is applied or is to be applied

3.34
system
all of the various *materials* (3.17) and the combination thereof, which can include layers of anti-corrosion, insulation, adhesive, and protective materials, as defined by cross-section to the underlying *substrate* (3.33) at a single point, which function together to act as a *wet thermal insulation* (3.44)

3.35
system maximum and minimum rated temperature
maximum and minimum temperature to which a particular *system* (3.34) can be continuously exposed, as per *system provider* (3.36) recommendation, during storage or in service

3.36
system provider
legal entity which is selling/marketing the applied *system* (3.34)

3.37
system purchaser
legal entity which is purchasing the applied *system* (3.34)

3.38
thermal conductivity
k-value
conductivity
heat flow through a unit length of *material* (3.17) under the influence of a thermal gradient

Note 1 to entry: Thermal conductivity is expressed in $W \cdot m^{-1} \cdot K^{-1}$

3.39
thermoplastic
material (3.17), which is a polymeric compound that solidifies upon cooling and can flow and be reformed upon reheating

EXAMPLE Polypropylene.

3.40
tie-in field joint
connection of a *pipeline* (3.21) to a facility or *subsea equipment* (3.32), to other pipeline systems, or the connecting together of different sections of a single pipeline

3.41
U-value
overall heat transfer coefficient
rate of heat transfer from a reference surface under the influence of a thermal gradient

Note 1 to entry: Note1 to entry: U-value is expressed in $W \cdot m^{-2} \cdot K^{-1}$.

3.42
validation
demonstration of *material* (3.17) and *system* (3.34) performance during storage, handling and operation, within a defined envelope of use, as determined by the *system provider* (3.36)

3.43
validation dossier
collection of documentation and test reports, which provides detailed information on the proposed *system* (3.34), method of application, the *materials* (3.17) which form said system, and demonstration of system performance, prepared in accordance with this document

3.44
wet thermal insulation
system (3.34) that provides external corrosion protection and thermal insulation, and that is in direct contact with surrounding fluid

4 Symbols and abbreviated terms

4.1 Symbols

E_{kin}	impact energy (kinetic energy), expressed in Joules
g	standard gravity, equivalent to 9,81 metres per seconds squared
H	pendulum height, expressed in metres
m_h	mass of hammer, expressed in kilograms
$Q_{ave,i}$	average value of heat flux transducers signals for sample i, where i = 1, 2, or 3, expressed in microVolts
Q_{lower}	lower plate heat flux transducer signal, expressed in microVolts
$Q_{Lower,Average}$	average lower plate heat flux transducer signal, expressed in microVolts
$Q_{Ref\ Mat\ ave}$	average value of heat flux transducers signals for reference material sample, expressed in Watts per microVolts
$Q_{Ref\ Mat\ ave,1}$	average value of heat flux transducers signals for reference material sample 1 (typically the thinner sample), expressed in Watts per microVolts

$Q_{Ref\,Mat\,ave,2}$	average value of heat flux transducers signals for reference material sample 2 (typically the thicker sample), expressed in Watts per microVolts
Q_{upper}	upper plate heat flow, expressed in microVolts
$Q_{Upper,Average}$	average upper plate heat flow, expressed in microVolts
S_{Cal}	calibration factor, expressed in watts per microVolts
S_{Cal1}	single-thickness calibration factor, proportional factor between the electrical signal and heat flow, expressed in Watts per microVolts
S_{Cal2}	two-thickness calibration factor, proportional factor between the electrical signal and heat flow, expressed in Watts per microVolts
$S_{Cal,Lower}$	lower plate calibration factor, expressed in Watts per microVolts
$S_{Cal,Upper}$	upper plate calibration factor, expressed in Watts per microVolts
$\bar{R}_{ave}$	total average measured thermal resistance across all samples, expressed in metres square degrees Kelvin per Watt
$R_{ave,i}$	average measured thermal resistance of sample i, where i = 1, 2, or 3, expressed in metres square degrees Kelvin per Watt
R_{cal}	calibration contact resistance, expressed in metres square degrees Kelvin per Watt
$2R_{Cal,Lower}$	lower plate calibration contact resistance, expressed in metres square degrees Kelvin per Watt
$2R_{Cal,Upper}$	upper plate calibration contact resistance, expressed in metres square degrees Kelvin per Watt
$2R_{sample}$	contact resistance of the sample, expressed in metres square degrees Kelvin per Watt
ΔT	average temperature difference across the sample(s), expressed in degrees Celsius
T_{lower}	lower plate temperature, expressed in degrees Celsius
T_{upper}	upper plate temperature, expressed in degrees Celsius
$x_{ave,i}$	average measured thickness of sample i, where i = 1, 2, or 3, expressed in metres
$\bar{x}_{ave}$	total average measured thickness across all samples
$x_{Ref\,Mat\,ave}$	average thickness of the reference material sample, expressed in metres
$x_{Ref\,Mat\,ave,1}$	average thickness of reference material sample 1 (typically the thinner sample), expressed in metres
$x_{Ref\,Mat\,ave,2}$	average thickness of reference material sample 2 (typically the thicker sample), expressed in metres
$\lambda_{Ref\,Mat}$	thermal conductivity of the calibration reference material, expressed in Watts per metre Kelvin
$\lambda_{sampleA1}$	thermal conductivity of Test Type A1 specimen, expressed in Watts per metre Kelvin
$\lambda_{sampleA2}$	thermal conductivity of Test Type A2 specimen, expressed in Watts per metre Kelvin

4.2 Abbreviated terms