BS EN ISO 12736-3:2023

BSI Standards Publication

Oil and gas industries including lower carbon energy — Wet thermal insulation systems for pipelines and subsea equipment

Part 3: Interfaces between systems, field joint system, field repairs and prefabricated insulation

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Full document details: BS EN ISO 12736-3:2023

National foreword

This British Standard is the UK implementation of EN ISO 12736-3:2023. It is identical to ISO 12736-3:2023. Together with BS EN ISO 12736-2:2023 and BS EN ISO 12736-1:2023, it supersedes BS EN ISO 12736:2014, which will be withdrawn upon publication of the rest of the series.

The UK participation in its preparation was entrusted to Technical Committee PSE/17/2, Transmission pipelines.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Erdöl- und Erdgasindustrie - Wärmedämmschicht für Rohrleitungen und Unterwasseranlagen - Teil 3: Schnittstellen zwischen Systemen, Feldfugensystem, Feldreparaturen und vorgefertigte Isolierungen (ISO 12736-3:2023)

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European foreword

This document (EN ISO 12736-3:2023) has been prepared by Technical Committee ISO/TC 67 "Oil and gas industries including lower carbon energy" in collaboration with Technical Committee CEN/TC 12 “Oil and gas industries including lower carbon energy” the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2024, and conflicting national standards shall be withdrawn at the latest by April 2024.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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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 document 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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This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 2, *Pipeline transportation systems,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Oil and gas industries including lower carbon energy,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 12736-3, together with ISO 12736-1 and ISO 12736-2, cancels and replaces ISO ISO 12736:2014.

The main changes are as follows:

— clearer delineation between commercial projects and validation;

— introduction of material classes;

— introduction of interface types;

— elimination of system specific qualification testing tables;

— introduction of project specific functional tests;

— addition of items related to pre-fabricated insulation;

— addition of Annexes A, B and D with guidance for using this document, design of systems, and pre-fabricated insulation.

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.

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Oil and gas industries including lower carbon energy — Wet thermal insulation systems for pipelines and subsea equipment —

Part 3: Interfaces between systems, field joint systems, field repairs and pre-fabricated insulation

1 Scope

This document specifies requirements for project specific product and process qualification of field applied wet thermal insulation systems applied at interfaces (e.g. field joints) and pre-fabricated insulation 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:

— the project qualification of anticorrosion coatings or the requirements for application thereof;

— 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 48-4, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 4: Indentation hardness by durometer method (Shore hardness)*

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

ISO 1133-1, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method*

ISO 1133-2, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 2: Method for materials sensitive to time-temperature history and/or moisture*

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

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

ISO 2884-2, *Paints and varnishes — Determination of viscosity using rotary viscometers — Part 2: Disc or ball viscometer operated at a specified speed*

ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

ISO 3219 (all parts), *Rheology*

ISO 6502 (all parts), *Rubber — Guide to the use of cure meters*

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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 12736-1, *Oil and gas industries including lower carbon energy — Wet thermal insulation systems for pipelines, flow lines, equipment and subsea structures — Part 1*

ISO 12736-2, *Oil and gas industries including lower carbon energy — Wet thermal insulation systems for pipelines, flow lines, equipment and subsea structures — Part 2*

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

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

3 Terms and definitions

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

ISO and IEC maintain terminology 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
agreed
specified in the purchase order

Note 1 to entry: To be discussed by the *system provider* (3.41) and *system purchaser* (3.42) with input from *end user* (3.9) as required.

3.2
application procedure specification
APS
quality specification document, or group of specifications, describing procedures, method, equipment, tools, etc. used for *system* (3.40) application

3.3
batch
quantity of *material* (3.22) produced in a continuous manufacturing operation using raw materials of the same source or grade

3.4
blown foam
insulation *material* (3.22) formed by incorporating a gas phase into a polymer matrix

3.5
certificate of analysis
document provided by the manufacturer that indicates results of specific tests or analysis, including test methodology, performed on a specified lot of the manufacturer's product and corresponding conformity ranges

3.6
chamfer
exposed pre-shaped termination of a *system* (3.40) to be interfaced with

Note 1 to entry: Chamfer geometry (e.g. angle, shape) and tolerances are project specific.

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3.7
cool down time
time taken for a fluid contained within a *pipeline* (3.25) or *subsea equipment* (3.38) to reach a pre-determined temperature from specific start temperatures (internal and external) when flow is stopped

3.8
cutback
length of item left uncoated at each end for joining purposes

Note 1 to entry: Welding is an example of joining purposes.

3.9
end user
company that owns and/or operates the *pipeline* (3.25) or *subsea equipment* (3.38)

3.10
factory applied
applied in a permanent facility

3.11
field joint
field joint system
uncoated area that results when two pipe sections, or a pipe section and a *fitting* (3.12), with *cutbacks* (3.6) are assembled by welding or other methods

3.12
fitting
receptacle on a piece of *subsea equipment* (3.38), which interfaces to a *pipeline* (3.25)

3.13
high molecular weight precursor thermoset
material (3.22), 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.

3.14
inorganic syntactic foam
insulation *material* (3.22) formed by dispersing inorganic hollow particles within a polymer matrix

3.15
inspection and test plan
ITP
document providing an overview of the sequence of inspections and tests, including appropriate resources and procedures

3.16
inspection document
document issued by the *system provider* (3.41) and attesting that the supplied *system* (3.40) is in conformity with the requirement given in the purchase order

Note 1 to entry: See also ISO 10474.

3.17
interface
location where two *systems* (3.40) meet and affect each other

Note 1 to entry: A *field joint* (3.11) *system* (3.40) has two interfaces.

Note 2 to entry: In the case of multilayer *systems* (3.40), interfaces can be made up of multiple sub-interfaces.

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3.18
J-lay
method of *pipeline* (3.25) installation in which pipelines are assembled by welding together pre-insulated pipes with subsequent application of a *field joint* (3.11) *system* (3.40) in a vertical position, onboard an installation vessel with a tower

Note 1 to entry: The pipeline is lowered into the water vertically and creates a characteristic J-shape when touching the seabed.

Note 2 to entry: This method is used mainly for deep water.

3.19
liquid precursor elastomeric thermoset
material (3.22), 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.

3.20
liquid precursor non-elastomeric thermoset
material (3.22), 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.

3.21
mainline
portion of a *pipeline* (3.25) that is not a *field joint* (3.11)

3.22
material
polymeric compound applied to the *substrate* (3.39) protected or insulated in units of discrete thickness (layers) to build up a *system* (3.40)

3.23
material data sheet
document containing typical data regarding the physical and mechanical properties of a particular *material* (3.22) used in the coating process including guidelines and recommendations for its processing and use

3.24
material manufacturer
entity responsible for the manufacture of one or more *materials* (3.22) utilized in a *system* (3.40)

3.25
pipeline
flowline
tubular piping used to convey fluids

Note 1 to entry: Pipeline includes jumpers, *risers* (3.32) and *field joints* (3.11).

3.26
pi tape
precision Vernier periphery tape that allows the direct and accurate measurement of the diameter of tubular objects without the need for callipers or micrometres

3.27
pre-fabricated insulation
section of stand-alone insulation, which is factory manufactured into its final form and then installed in the field by mechanically fastening or bonding to a corrosion protected structure

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3.28
pre-production trial
PPT
series of tests performed immediately before the start of production, designed to demonstrate that the requirements of the *validated* (3.48) *system* (3.40) and *procedure qualification trial* (3.29) or both are achieved

Note 1 to entry: Requirements for PPT are as outlined in this document and as *agreed* (3.1).

3.29
procedure qualification trial
PQT
series of tests designed to demonstrate that the *materials* (3.22), *system provider* (3.41), equipment and procedures can produce the *system* (3.40) in accordance with the *validation dossier* (3.49) and meet specific *project* (3.30) requirements as *agreed* (3.1)

Note 1 to entry: Requirements for PQT are as outlined in this document and as *agreed* (3.1).

3.30
project
scope of work agreed upon contractually between *system purchaser* (3.42) and *system provider* (3.41)

3.31
R-lay
reel-lay
method of *pipeline* (3.25) installation in which long *stalks* (3.37) of pre-insulated pipes are pre-assembled by welding and application of *field joint* (3.11) *system* (3.40) onshore before being spooled onto large reels onboard the installation vessel, which then lays the pipes by unspooling the reel offshore

3.32
riser
vertical portion of a *pipeline* (3.25), including the bottom bend, arriving on or departing from an offshore surface installation

3.33
safety data sheet
SDS
DEPRACATED: material safety data sheet
document intended to provide workers and emergency personnel with procedures for handling and working with a *material* (3.22) utilized in the manufacture of the *system* (3.40) in a safe manner including physical data, first aid, etc.

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

3.34
service life
specified period of use for a *system* (3.40) in service

3.35
S-lay
method of *pipeline* (3.25) installation in which pipelines are assembled by welding together pre-insulated pipes, with subsequent application of a *field joint* (3.11) *system* (3.40), onboard an installation vessel in a horizontal orientation

Note 1 to entry: The pipeline curvature created from the vessel down to the seabed is a characteristic S-shape.

Note 2 to entry: This method is used mainly for low to medium water depths.

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3.36
solid/solid filled
insulation *material* (3.22) that systematically does not contain voids, or hollow particles

3.37
stalk
continuous string of welded and *field joint* (3.11) coated pipe, which is prepared in readiness for pipe spooling onto a R-*lay* (3.31) barge

Note 1 to entry: A number of stalks will normally be required to make up a *pipeline* (3.25).

3.38
subsea equipment
components from a subsea production system, including subsea processing items and structures, meant to control hydrocarbons, not including *pipelines* (3.25)

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

3.39
substrate
surface to which a *material* (3.22) is applied or will be applied

3.40
system
all of the various *materials* (3.22) 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* (3.39) at a single point, which function together to act as a *wet thermal insulation* (3.50)

3.41
system provider
entity which is selling the applied *system* (3.40)

3.42
system purchaser
entity which is purchasing the applied *system* (3.40)

3.43
thermal conductivity
k-value
conductivity
heat flow through a unit length of *material* (3.22) under the influence of a thermal gradient

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

3.44
thermoplastic
material (3.22), which is a polymeric compound that solidifies upon cooling and can flow and be reformed upon reheating

EXAMPLE Polypropylene.

3.45
tie-in field joint
connection of a *pipeline* (3.25) to a facility or *subsea equipment* (3.38), to other pipeline, or the connecting together of different sections of a single pipeline

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3.46
unit of production
quantity of product, given as either a percentage of total output, produced over a short period of time or produced from a specific combination of raw *material* (3.22) *batch* (3.3) numbers, as *agreed* (3.1)

Note 1 to entry: A short period of time can be for example up to 24 hours, or across shift changes, which is based on manufacturing capacity, job length and product line.

3.47
U-value
overall heat transfer coefficient
rate of heat transfer from a reference surface under the influence of a thermal gradient

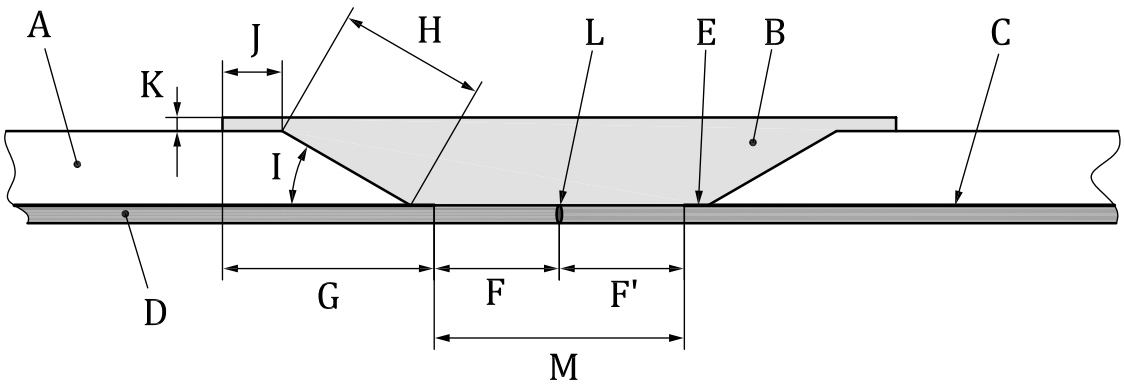
Note 1 to entry: U-value is expressed in $W \cdot m^{-2} \cdot K^{-1}$.

3.48
validation
demonstration of *material* (3.22) and *system* (3.40) performance during storage, handling and operation, within a specified envelope of use, as determined by the *system provider* (3.41)

3.49
validation dossier
collection of documentation and test reports, prepared in accordance with specific requirements, which provides detailed information on the proposed *system* (3.40), method of application, the *materials* (3.22) which form said *system* (3.40), and demonstration of *system* (3.40) performance

Note 1 to entry: Specific requirements are found in ISO 12736-1:2023, 7.6.

3.50
wet thermal insulation
system (3.40) that provides external corrosion protection and thermal insulation, and that is in direct contact with surrounding seawater



Key

A	factory applied mainline system	G	mainline system and field joint system interface
B	field joint system	H	chamfer
C	mainline ACC	I	chamfer angle
D	steel substrate	J	overlap length of field joint system over mainline system
E	exposed mainline ACC	K	thickness of field joint system overlap over mainline system
F	cutback	L	weld

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F' cutback, may not be the same as F

M field joint

4 Abbreviated terms

ACC	anti-corrosion coating
CP	cathodic protection
HSE	health, safety and the environment
MFR	melt flow rate
OD	outer diameter
QC	quality control
ROV	remotely operated vehicle

5 Conformance

5.1 Rounding

Unless otherwise stated in this document 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.

NOTE For the purpose of this provision, the rounding method of ASTM E29 is equivalent to ISO 80000-1:2022, Annex B, Rule A.

5.2 Conformity to requirement

Systems for quality and environmental management, and the competence of testing and calibration laboratories, should be used.

NOTE The following documents can be used:

— ISO 29001 gives sector-specific requirements with guidance for the use of quality management systems;

— ISO 14001 gives requirements with guidance for the use of environmental management systems;

— ISO/IEC 17025 gives general requirements for the competence of testing and calibration laboratories.

The system provider shall be responsible for conforming with all the applicable requirements for the application of this document. The system purchaser shall be allowed to make any investigation necessary to ensure conformity by the system provider and to reject any material and/or system that does not conform with this document.

6 Field joint material, system interfaces and repairs

6.1 Material classes

The wet thermal insulation systems covered by this document are based on materials classified in Table 1. Each material used to make up the field joint system shall have been classified into the appropriate class by the system provider as part of the validation dossier in accordance with ISO 12736-1.

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Table 1 — Material classes

	Solid/solid filled	Blown foam	Inorganic syntactic foam
Thermoplastics	1A	1B	1C
Liquid precursor non-elastomeric thermosets	2A	2B	2C
Liquid precursor elastomeric thermosets	3A	3B	3C
High molecular weight precursor thermosets	4A	4B	4C
NOTE Reproduction of ISO 12736-1:2023, Table 1.			

6.2 Types of interfaces

The different types of interfaces shall be defined as per Table 2.

Table 2 — Types of interfaces

	Interface reference	Interface description
R-lay	a)	Between factory applied system on a pipeline and onshore field applied system applied over a field joint between two pipeline sections. This interface can be between similar or dissimilar materials.
	b)	Between factory applied system on a pipeline and onshore field applied system applied over a tie-in field joint between two pipeline sections. This interface can be between similar or dissimilar materials.
	c)	Between factory applied system on a pipeline and offshore field applied system applied over a tie-in field joint between two pipeline sections. This interface can be between similar or dissimilar materials.
S or J-lay	d)	Between factory applied system on a pipeline and onshore field applied system applied over a field joint between two pipeline sections. This interface can be between similar or dissimilar materials.
	e)	Between factory applied system on a pipeline and offshore field applied system applied over a field joint between two pipeline sections. This interface can be between similar or dissimilar materials.
Subsea equipment	f)	Between a field joint system bridging a factory applied system on a pipeline and a system on subsea equipment at the fitting. This interface is typically between dissimilar materials, possibly on both sides.

Each field joint has two interfaces. In the case of multilayer systems, interfaces may be made up of multiple sub-interfaces.

7 Project specific qualification processes for production and application procedures for field joints

7.1 General requirements

The following requirements apply for project specific qualification and QC activities:

a) All materials and systems shall be previously validated in conformity with the requirements of ISO 12736-1. ACC should be applied in accordance with ISO 21809-3.

b) The validation dossier of the materials and systems shall be given by the system provider to the system purchaser and/or end user for approval.

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c) If the ACC selected by the system purchaser is different from the one used by the system provider for validation, both parties shall agree upon a test program to ensure that ACC and materials are compatible for the project requirements.

d) The preparation of a project specific APS and related ITP is required and shall be approved by the system purchaser and/or end user.

e) If requested by the system purchaser, a PQT can be performed for qualification of the approved APS (or part of it) and performed according to an approved ITP.

f) Before production starts, a PPT shall be performed according to a dedicated ITP. By agreement, the PPT and the PQT can be executed at the same time, i.e. the PQT and PPT can be merged.

g) Those parts of the project specific qualification process that are waived by the system purchaser shall be clearly stated and identified in the contract.

h) During the production, an inspection system shall be implemented by the system provider to monitor and execute all the inspection activities reported in the approved ITP for production.

i) Inspection and testing shall be carried out during production in accordance with the approved ITP.

j) Test procedures, testing frequencies and acceptance criteria shall be defined in the ITP.

k) If other materials than those classified in Table 1 are used, the system provider shall have identified the class that most closely represents the material and shall provide a gap analysis to the requirements for that class to be included in the validation dossier.

l) Damaged areas created by testing shall be removed and repaired in accordance with Clause 9.

m) The system provider shall prepare a set of samples or pipe sections according to the dimensions and characteristics approved by the system purchaser, in order to perform any required destructive tests on the applied system.

n) All data collected during inspections and tests shall be recorded in a proper form and shall be delivered to the system purchaser as required in the ITP.

7.2 Purchase order requirements

7.2.1 General information

The purchase order, and optionally the request for quotation if known, shall include the following information:

a) reference to this document (i.e. ISO 12736-3:2023);

b) type of interfaces as per 6.2, FJ system and system(s) as per 6.1 to be overlapped;

c) project conditions (e.g. water depth, operating and design temperature, installation method);

d) thermal performance requirements;

e) identification and description of item to be insulated (e.g. item quantity, outside diameter, external geometry, wall thickness, nominal length, grade of steel, cutback configuration and pipe ends finish, at least cutback length and chamfer angle, length of visible epoxy, presence of temporary protection;

f) identification of the ACC selected by system purchaser or already applied to the items to be insulated;

g) requirement for execution of any PQT;

h) type of inspection document in accordance with ISO 10474;

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i) laying method and details of installation including, but not limited to, installation temperature, any bending strain or gripping requirements, time constraints, vessel space constraints, if relevant.

7.2.2 Additional information

The purchase order should specify which of the following provisions apply for the specific item ordered:

a) special requirements relative to supply of materials (e.g. manufacturer-specific products and certification);

b) items to be insulated tracking and traceability of items to material batches;

c) inspection of incoming items;

d) holiday inspection of ACC before application of system, including responsibility for repair of anticorrosion coating;

e) ITP and/or daily log;

f) required modifications to PQT, if applicable, PPT or production ITP requirements with respect to the requirements of this document;

g) additional PQT test requirements (e.g. functional testing);

h) marking of insulated item and any colour coding requirement at external surface;

i) permissible number of repairs on applied system, maximum area of repair and acceptable locations of repairs;

j) entity responsible for performing repairs;

k) handling and storage procedures;

l) protection against adverse ambient conditions during storage;

m) documentation and schedule for supply of documentation.

7.3 Production qualification process

7.3.1 Process description

The production qualification process consists of:

— PQT, if applicable, which shall be performed in conformance with an approved APS and its related ITP (see 7.3.3, 7.4.1 and 7.4.2, respectively);

— PPT, which shall be performed in conformance with an approved APS and its related ITP (see 7.3.4, 7.4.1 and 7.4.2, respectively);

— inspection during production (see 7.3.5), which shall be performed in conformance with an approved ITP.

If requested and agreed per 7.2.2 item f, the PQT and the PPT may be performed at the same time, just before production start. In this case, the PQT and PPT tests can be merged.

It is allowed to issue only one APS and one ITP grouping the PPT and production activities.

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7.3.2 Project specific qualification considerations

Functional tests may be requested by the system purchaser if the specific project conditions are outside the test parameter ranges, reported in the validation dossier, or to provide additional information to support the specific project requirements (e.g. cyclic loading for steel catenary risers).

NOTE Examples of tests that can be applicable:

— Bend test (for interfaces types a and b);

— Roller box test for interface type e (S-lay only).

Special cases resulting in discontinuities and/or inclusions in the FJ shall also be considered (e.g. an anode bracket).

Typically, functional tests are performed during the PQT to allow for availability of results and identification of risks in advance of production.

7.3.3 Procedure qualification trial

If required by the system purchaser, the APS shall be validated by a PQT. Test methods, acceptance criteria and frequencies for the PQT shall be in accordance with Table 2 to Table 9 and shall be specified in the ITP.

The main purpose of the PQT is to demonstrate that the APS, ITP, equipment and personnel (e.g. skills relevant to their tasks) are able to apply the selected field joint system to achieve the stated performance of the system in accordance with the validation dossier. It is not intended to validate the selection of the system for a project. However, the APS and ITP used in the PQT can be compared with the APS and ITP used for the field joint system application during system validation and, if applicable, a gap analysis can be carried out.

For projects with specific requirements outside the envelope of testing and historical data contained within the validation dossier, the PQT may also be utilized to test and demonstrate project specific performance at the system purchaser's request.

Repair procedures shall be established for each system in accordance with Clause 9. Repair procedures shall include repair down to steel. Repair procedures shall be tested at the PQT stage.

Evaluation of the removal of deteriorated/damaged system and repair shall be part of the PQT. The selected methods shall be risk assessed to ensure there is no damage to the metallic substrate. HSE risks associated with removal of the system shall be assessed before the PQT.

The PQT should be carried out in the presence of the system purchaser (or their representative), unless otherwise agreed in the order.

The system provider may request the material manufacturer to assist during the PQT to ensure the correct processing and application of the material(s) and to train the system provider's personnel.

Qualification tests shall be carried out on representative pipes or subsea components. The shape of the workpiece shall simulate stress raisers present on the actual piece(s) to be coated. The length and volume of material on the workpiece shall be representative. A feature representing a weld cap in the steel structure shall be included in the test piece.

If heating of the area to be coated is specified in the APS, parameters shall be optimized to minimize detrimental effect to the existing system to be overlapped.

All tools and equipment (e.g. for induction heating, abrasive blasting, material application and inspection) to be used for PQT shall be of the same model/type as those to be used for the actual production (identical serial number on tools and equipment is not required for PQT vs production).

The system provider shall submit a complete report of the qualification test results to the system purchaser and/or end user for approval.

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Relevant parameters for the application process recorded during PQT shall be implemented during PPT and production. The allowable ranges for these parameters should be agreed in the APS and ITP between the system provider and system purchaser. If these parameters fall outside the required ranges, additional testing shall be performed to demonstrate equal or better performance when compared to PQT and PPT.

7.3.4 Pre-production trial

A PPT shall be performed at start of production to verify the PQT or any previous qualification or historical data.

If agreed by the purchase order and if a PQT is performed just before production start, the PPT can be considered as included in the PQT itself with no need for repetition.

Test methods, acceptance criteria and frequencies for PPT are identified in the Table 3 to Table 10 (see 8.5) and shall be specified for the system in a dedicated ITP.

PPT shall be carried out in the presence of the system purchaser (or their representative) at the start of operations when equipment and personnel are mobilized on site or on the laying vessel. For special cases, the PPT can be performed at another location than actual production, as agreed. The PPT shall be performed on the first field joint to be coated or, if agreed, on a dummy pipe or structure which is representative of the project requirements in length, volume, and shape.

The system provider shall submit a complete report of the tests containing the values and other results obtained in the PPT.

7.3.5 Production testing

The system provider shall perform inspection and testing during production as detailed in Table 3 to Table 10 (see 8.5) and in accordance with an ITP to verify the substrate preparation, raw materials and system application.

The ITP shall be prepared by the system provider and shall be approved by the system purchaser and/or end user prior to the start of production. The ITP shall identify all inspection activities and tests, their frequency and the relevant inspection authorities.

7.4 Application procedures

7.4.1 Application procedure specification

The APS shall be prepared by the system provider based upon their experience and the material data sheet, SDS and application instructions. Before use and before the start of the PQT/PPT, the APS shall be approved by the system purchaser and/or end user. Once approved, the APS shall not be changed without prior written authorization from the system purchaser.

The responsibilities and interactions between each party involved in the process shall be clearly described.

The APS shall be specific to the system being applied.

The APS shall cover all items associated with quality control as defined in this document and any agreed options for the specific system.

All application work, testing and inspection shall be carried out according to the APS.

The APS shall address the following as a minimum, where applicable to the system:

a) material(s) identification;

b) tools, consumables, and equipment required to apply the system;

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c) equipment set up and calibration of instrumentation;

d) approved solvents or other cleaning agents to be used to clean substrate;

e) inspection of existing ACC (e.g. cutback, bevel, holiday detection, repairs and precaution measures, when necessary);

f) preparation of substrates, including final surface profile, materials and contamination mitigation;

g) preheating methods, for existing system and repair material;

h) substrate temperature range for substrate preparation;

i) ambient conditions considering dew point temperature at the substrate to be coated;

j) material preparation requirements (e.g. drying, mixing, pot life and thinning procedures, vacuum, extrusion parameters, pre-heats);

k) system thickness range;

l) system application method and critical equipment range settings;

m) material/system curing or cooling schedule and conditions, including limitations, such as minimum time before mould removal and minimum time before movement of item;

n) overcoat time, if applicable;

o) repair methods, considering the range of possible repair scenarios from surface damage to damage down to steel, and repairs performed in the fabrication location and remote locations;

p) removal procedure;

q) remedial actions;

r) time to inspection;

s) handling and storage requirements for raw materials and insulating joints, including the following, as applicable:

   1) temperature limitations (e.g. freezing, excessive heat);

   2) humidity;

   3) protection from the elements (e.g. snow, rain, sunlight);

   4) protection from contaminants (e.g. dust, water, chemicals);

   5) expiration date;

   6) protection from physical damage.

t) handling of insulated pipes and cutback as applicable, including the following:

   1) temperature limitations (e.g. freezing, excessive heat);

   2) humidity;

   3) protection from the elements (e.g. snow, rain, sunlight);

   4) protection from contaminants (e.g. dust, water, chemicals);

   5) protection from physical damage.

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7.4.2 Inspection and testing plan

A dedicated ITP shall be prepared by the system provider for each of the process steps (PQT, PPT, production). The contents of the ITP shall reflect all the process items, the items to be inspected and tested including the frequency thereof, and acceptance criteria.

The following activities shall be listed at the minimum:

a) description of the activities;

b) identification of coated item and substrate;

c) selected system;

d) inspection points for each of the activities;

e) applicable reference documents including procedures and methods;

f) applicable instruments and tools;

g) acceptance criteria;

h) frequency of the checks;

i) type of report;

j) persons/parties required to be present at the inspections/intervention points.

All reporting and logs (e.g. traveller sheets, job cards) shall at least include all the requirements of the ITP.

7.4.3 Qualification of operators

7.4.3.1 General

The qualification, via specific training scheme, may be verified by demonstration at PQT (if any), during PPT, or during supervised participation in production. The specific training scheme is established by the system provider subject to approval by the system purchaser and/or end user.

The system provider may request the material manufacturer(s) and equipment suppliers to provide technical assistance to the operators if necessary.

Proof of successful qualification shall be documented.

Inspectors carrying out the QC activities and inspection shall be trained and qualified.

The inspector competency may be demonstrated by attested experience, specific training by the system provider and/or by the certification body in conformance with the certification schemes approved by the system purchaser and/or end user.

7.4.3.2 Requirements

The system provider shall be responsible for ensuring that the operators are trained and qualified for their specific activity prior to the start of work by:

a) preparing test samples in accordance with the approved APS;

b) evaluating test samples against acceptance criteria;

c) evaluating general competency under criteria described in this subclause.

Test samples shall be made of pipe or components that approximate, as closely as practicable, to the situations and conditions that will be found during construction or repair.

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