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Oil and gas industries including lower carbon energy — Thermoplastics lined tubing for wells

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Foreword

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This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 5, *Casing, tubing and drill pipe*.

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.

Oil and gas industries including lower carbon energy — Thermoplastics lined tubing for wells

1 Scope

This document specifies requirements for downhole thermoplastics lined tubing (TLT) used in the oil and gas industries , including configuration, materials, manufacturing, inspection and testing, documentation, marking, packaging, transportation, storage and use.

This document is applicable to downhole thermoplastics lined tubing (TLT) used in contact with media related to oil and gas exploration and production (which involves multiphase flow, as well as water injection).

This document is suitable for thermoplastics including but not limited to polyethylene (PE), polyethylene of raised temperature resistance (PE-RT), ultra-high molecular weight polyethylene (PE-UHMW), crosslinked polyethylene (PE-X), polypropylene (PP), unplasticized polyamide (PA-U), polyketone (PK), polyphenylene sulfide (PPS), polyvinylidene fluoride (PVDF), and polyetheretherketone (PEEK) which meet the requirements of relevant design specifications, standards or regulations.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes the 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 472:2013, *Plastics — Vocabulary*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 10405:2000, *Petroleum and natural gas industries — Care and use of casing and tubing*

ISO 10893-3, *Non-destructive testing of steel tubes — Part 3: Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections*

ISO 11960:2020, *Petroleum and natural gas industries — Steel pipes for use as casing or tubing for wells*

ISO 13678, *Petroleum and natural gas industries — Evaluation and testing of thread compounds for use with casing, tubing, line pipe and drill stem elements*

ISO 13679, *Petroleum and natural gas industries — Procedures for testing casing and tubing connections*

ISO 15156-2, *Petroleum and natural gas industries — Materials for use in H2S-containing environments in oil and gas production — Part 2: Cracking-resistant carbon and low-alloy steels, and the use of cast irons*

ISO 15527, *Plastics — Compression-moulded sheets of polyethylene (PE-UHMW, PE-HD) — Requirements and test methods*

ISO 23936-1:2022, *Petroleum, petrochemical and natural gas industries — Non-metallic materials in contact with media related to oil and gas production — Part 1: Thermoplastics*

API RP 5B1, *Gauging and Inspection of Casing, Tubing and Pipe Line Threads*

API Spec 5B, *Specification for Threading, Gauging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads*

API Spec 15S:2020, *Spoolable Reinforced Plastic Line Pipe*

API 17 TR-2, *The Ageing of Offshore Polyamides PA 11 and PA 12 in Flexible Pipes*

ASTM A700, *Standard Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and the following 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/

3.1.1
backing pipe
tubing before being lined with a thermoplastic *liner* (3.1.12)

[SOURCE: ISO/PAS 24565:2022, 3.1.1, modified — "ceramic liner" has been replaced by "a thermoplastic liner".]

3.1.2
batch release test
BRT
test performed by or on behalf of the manufacturer on a batch of products, which must be satisfactorily completed before the batch can be released

3.1.3
bonding strength
shear stress required to strip off the *liner* (3.1.12) from the *backing pipe* (3.1.1) along the axial direction

3.1.4
compatibility
degradation degree of material properties caused by physical or chemical reactions with produced or injected fluids, as well as the stability of the materials in sunlight

3.1.5
CB ring
corrosion barrier ring
polymeric ring inserted between adjacent lengths of *liner* (3.1.12) in a tubing string to provide continuity of corrosion protection

[SOURCE: ISO/PAS 24565:2022, 3.1.6, modified — The full form "corrosion barrier ring" has been changed from a preferred term to an admitted term.]

3.1.6
coupling
internally threaded cylinder for joining two lengths of threaded pipe

[SOURCE: ISO 11960:2020, 3.1.8]

3.1.7
drift mandrel
device used to check the size of casing and tubing before it is run

Note 1 to entry: The drift mandrel is put through each joint of casing and tubing to make certain the inside diameters are sizes specified for the particular job.

3.1.8
flare of the liner end
edge formed by turning the outer edge of the *thermoplastic pipe* (3.1.17) along the cross-section of the *backing pipe* (3.1.1)

3.1.9
gas transmission rate
volume of gas passing through a plastic material, per unit area and unit time, under unit partial-pressure difference between the two sides of the material

Note 1 to entry: It is expressed as volume value at standard temperature and pressure, in $cm^3/(m^2 \cdot d \cdot Pa)$.

[SOURCE: ISO 15105-1:2007, 3.1, modified — The abbreviated term "GTR" has been removed; the original note 1 to entry has been replaced by a new one.]

3.1.10
gas permeability
volume of gas passing through a plastic material of unit thickness, per unit area and unit time, under unit partial-pressure difference between the two sides of the material

Note 1 to entry: It is expressed as volume value at standard temperature and pressure, in $cm^3 \cdot cm/(cm^2 \cdot s \cdot Pa)$.

[SOURCE: ISO 15105-1:2007, 3.2, modified — The admitted term "coefficient of gas permeability" and the symbol "*P*" have been removed; the original notes to entry have been replaced by a new one.]

3.1.11
lable 1
dimensionless designation for the size or specified outside diameter that can be used when ordering the pipe

Note 1 to entry: see Table 1.

[SOURCE: ISO 11960:2020, 3.1.24, modified — Note 1 to entry has been added.]

3.1.12
liner
thermoplastic pipe (3.1.17) lined onto the inner wall of the *backing pipe* (3.1.1)

Note 1 to entry: The liner is aimed at preventing corrosion and scaling, and improving wear resistance.

3.1.13
maximum operating temperature
maximum temperature to which a component is subjected, including deviations from normal operations, such as start-up/shutdown

[SOURCE: ISO 23936-1:2022, 3.1.12]

3.1.14
premium connection
threads used in tubing and casing of which the structure and characteristics are different from those specified in API standards

3.1.15
renovation
work incorporating all or part of the original fabric of the pipeline, by means of which its current performance is improved

[SOURCE: ISO 11295:2022, 3.1.6]

3.1.16
thermoplastic, noun
plastic that is capable of being softened repeatedly by heating and hardened by cooling through a temperature range characteristic of the plastic and, in the softened state, of being shaped by flow repeatedly into articles by moulding, extrusion, or forming

Note 1 to entry: See ISO 472:2013, 2.1177 and 2.1178.

3.1.17
thermoplastic pipe
extruded pipe with *thermoplastic* (3.1.16) as the main raw material and no more than 5 % of other components added

3.1.18
thermoplastics lined tubing
TLT
steel tubing with *thermoplastic pipe* (3.1.17) lined onto its inner wall by diameter-compression and/or drawing processes

3.1.19
type test
TT
test performed to prove that the product is capable of conforming to the requirements given in the relevant standard

Note 1 to entry: The type test results remain valid until there is a change in the product provided that the process verification tests are done regularly.

3.2 Symbols and abbreviated terms

3.2.1 Symbols

t	wall thickness of liner

3.2.2 Abbreviated terms

CB	corrosion barrier
ID	inner diameter of backing pipe
OD	outer diameter of liner
PA-U	polyamide, unplasticized (PA-U11, PA-U12)
PE	polyethylene (PE-HD, PE-MD)
PE-RT	polyethylene of raised temperature resistance
PE-UHMW	ultra-high molecular weight polyethylene
PE-X	polyethylene, crosslinked (PE-Xb)
PEEK	polyetheretherketone
PK	polyketone
PP	polypropylene (PP-H, PP-B, PP-R, PP-RCP)
PPS	polyphenylene sulfide

PTFE polytetrafluoroethylene

PVDF polyvinylidene fluoride

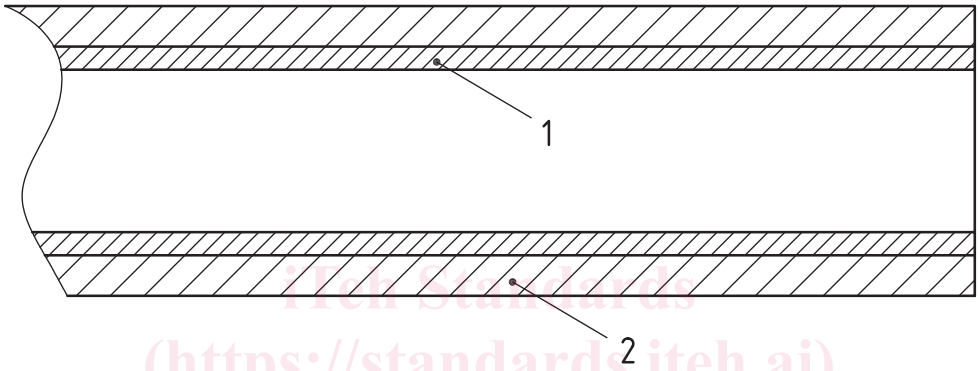
4 TLT configuration

4.1 Configuration

TLT consists of the backing pipe and the liner. The typical configuration of TLT body under mechanical fit design is shown in Figure 1.

Other manufacturers may pump a holding layer of viscous material that hardens over time (grout) to fill the annulus between the backing pipe nominal ID and the liner OD.

The purchasers shall select the appropriate design and performance requirements based on downhole conditions, well type and other commercial considerations.



Key

1 liner

2 backing pipe

Figure 1 — Configuration of TLT body

4.2 Pipe ends

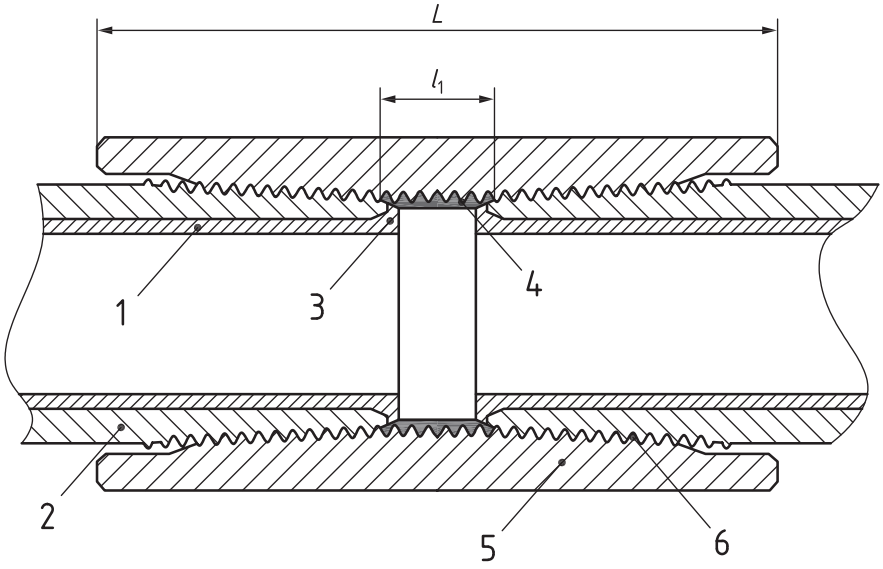
Unless otherwise specified in the order, backing pipes for TLT shall be supplied with API Spec 5B threads at both ends and with corresponding couplings. If specified in the order, backing pipes shall be supplied with threads at both ends and without couplings, or with other premium connections.

4.3 Connection type

Lengths of backing pipes shall be connected with each other with couplings. Example of the connection type is shown in Figure 2. The minimum coupling length shall conform to the requirements specified in Table 1. CB rings are usually equipped on the inner wall of the coupling to ensure liner continuity for corrosion protection of exposed backing pipe and connection. The length of the CB ring shall conform to the requirements specified in Table 2. Other forms of coupling protection, such as coatings, may be used, but the coupling make-up torque shall not be affected.

The flare of the liner end shall extend over the whole end of the backing pipe and shall be in contact with the CB ring in the coupling putting the CB ring in compression, thus ensuring the integrity of the whole connecting structure. Other forms of coupling protection are acceptable.

The previously mentioned requirements are applicable for all manufacturers' technologies including grout backed lining.



Key

1 liner
2 backing pipe
3 flare of the liner end
4 CB ring (or coating)
5 coupling
6 threads
l_1 CB ring length
L coupling length

Figure 2 — Example configuration of TLT connection

Table 1 — The minimum length of the coupling

Lable 1	Minimum length of coupling, L mm	
	non-upset tubing	external upset tubing
2-3/8	124	140
2-7/8	151	158
3-1/2	166	171
4-1/2	182	186

Table 2 — Length range of CB ring

Lable 1	CB ring length, l_1 mm
2-3/8	30 to 40
≥2-7/8	40 to 55