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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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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~~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](http://www.iso.org/directives)).

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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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 67, ~~Materials, equipment~~Oil and offshore structures for petroleum, petrochemical and natural 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](http://www.iso.org/members.html).

## Introduction

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

In this document, the following verbal forms are used:

- “shall” indicates a requirement;
- “should” indicates a recommendation;
- “can” indicates a possibility or a capability;
- “may” indicates a permission.

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# 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 ~~petroleum~~oil and ~~natural~~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 11295:2022, *Classification and information on design and applications of plastics piping systems used for renovation and replacement*~~

~~ISO-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 15105 1:2007, *Plastics — Film and sheeting — Determination of gas transmission rate — Part 1: Differential pressure methods*~~

~~ISO-ISO 15156-2, *Petroleum and natural gas industries — Materials for use in H<sub>2</sub>S-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/DPAS 16846(E:(en))

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*

~~ISO/PAS 24565:2022, *Petroleum and natural gas industries — Ceramic lined tubing*~~

~~CEN/TS 14541:2013, *Plastics pipes and fittings — Characteristics for utilization of non virgin PVC-U, PP and PE materials*~~

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 ~~terminological~~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)~~ (3.1.12) ~~ds/iso/729a5fd8-3600-4819-b7dc-389dabfd7c7b/iso-dpas-16846~~

[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 ~~needs to~~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)~~ (3.1.12) from the backing pipe ~~(3.1.1)~~ (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

**CB 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**

~~A 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.

~~3.1.3 —~~

~~**external reprocessed material**~~

~~material from the production of unused thermoplastic products, regardless of where they are manufactured~~

~~[SOURCE: CEN/TS 14544:2013, 3.1.3]~~

~~3.1.123.1.8~~

~~**flare of the liner end**~~

~~edge formed by turning the outer edge of the *thermoplastic pipe* (3.1.17) (3.1.20) along the cross-section of the *backing pipe* (3.1.1) (3.1.1) —~~

~~3.1.133.1.9~~

~~**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: ~~Expressed It is expressed~~ as volume value at standard temperature and pressure, in cm<sup>3</sup>/(m<sup>2</sup>·d·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.~~

~~3.1.143.1.10~~

~~**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: ~~Expressed It is expressed~~ as volume value at standard temperature and pressure, in cm<sup>3</sup>·cm/(cm<sup>2</sup>·s·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.~~

~~3.1.153.1.11~~

~~3.1.1 —~~

ISO/DPAS 16846(E:(en))

**Table 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.]

Note 1 to entry: see Table 1.

**3.1.173.1.12**

**liner**

thermoplastic pipe (3.1.17(3.1.20)) lined onto the inner wall of the backing pipe (3.1.1(3.1.1)-)

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

**3.1.183.1.13**

**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]

**3.1.193.1.14**

**own reprocessed material**

material prepared from rejected unused pipes, gutters, fittings and ancillaries, including trimmings from the production, that will be reprocessed in a manufacturer's plant after having been previously processed by the same manufacturer by a process such as moulding or extrusion and for which the complete formulation is known

[SOURCE: CEN/TS 14541:2013, 3.1.2]

**3.1.2**

**premium connection**

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

**3.1.203.1.15**

**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]

**3.1.213.1.16**

**recycled material**

material from used thermoplastic products which have been cleaned and crushed or ground

[SOURCE: CEN/TS 14541:2013, 3.1.4]

**3.1.3**

**thermoplastic, noun**

plastic that has thermoplastic properties which 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

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

3.1.223.1.17

**thermoplastic pipe**

extruded pipe with *thermoplastic* (3.1.16(3.1.19)) as the main raw material and no more than 5 % of other components added

3.1.233.1.18

**thermoplastics lined tubing**

**TLT**

steel tubing with *thermoplastic pipe* (3.1.17(3.1.20)) lined onto its inner wall by diameter-compression and/or drawing processes

3.1.243.1.19

**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 (3.1.13)~~

$t$  — wall thickness of liner

**3.2.2 Abbreviated terms**

~~CB — corrosion barrier~~

~~ID — inner diameter of backing pipe (3.1.1)~~

~~OD — outer diameter of liner (3.1.13)~~ <https://standards.iso.org/iso/729a5fd8-3600-4819-b7dc-389dabfd7c7b/iso-dpas-16846>

~~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~~

## ISO/DPAS 16846(E:en)

BRT — batch release test

TLT — thermoplastics lined tubing

TT — type test

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.

