INTERNATIONAL STANDARD

ISO 11296-4

Second edition
2018-02

Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks —

Part 4: Lining with cured-in-place pipes

Systèmes de canalisations en plastique pour la rénovation des réseaux de branchements et de collecteurs d'assainissement enterrés sans pression —

Partie 4: Tubage continu par tubes polymérisés sur place

Reference number
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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 on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 8, *Rehabilitation of pipeline systems*.

This second edition cancels and replaces the first edition (ISO 11296-4:2009), which has been technically revised.

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

— the service temperature range has been explicitly stated in the scope;

— in Clause 3, new definitions have been added for temporary, permanent and semi-permanent membranes, with Annex A and the definition of preliner updated accordingly; for nominal wall thickness specialized for CIPP; and for service temperature and type testing adopted from other standards;

— type “R” and “E-CR” glass fibres have been added to Table 1;

— the requirements on “M” stage strength characteristics of the neat resin system have been removed in Table 2, as they have been effectively covered in Table 5 by the “I” stage requirements on mechanical characteristics of the cured composite;

— new requirements for the nature of the bond of any semi-permanent internal membrane to the underlying composite, and for declaration of class of composite in accordance with ISO 14125, have been added in 8.1;

— a new subclause has been added to 8.5 to specify reference temperature for testing, and procedure for determining temperature re-rating factors where required;

— separate tables for short and long-term mechanical characteristics have been created in 8.5, and minima for declared values removed except for ring stiffness, strain capacity and creep factor;

— the following have been added to Table 6:

  a) option of ring test for wet creep factor;

  b) test for long-term flexural strength under dry or wet conditions by the method detailed in the new Annex D;

— a test for stress corrosion (new Annex D test in acid environment) has been added to Table 7;

— further requirements for documenting specific installation parameters and procedures, and the related environmental precautions, in the installation manual for each individual CIPP technique, have been added in 9.4;

— requirements for documentation in the installation manual of technique-specific methods for sealing liner connections at manholes and laterals have been added in 9.7;

— Annex B has been revised to relax curvature restriction on 3-point bend test samples, and to include a full new procedure for calculation and reporting of test results without partial reference to ISO 178;

— the previous Annexes C and D has been merged into a single new Annex C specifying a common procedure for determination of long-term modulus under either dry or wet conditions.

A list of all the parts in the ISO 11296 series can be found on the ISO website.

Introduction

System standards dealing with the following applications are either available or in preparation:

— ISO 11296, *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks* (this document);

— ISO 11297, *Plastics piping systems for renovation of underground drainage and sewerage networks under pressure*;

— ISO 11298, *Plastics piping systems for renovation of underground water supply networks*;

— ISO 11299, *Plastics piping systems for renovation of underground gas supply networks*.

These system standards are distinguished from those for conventionally installed plastics piping systems because they set requirements for certain characteristics in the “as-installed” condition after site processing. This is in addition to specifying requirements for plastics piping system components, “as manufactured”.

This document (system standard) comprises a

— *Part 1: General*

and the following technique family-related parts:

— *Part 2: Lining with continuous pipes*;

— *Part 3: Lining with close-fit pipes*;

— *Part 4: Lining with cured-in-place pipes*;

— *Part 5: Lining with discrete pipes*;

— *Part 7: Lining with spirally-wound pipes*;

— *Part 8: Lining with pipe segments*;

— *Part 9: Lining with a rigidly anchored plastics inner layer*;

— *Part 10: Lining with sprayed polymeric materials*.

The requirements for any given renovation technique family are given in ISO 11296-1 applied in conjunction with the other relevant parts. For example, both ISO 11296-1 and this document together specify the requirements relating to lining with cured-in-place pipes. For complementary information, see ISO 11295. Not all technique families are applicable to every area of application and this is reflected in the part numbers included in each system standard.

A consistent structure of clause headings has been adopted for all parts to facilitate direct comparisons across renovation technique families.

Figure 1 shows the common structure and the relationship between ISO 11296 and the system standards for other application areas.

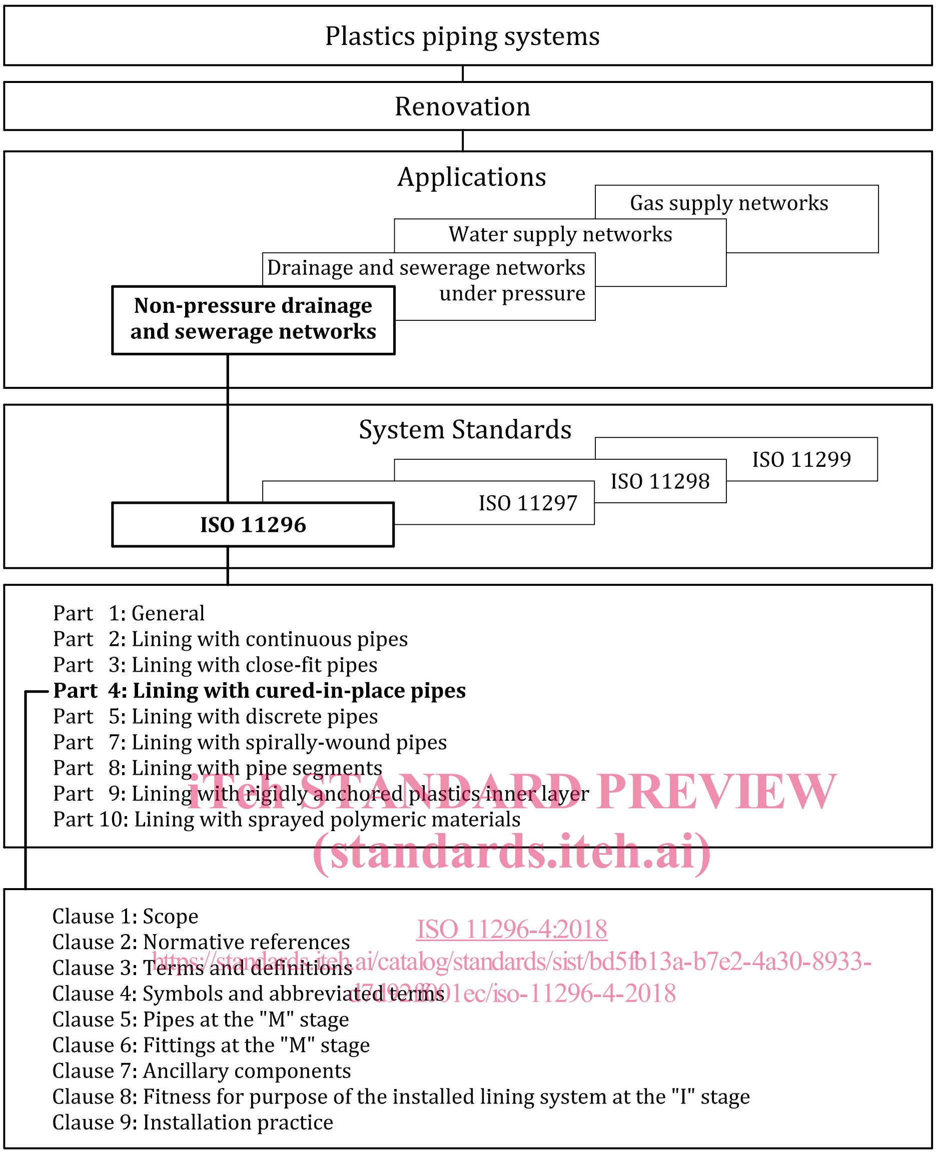

Figure 1 — Format of the renovation system standards

Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks —

Part 4:
Lining with cured-in-place pipes

1 Scope

This document, in conjunction with ISO 11296-1, specifies requirements and test methods for cured-in-place pipes and fittings used for the renovation of underground non-pressure drainage and sewerage networks with service temperatures up to 50 °C.

It applies to the use of various thermosetting resin systems, in combination with compatible fibrous carrier materials, reinforcement, and other process-related plastics components (see 5.3).

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 75-2:2013, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 178:2010+A1:2013, *Plastics — Determination of flexural properties*

ISO 899-2:2003, *Plastics — Determination of creep behaviour — Part 2: Flexural creep by three-point loading*

ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

ISO 4435, *Plastics piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride) (PVC-U)*

ISO 7684, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the creep factor under dry conditions*

ISO 7685:1998, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of initial specific ring stiffness*

ISO 8513:2016, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Test methods for the determination of the initial longitudinal tensile strength*

ISO 8773, *Plastics piping systems for non-pressure underground drainage and sewerage — Polypropylene (PP)*

ISO 10467:—[1], *Plastics piping systems for drainage and sewerage with or without pressure — Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP) — Specifications for pipes, fittings and joints*

ISO 10468, *Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the long-term specific ring creep stiffness under wet conditions and calculation of the wet creep factor*

ISO 10928:2016, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Methods for regression analysis and their use*

1) To be published. (Revises ISO 10467:2004)

ISO 10952, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Determination of the resistance to chemical attack for the inside of a section in a deflected condition*

ISO 11296-1:2018, *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks — Part 1: General*

ISO 13002, *Carbon fibre — Designation system for filament yarns*

ISO 14125:1998+A1:2011, *Fibre-reinforced plastic composites — Determination of flexural properties*

EN 14364:2013, *Plastics piping systems for drainage and sewerage with or without pressure. Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP). Specifications for pipes, fittings and joints*

3 Terms and definitions

For the purposes of this document the terms and definitions given in ISO 11296-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org./obp

3.1 General terms

3.1.1
abrasion layer
inner layer of composite of declared thickness provided as a sacrificial layer for anticipated abrasion of the *CIPP product* (3.1.3) in service

3.1.2
carrier material
porous component of the liner, which carries the liquid *resin system* (3.1.16) during insertion into the pipe being renovated and forms part of the installed lining system once the resin has been cured

3.1.3
CIPP product
cured-in-place pipe product
cured-in-place pipe of a particular design, produced from a liner of specified materials, with a wall structure which is uniquely defined for each diameter/wall thickness combination, and which is impregnated with a specific *resin system* (3.1.16) and installed by a specific process

3.1.4
CIPP unit
specific cured-in-place pipe produced from a continuous liner, which has been impregnated in one process and installed as a single length

3.1.5
close fit
situation of the outside of the installed liner relative to the inside of the existing pipeline, which can either be an interference fit or include a small annular gap resulting from shrinkage and tolerances only

3.1.6
composite
combination of cured *resin system* (3.1.16), *carrier material* (3.1.2) and/or *reinforcement* (3.1.15), excluding any internal or external membranes

3.1.7
curing
process of resin polymerization, which may be initiated or accelerated by the use of heat or exposure to light

3.1.8
design thickness
required wall thickness of the *composite* (3.1.6), excluding any *abrasion layer* (3.1.1), as determined by structural design

3.1.9
first break
elastic limit or first major discontinuity of the stress-strain curve associated with local failure of the resin matrix or reinforcing fibres

3.1.10
lateral connection collar
fitting for reconnecting a lined main pipe to an existing or renovated lateral pipe

3.1.11
lining tube
flexible tube, consisting of *carrier material* (3.1.2) , *resin system* (3.1.16) and any membranes and/or *reinforcement* (3.1.15), as combined prior to insertion in the pipe to be lined

3.1.12
nominal CIPP wall thickness
one of a range of discrete lining tube wall thicknesses dictated by the sum of the thicknesses of the individual layers of materials used for tube construction at the "M" stage

3.1.13
permanent membrane
internal or external membrane designed to retain its integrity through the processes of lining tube insertion and *resin system* (3.1.16) cure, and to provide functions for the operational life of the CIPP liner

3.1.14
preliner
permanent or semi-permanent external membrane which is installed separately before the insertion of the resin-impregnated *lining tube* (3.1.11)

3.1.15
reinforcement
fibres incorporated in the liner which enhance the dimensional stability of the liner and/or the structural properties of the cured *composite* (3.1.6)

Note 1 to entry: The reinforcement can be incorporated in the *carrier material* (3.1.2), constitute the carrier material, or can be a separate layer.

3.1.16
resin system
thermosetting resin including the *curing* (3.1.7) agent(s) and any fillers or other additives in specified proportions

3.1.17
semi-permanent membrane
internal or external membrane designed to retain its integrity through the processes of *lining tube* (3.1.11) insertion and *resin system* (3.1.16) cure, but not relied on to retain its integrity at the "I" stage

3.1.18
service temperature
maximum sustained temperature at which a system is expected to operate

Note 1 to entry: Service temperature is expressed in degrees Celsius (°C).

3.1.19
temporary membrane
membrane forming the internal or external surface of the pipe at the “M” stage, with functions at the “M” stage only

Note 1 to entry: It is removed during or after the installation.

3.1.20
total thickness
thickness of CIPP at the "I" stage comprising the *composite* (3.1.6) and any *semi-permanent* (3.1.17) and *permanent membranes* (3.1.13)

3.1.21
type testing
testing performed to prove that the material, product, joint or assembly is capable of conforming to the requirements given in the relevant standard

3.2 Techniques

3.2.1
inversion
process of turning a flexible tube or hose inside out by the use of fluid (water or air) pressure

3.2.2
inverted-in-place insertion
method whereby the impregnated lining tube is introduced by *inversion* (3.2.1) to achieve simultaneous insertion and inflation

3.2.3
winched-in-place insertion
method whereby the flat impregnated lining tube is first pulled into the pipe to be lined and then inflated to bring it up to size

Note 1 to entry: With some techniques, inflation is achieved by *inversion* (3.2.1) through the pulled-in *lining tube* (3.1.11) of a separate impregnated tube or dry hose, which is either withdrawn after resin cure or left in place as a permanent internal membrane.

4 Symbols and abbreviated terms

4.1 Symbols

b width of test piece

C_E correction factor on 3-point flexural modulus for curvature of test piece

C_σ correction factor on 3-point flexural stress for curvature of test piece

d_m mean diameter of pipe sample at mid-thickness of the composite (= $2R_2$)

d_n nominal outside diameter

E_0 short-term flexural modulus

E_c apparent flexural modulus of curved 3-point bend test piece before correction for curvature

E_f apparent flexural modulus of flat 3-point bend test piece

E_x long-term flexural modulus at *x* years

E_t flexural creep modulus at time, *t*

e_1 thickness of the internal membrane

e_2 thickness of the external membrane

e_c thickness of the composite

e_{tot} total thickness

$e_{c,m}$ mean thickness of the composite

$e_{c,min}$ minimum thickness of the composite

F force applied in flexural test

h total thickness of the test piece

h_m mean total thickness of the test piece

I moment of inertia (the second moment of area) per unit length of the pipe wall

L distance between supports in flexural test

L_1 distance between points of contact of curved flexural test piece with supports

L_2 true span of the curved flexural test piece

L_3 total chord length of the curved flexural test piece

r radius of the support

R_2 radius of curvature of the test piece at mid-thickness of the composite

R_1 radius of curvature of the inside surface of test piece

V rise of centre of the curved flexural test piece above its points of contact with supports

s deflection measured in flexural test

s_t deflection of flexural test piece at time, *t*

S_0 initial specific ring stiffness

t elapsed time in long-term test

x time to which long-term test results are extrapolated for design purposes

α_x creep factor at *x* years

ε_c apparent flexural strain in curved 3-point bend test piece before correction for curvature

ε_{f0} initial flexural strain at zero stress

ε_{fb} flexural strain at first break