INTERNATIONAL STANDARD

ISO 11296-4

First edition
2009-11-01

Corrected version
2010-06-01

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 matières plastiques pour la rénovation des réseaux d'assainissement gravitaires enterrés —
Partie 4: Tubage continu par tubes polymérisés sur place

Reference number
ISO 11296-4:2009(E)

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 11296-4 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*.

ISO 11296 consists of the following parts, under the general title *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks*:

— *Part 1: General*

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

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

Lining with continuous pipes is to form the subject of a part 2, lining with discrete pipes is to form the subject of a part 5 and lining with spirally-wound pipes is to form the subject of a part 7.

This corrected version of ISO 11296-4:2009 incorporates the replacement of “ISO 178” with “ISO 178 as modified by Annex B” in the fourth row and fifth column of Table 5.

Introduction

The System Standard, of which this is part 4, specifies the requirements for plastics piping systems of various materials used for renovation of existing pipelines in a specified application area. System Standards for renovation specify procedures for the following applications:

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

— plastics piping systems for renovation of underground drainage and sewerage networks under pressure;

— plastics piping systems for renovation of underground water supply networks;

— 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.

Each of the System Standards comprises a part 1 (general) and all applicable renovation technique family-related parts from the following:

— 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.

The requirements for any given renovation technique family are given in part 1, applied in conjunction with the other relevant part. For example, parts 1 and 2 specify the requirements relating to lining with continuous 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 gives the common structure and the relationship between ISO 11296 and the System Standards for other application areas.

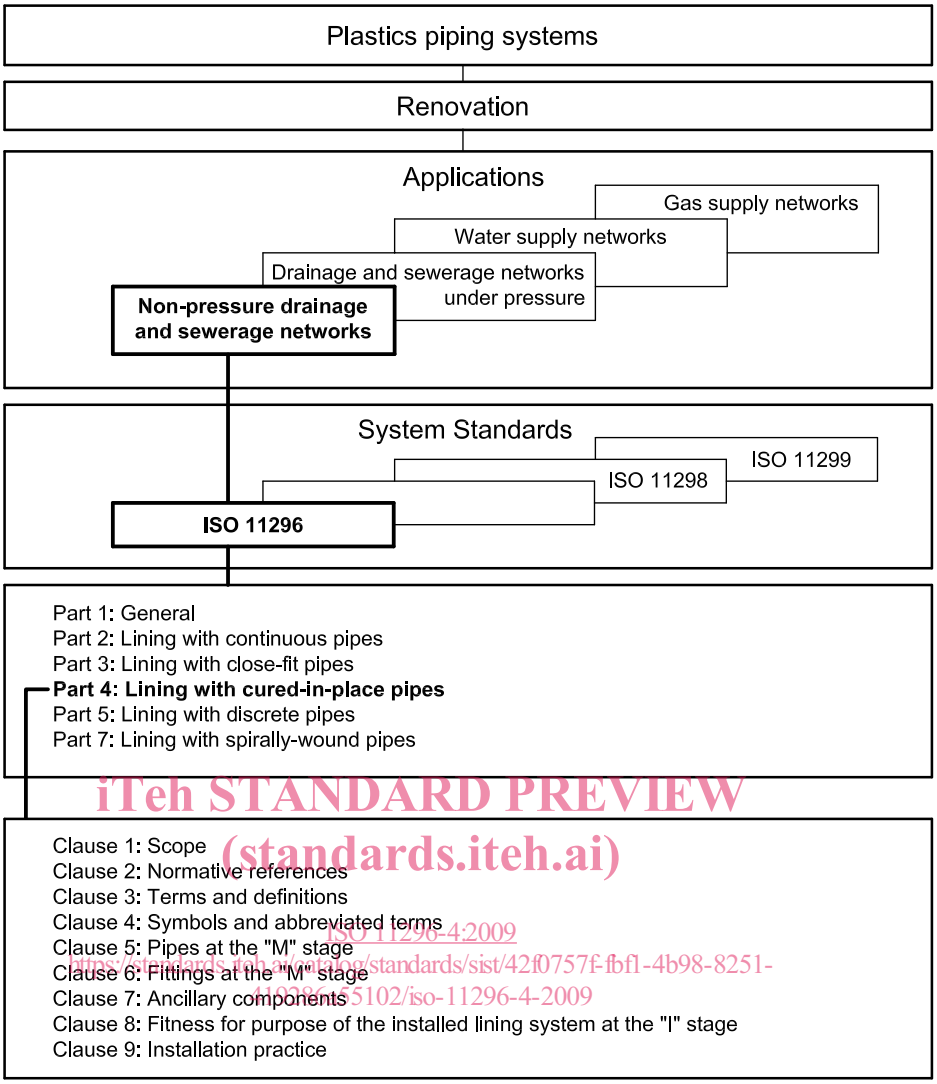

Figure 1 — Format of the renovation System Standards

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

Part 4: Lining with cured-in-place pipes

1 Scope

This part of ISO 11296, 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.

It applies to the use of various thermosetting resin systems, in combination with compatible fibrous carrier materials and other process-related plastics components (see 5.1).

2 Normative references

The following referenced documents are indispensable for the application 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, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 178:2001, *Plastics — Determination of flexural properties*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

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

ISO 8513, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of longitudinal tensile properties*

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

ISO 10928[1)], *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Methods for regression analysis and their use*

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:—[2)], *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 25780:—[3)], *Plastics piping systems for pressure and non-pressure water supply, irrigation, drainage or sewerage — Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin — Pipes with flexible joints intended to be installed using jacking techniques*

EN 14364:2006, *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.

3.1 General terms

3.1.1
carrier material
porous component of the liner, which carries the liquid resin system during insertion into the pipe being renovated and forms part of the installed lining system once the resin has been cured

3.1.2
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 and installed by a specific process

3.1.3
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

3.1.4
close-fit
situation of the outside of the installed liner relative to the inside of the existing pipeline, which may either be an interference fit or include a small annular gap resulting from shrinkage and tolerances only

3.1.5
composite
combination of cured resin system, carrier material and/or reinforcement, excluding any internal or external membranes or any layer of excess neat resin

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1) To be published.

2) To be published.

3) To be published.

3.1.6
first break
elastic limit or first major discontinuity of the stress-strain curve associated with local failure of the resin matrix or reinforcing fibres

3.1.7
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, as determined by structural design

3.1.9
internal membrane
membrane forming the inside surface of the pipe after installation

3.1.10
external membrane
membrane forming the outside surface of the pipe after installation

3.1.11
lateral connection collar
fitting for reconnecting a lined main pipe to an existing or renovated lateral pipe

3.1.12
lining tube
flexible tube, consisting of carrier material, resin system and any membranes and/or reinforcement, as combined prior to insertion in the pipe to be lined

3.1.13
nominal thickness
one of a range of discrete liner wall thicknesses dictated by the materials used for liner construction and chosen so as to result in a finished wall thickness of the composite not less than the design thickness

3.1.14
preliner
external membrane which is installed separately and before the resin-impregnated liner

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

NOTE The reinforcement can be incorporated in the carrier material, constitute the carrier material, or can be a separate layer.

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

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 liner is introduced by inversion to achieve simultaneous insertion and inflation

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

NOTE Inflation can be achieved by means of a separate pressurized tube or hose inside the liner which is either withdrawn after resin cure or left in place as a permanent internal membrane.

3.2.4
temporary membrane
internal membrane, used to separate process fluid (typically water or air) from the resin system during liner insertion, which is withdrawn after resin cure

4 Symbols and abbreviated terms

The symbols and abbreviated terms given in ISO 11296-1 and the following apply.

4.1 Symbols

b width of test piece

E_0 short-term flexural modulus

E_x long-term flexural modulus at x years

E_t flexural creep modulus at time t

F force applied in flexural test

h thickness of test piece

h_m mean thickness of 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 curved flexural test piece

r radius of support

R_2 radius of curvature of test piece at mid-thickness

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

S_0 initial specific ring stiffness

δ_t deflection of flexural test piece at time t

$\alpha_{x,\,dry}$ dry creep factor at x years

ε_{f0} initial flexural strain at zero stress

ε_{fb} flexural strain at first break

ε_{fM} flexural strain at maximum applied load

σ_0 required flexural stress in creep test

σ_{fb} flexural stress at first break

σ_{fM} flexural stress at maximum applied load

σ_l ultimate longitudinal tensile stress

4.2 Abbreviated terms

CIPP Cured-in-place pipe

EP Epoxy resin

GRP Glass-reinforced thermosetting plastics

PA Polyamide

PAN Polyacrylonitrile

PE Polyethylene

PEN Poly(ethylene naphthate)

PET Poly(ethylene terephthalate)

PP Polypropylene

PUR Polyurethane

PVC-U Unplasticized poly(vinyl chloride)

UP Unsaturated polyester resin

VE Vinyl ester resin

5 Pipes at the “M” stage

NOTE This clause specifies requirements for the lining tube (i.e. all components before resin cure). For requirements for the cured composite, see Clause 8.