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**Plastics piping systems for renovation  
of underground water supply  
networks —**

**Part 1:  
General**

*Systèmes de canalisations en plastique pour la rénovation des réseaux  
enterrés d'alimentation en eau —*

*Partie 1: Généralités*

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# Contents

	Page
<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vi</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Symbols and abbreviated terms</b> .....	<b>8</b>
4.1 Symbols.....	8
4.2 Abbreviated terms.....	8
<b>5 Pipes at the “M” stage</b> .....	<b>9</b>
5.1 Materials.....	9
5.2 General characteristics.....	9
5.3 Material characteristics.....	9
5.4 Geometric characteristics.....	9
5.5 Mechanical characteristics.....	9
5.6 Physical characteristics.....	9
5.7 Jointing.....	9
5.8 Marking.....	9
<b>6 Fittings at the “M” stage</b> .....	<b>10</b>
6.1 Materials.....	10
6.2 General characteristics.....	10
6.3 Material characteristics.....	10
6.4 Geometric characteristics.....	10
6.5 Mechanical characteristics.....	10
6.6 Physical characteristics.....	10
6.7 Jointing.....	10
6.8 Marking.....	10
<b>7 Ancillary components</b> .....	<b>11</b>
<b>8 Fitness for purpose of the installed lining system at the “I” stage</b> .....	<b>11</b>
8.1 Materials.....	11
8.2 General characteristics.....	11
8.3 Material characteristics.....	12
8.3.1 Effect on water quality.....	12
8.3.2 Sealing rings.....	12
8.4 Geometric characteristics.....	12
8.5 Mechanical characteristics.....	12
8.6 Physical characteristics.....	13
8.7 Additional characteristics.....	13
8.8 Sampling.....	13
8.9 Regional requirements for the installed lining system.....	13
<b>9 Installation practice</b> .....	<b>13</b>
9.1 Preparatory work.....	13
9.2 Storage, handling and transport of pipes and fittings.....	13
9.3 Equipment.....	13
9.3.1 General.....	13
9.3.2 Inspection equipment.....	13
9.3.3 Lifting equipment.....	13
9.4 Installation.....	14
9.4.1 General.....	14
9.4.2 Safety precautions.....	14
9.4.3 Simulated installations.....	14
9.5 Process-related inspection and testing.....	14

9.6	Lining termination.....	15
9.7	Reconnection to the existing pipeline system.....	15
9.8	Final inspection and testing.....	15
9.9	Documentation .....	15
<b>Bibliography</b> .....		<b>16</b>

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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](http://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](http://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](http://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 11298-1:2010), which has been technically revised. The main changes are in [Clauses 2, 3.1, 3.2, 3.3, 4.2, and 8.9](#), and [Figures 1 and 2](#).

A list of all parts in the ISO 11298 series, can be found on the ISO website.

## Introduction

This document is a part of a System Standard for plastics piping systems of various materials used for the renovation of existing pipelines in a specified application area. System Standards for renovation deal with the following applications:

- ISO 11296: *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks*;
- 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* (this document);
- 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 by the requirement to verify 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* (this document)

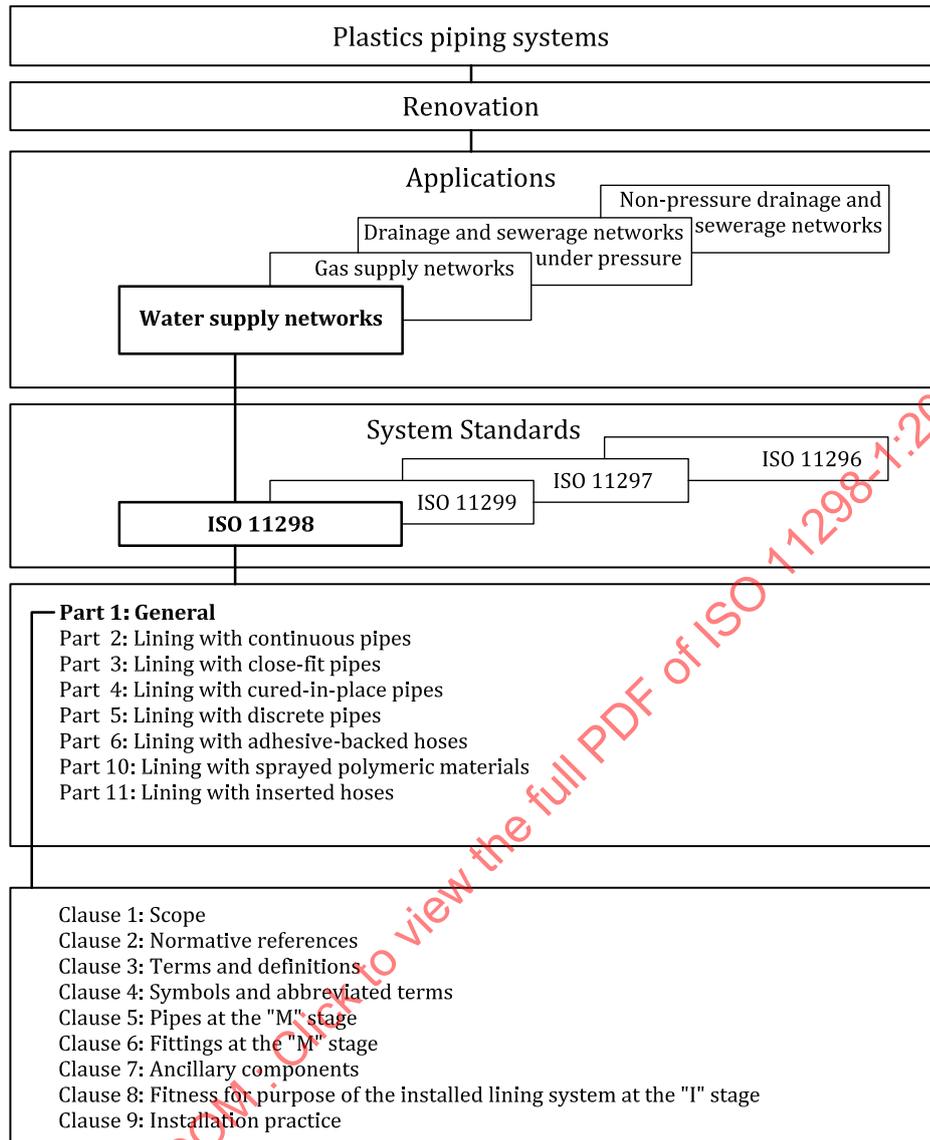
and all applicable renovation technique family-related parts, which for water supply networks include or potentially include the following:

- *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 6: Lining with adhesive-backed hoses*;
- *Part 10: Lining with sprayed polymeric materials*;
- *Part 11: Lining with inserted hoses*.

The requirements for any given renovation technique family are specified in Part 1, applied in conjunction with the relevant other part. For example, this document and ISO 11298-3 specify the requirements relating to lining with close-fit pipes. For complementary information, see ISO 11295. Not all technique families are pertinent 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 of ISO 11298, in order to facilitate direct comparisons across renovation technique families.

[Figure 1](#) shows the common part and clause structure and the relationship between ISO 11298 and the System Standards for other application areas.



**Figure 1 — Format of the renovation system standards**

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# Plastics piping systems for renovation of underground water supply networks —

## Part 1: General

### 1 Scope

This document specifies the requirements and test methods for plastics piping systems intended to be used for the renovation of underground water supply networks. It is applicable to pipes and fittings, as manufactured, as well as to the installed lining system. It is not applicable to the existing pipeline or any non-structural sprayed coatings or annular filler.

This document gives the general requirements common to all relevant renovation techniques.

### 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 4633, *Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials*

EN 681-1, *Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber*

EN 681-2, *Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications — Part 2: Thermoplastic elastomers*

EN 681-3, *Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications — Part 3: Cellular materials of vulcanized rubber*

EN 681-4, *Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications — Part 4: Cast polyurethane sealing elements*

### 3 Terms and definitions

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

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1 General

##### 3.1.1

##### **pipeline system**

interconnecting pipe network for the conveyance of fluids

**3.1.2**

**rehabilitation**

measures for restoring or upgrading the performance of existing systems, including renovation, repair and replacement

**3.1.3**

**renovation**

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

**3.1.4**

**replacement**

construction of a new pipeline, on or off the line of an existing pipeline, where the function of the new pipeline system incorporates that of the old

**3.1.5**

**maintenance**

routine work undertaken to ensure the existing performance of an asset

**3.1.6**

**repair**

rectification of local damage

**3.1.7**

**lining pipe**

pipe inserted for renovation purposes

**3.1.8**

**liner**

lining pipe after installation

**3.1.9**

**lining system**

lining pipe and all relevant fittings for insertion into an existing pipeline for the purposes of renovation

**3.1.10**

**renovated pipeline system**

existing pipeline system plus the installed lining system used to renovate it, as well as any grout or other annular filling material used.

**3.1.11**

**characteristic**

property, dimension or other feature of a material or component

**3.1.12**

**declared value**

limiting value of a characteristic declared in advance by the lining system supplier, which becomes the requirement for the purposes of assessment of conformity

**3.1.13**

**annular filler**

material for grouting annular space between existing pipeline and lining system

**3.1.14**

**grouting**

process of filling voids around the lining system

**3.1.15****system test pressure****STP**

hydrostatic pressure applied to the installed pipeline system in order to ensure its integrity and leaktightness

**3.1.16****simulated installation**

installation of a lining system into a simulated host pipeline, using representative equipment and processes, to provide samples for testing which are representative of an actual installation

**3.1.17****simulated host pipeline**

section of pipeline, which is not part of an operational network, but which replicates the environment of an operational network

**3.1.18****technique family**

group of renovation techniques which are considered to have common characteristics for standardization purposes

**3.1.19****independent pressure pipe liner**

liner capable on its own of resisting without failure all applicable internal loads throughout its design life

**3.1.20****interactive pressure pipe liner**

liner which relies on the existing pipeline for some measure of radial support in order to resist without failure all applicable internal loads throughout its design life

**3.1.21****fully structural renovation**

use of an independent pressure pipe liner, which is capable of resisting all external loads irrespective of the condition of the existing pipeline

**3.1.22****semi-structural renovation**

use of an interactive pressure pipe liner which is capable of long-term hole and gap spanning at operational pressure

**3.1.23****type testing**

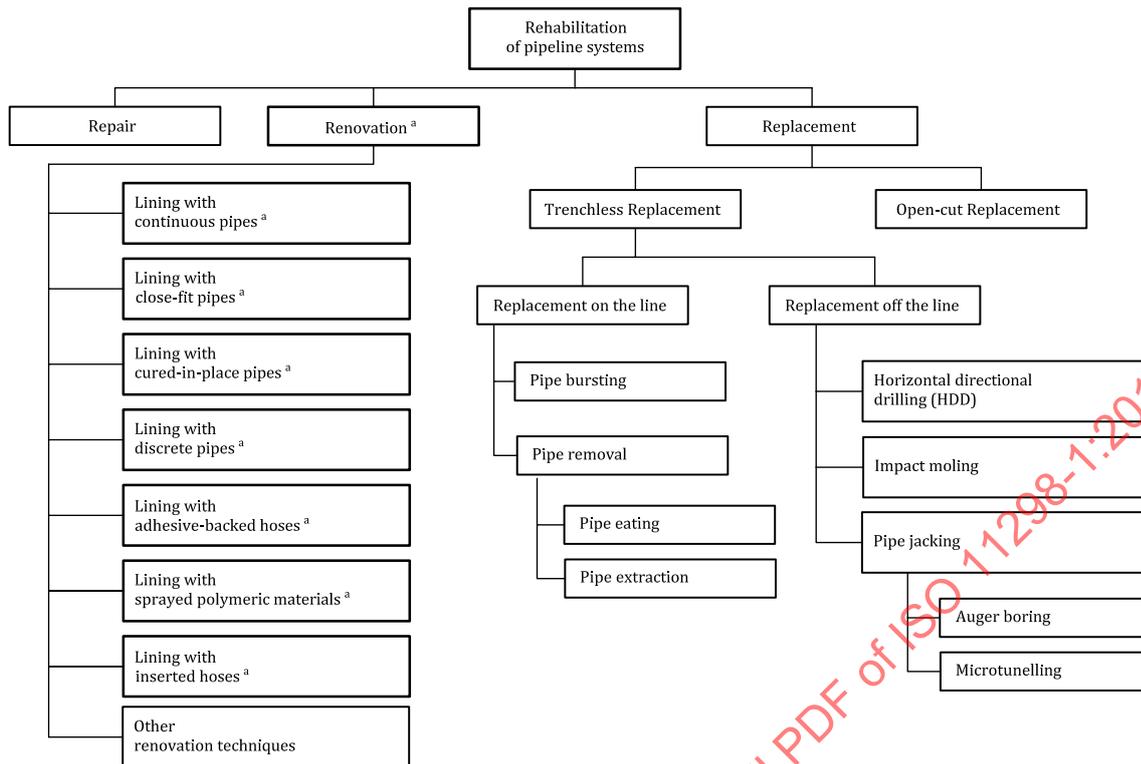
testing performed to prove that a material, component, joint or assembly is capable of conforming to the requirements given in the applicable standard

**3.1.24****CCTV**

system comprised of cameras, recorders, interconnections and displays that are used to inspect pipelines

**3.2 Techniques**

The various techniques for renovation of underground water supply networks under pressure, within the scope of pipeline rehabilitation techniques generally, are shown schematically in [Figure 2](#). For definitions of standardized renovation techniques shown in [Figure 2](#), but outside the scope of this document, see ISO 11295.



a This document is applicable.

**Figure 2 — Technique families for renovation of underground water supply networks using plastics pipes, within the scope of pipeline rehabilitation techniques**

**3.2.1**

**lining with continuous pipes**

lining with pipe made continuous prior to insertion, where the diameter of the lining pipe remains unchanged

**3.2.2**

**lining with close-fit pipes**

lining with a continuous pipe, of which the cross-section is reduced to facilitate installation and reverted after installation to provide a close fit to the existing pipe

Note 1 to entry: For the reduction in cross-section, the following are the two options:

- reduction in the pipe manufacturing plant: the pipe is usually supplied coiled on a reel, from which it is directly inserted;
- reduction on site: the pipe is usually fed through the reduction equipment and simultaneously inserted in one continuous string.

**3.2.3**

**lining with cured-in-place pipes**

lining with a flexible tube impregnated with a thermosetting resin, which produces a pipe after resin cure

**3.2.4**

**lining with discrete pipes**

lining with pipes shorter than the section to be renovated, which are jointed to form a continuous pipe only during insertion, the cross-section of the lining pipe remaining unchanged

**3.2.5****lining with adhesive-backed hoses**

lining with a reinforced hose which relies on an adhesive bond to the existing pipeline to provide resistance to collapse

**3.2.6****lining with sprayed polymeric materials**

lining with a sprayed two-part polymeric resin material that forms a continuous pipe after resin cure

**3.2.7****lining with inserted hoses**

lining with a reinforced hose which is either permanently shaped or re-rounded after installation by the application of an internal pressure

**3.3 Characteristics****3.3.1****nominal size****DN**

numerical designation of the size of a component, which is a convenient round number approximately equal to the inside or outside diameter in millimetres

**3.3.2****nominal size DN/OD****DN/OD**

nominal size, related to the outside diameter

[SOURCE: ISO 4427-1:2007, 3.1.1.2, modified to include abbreviation in term to distinguish it from term defined by [3.3.1](#).]

**3.3.3****nominal outside diameter** **$d_n$** 

specified outside diameter, in millimetres, assigned to a nominal size DN/OD

Note 1 to entry: For thermoplastics solid-wall components, the value of nominal outside diameter is identical to the minimum mean outside diameter,  $d_{em,min}$ .

[SOURCE: ISO 4427-1:2007, 3.1.1.3, modified by addition of Note 1 to entry.]

**3.3.4****mean outside diameter** **$d_{em}$** 

value of the measurement of the outer circumference of a pipe or spigot end of a fitting in any cross-section, divided by  $\pi$  ( $\approx 3,142$ ) and rounded to the next greater 0,1 mm

[SOURCE: ISO 4427-1:2007, 3.1.1.5]

**3.3.5****minimum mean outside diameter** **$d_{em,min}$** 

minimum value of the mean outside diameter as specified for a given nominal size

[SOURCE: ISO 4427-1:2007, 3.1.1.6]

**3.3.6****wall thickness** **$e$** 

value of the measurement of the wall thickness at any point around the circumference of a component

### 3.3.7

#### **mean wall thickness**

$e_m$   
arithmetic mean of a number of measurements of the wall thickness regularly spaced around the circumference and in the same cross-section of a component

### 3.3.8

#### **minimum wall thickness at any point**

$e_{min}$   
minimum value of the wall thickness at any point around the circumference of a component as specified

[SOURCE: ISO 4427-1:2007, 3.1.1.11]

### 3.3.9

#### **nominal wall thickness**

$e_n$   
numerical designation of the wall thickness of a component which is a convenient round number, approximately equal to the manufacturing dimension in millimetres

Note 1 to entry: For thermoplastics solid-wall components, the value of nominal wall thickness,  $e_n$ , is identical to the specified minimum wall thickness at any point,  $e_{min}$ .

[SOURCE: ISO 4427-1:2007, 3.1.1.9, modified by addition of Note 1 to entry.]

### 3.3.10

#### **standard dimension ratio**

##### **SDR**

ratio of the nominal outside diameter,  $d_n$ , to its nominal wall thickness,  $e_n$

[SOURCE: ISO 4427-1:2007, 3.1.1.15]

### 3.3.11

#### **internal pressure resistance**

capability to withstand internal pressurization by water or gas

### 3.3.12

#### **ring stiffness**

resistance of a pipe to diametric deflection in response to external loading applied along one longitudinal diametric plane

Note 1 to entry: This definition applies to both long and short-term values.

## 3.4 Materials

### 3.4.1

#### **virgin material**

material in a form such as granules, powder or liquid, which has not been subjected to use or processing other than that required for its manufacture and to which no reprocessable or recyclable material has been added

### 3.4.2

#### **own reprocessable material**

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

**3.4.3****external reprocessable material**

material from unused products or trimmings which will be reprocessed and which were originally processed by another manufacturer

Note 1 to entry: If a manufacturer has a production of products other than pipes and fittings, reprocessable material from that production is considered as external reprocessable material when used for pipes or fittings production.

**3.4.4****recyclable material**

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

**3.5 Product stages**

The characteristics of components used for renovation and the materials from which they are made can be considered at two distinct stages as follows.

**3.5.1****“M” stage**

stage as manufactured, before any subsequent site processing of components associated with the particular renovation technique

Note 1 to entry: For pipes and fittings at the “M” stage, see [Clauses 5](#) and [6](#), respectively.

**3.5.2****“I” stage**

stage as installed, i.e. in final configuration after any site processing of components associated with the particular renovation technique

Note 1 to entry: For pipes and fittings at the “I” stage, see [Clause 8](#).

**3.6 Service conditions****3.6.1****nominal pressure****PN**

numerical designation used for reference purposes related to the mechanical characteristics of the component of a piping system

Note 1 to entry: Extended definitions of PN applicable to thermoplastics and thermosetting piping systems respectively are given in the relevant other parts of ISO 11298.

**3.6.2****allowable operating pressure****PFA**

maximum internal hydrostatic pressure that a component is capable of withstanding continuously in service

Note 1 to entry: It is expressed in bars<sup>1)</sup>.

**3.6.3****surge**

rapid fluctuations of pressure, either positive or negative, caused by flow alterations over short periods of time, e.g. due to the switching on or off of pumps or the opening or closing of valves

1) 1 bar = 0,1 MPa = 0,1 N/mm<sup>2</sup> = 10<sup>5</sup> N/m<sup>2</sup>.

**3.6.4**  
**allowable maximum operating pressure**  
**PMA**

maximum internal hydrostatic pressure occurring from time to time, including surge, that a component is capable of withstanding in service

Note 1 to entry: It is expressed in bars.

**3.6.5**  
**surge factor**

$F_{\text{surge}}$   
value of the ratio PMA/PFA, which is generally a function of pipe material and rate of pressure rise

Note 1 to entry: The value assigned for design can also vary depending upon the anticipated frequency of the surge conditions.

## 4 Symbols and abbreviated terms

### 4.1 Symbols

$d_{\text{em}}$	mean outside diameter
$d_{\text{em,min}}$	minimum mean outside diameter
$d_{\text{n}}$	nominal outside diameter
$e$	wall thickness
$e_{\text{m}}$	mean wall thickness
$e_{\text{min}}$	minimum wall thickness at any point
$e_{\text{n}}$	nominal wall thickness
$F_{\text{surge}}$	value of the ratio PMA/PFA

### 4.2 Abbreviated terms

CCTV	closed circuit television
DN	nominal size
DN/OD	nominal size, related to the outside diameter
"I"	as installed
"M"	as manufactured
PFA	allowable operating pressure
PMA	allowable maximum operating pressure
PN	nominal pressure rating
SDR	standard dimension ratio

## 5 Pipes at the “M” stage

### 5.1 Materials

No general requirements regarding choice of material apply.

### 5.2 General characteristics

The choice of colour shall follow national identification requirements.

Colours used nationally for sewers and/or gas supply pipes should not be used for water supply pipes within that nation and vice versa.

### 5.3 Material characteristics

Pipes in contact with potable water shall be designed and constructed using components and materials which meet the appropriate requirements such that there is no unacceptable deterioration of water quality.

### 5.4 Geometric characteristics

No general geometric requirements apply.

### 5.5 Mechanical characteristics

No general mechanical requirements apply.

### 5.6 Physical characteristics

No general physical requirements apply.

### 5.7 Jointing

For the requirements for jointing techniques used to attach and/or assemble components, the applicable part of ISO 11298 for each technique family applies.

NOTE Integral joints are considered to be part of the pipe.

### 5.8 Marking

Pipes specified in detail in other parts of ISO 11298 shall be permanently and legibly marked in such a way that the marking does not initiate cracks or other types of premature failure and that storage, weathering, handling and installation (see [Clause 9](#)) do not affect the legibility of the marking.

The pipes shall be marked with at least the following information:

- a) reference to the relevant part of ISO 11298 or other standard as specified in that part;
- b) manufacturer's name and/or trademark;
- c) nominal size or other dimension (e.g.  $d_n$ );
- d) SDR or wall thickness or ring stiffness as applicable;
- e) pressure rating as PN or bar;
- f) material;

- g) manufacturer's information in clear figures or in code, providing traceability to the production period (specified by at least year and month) and production site, if manufacturer is producing at several sites;
- h) approval mark (if applicable);
- i) Water or W.

## **6 Fittings at the "M" stage**

### **6.1 Materials**

No general requirements regarding choice of material apply.

### **6.2 General characteristics**

The choice of colour shall follow national identification requirements.

Colours used nationally for sewers and/or gas supply pipes should not be used for water supply pipes within that nation, and vice versa.

### **6.3 Material characteristics**

Fittings in contact with potable water shall be designed and constructed using components and materials which meet the appropriate requirements such that there is no unacceptable deterioration of water quality.

### **6.4 Geometric characteristics**

No general geometric requirements apply.

### **6.5 Mechanical characteristics**

No general mechanical requirements apply.

### **6.6 Physical characteristics**

No general physical requirements apply.

### **6.7 Jointing**

For the requirements for jointing techniques used to attach and/or assemble components the applicable part of ISO 11298 for the relevant technique family applies.

NOTE Integral joints are considered to be part of the fitting.

### **6.8 Marking**

Where fittings are specified by normative reference to another plastics piping System Standard, no marking additional to that specified in the referenced standard shall be required.

Fittings specified in detail in other parts of ISO 11298 shall be marked with at least the following information:

- a) reference to the relevant part of ISO 11298 or other standard as specified in that part;
- b) manufacturer's name and/or trademark;

- c) nominal size or other dimension (e.g.  $d_n$ );
- d) SDR or wall thickness or ring stiffness as applicable;
- e) pressure rating as PN or bar;
- f) material;
- g) manufacturer's information in clear figures or in code, providing traceability to production period (specified by at least year and month), and production site if manufacturer is producing at several sites;
- h) approval mark (if applicable).

## 7 Ancillary components

All materials used for ancillary components intended for water supply systems shall be suitable for such an application. They shall not cause any unacceptable deterioration of the quality of water with which they come into contact.

For valves the relevant pressure capability shall be specified in the open position and in the closed position so that the valve function and its tightness are ensured under this pressure.

Certain liner pipe systems require mechanical, end-load-bearing fittings for liner terminations. Full details of these shall be included in the installation manual, if applicable.

## 8 Fitness for purpose of the installed lining system at the "I" stage

### 8.1 Materials

The pipe and any fittings may be made of different materials, provided these conform to [Clauses 5.1](#) and [6.1](#), respectively of the relevant part of ISO 11298.

NOTE For pipes and fittings at the "M" stage, see [Clauses 5](#) and [6](#), respectively.

### 8.2 General characteristics

The installed lining system shall meet a water pressure test to ensure the integrity of pipes, joints, fittings and other components, such as anchor blocks and the fitness for purpose requirements in the technique-related parts of ISO 11298, as applicable.

The System Test Pressure methodology and the pass/fail criteria shall be agreed on between the client and the system installer.

NOTE Because of the interaction between the liner and the host pipe upon pressurization when some techniques are utilized, it is possible for conventional plastics pipe testing methodologies to not apply in these instances.

Under normal circumstances, the installation point for the testing equipment shall be the lowest point of the test section.

**IMPORTANT — Attention is drawn to the need for care in respect of the potential for any residues of materials, lubricants or other chemical agents from the installation process to damage the surrounding environment.**

### 8.3 Material characteristics

#### 8.3.1 Effect on water quality

The installed lining system shall not cause any unacceptable deterioration of water quality when the water is intended for human consumption.

#### 8.3.2 Sealing rings

Elastomeric sealing rings shall conform to the performance requirements of ISO 4633.

### 8.4 Geometric characteristics

The installed lining system shall have a minimum free bore in accordance with the design requirements (e.g. flow capacity, structural stability and routine maintenance).

NOTE 1 Free bore has two aspects. The first (cross-sectional) free bore is to ensure that adequate cross-section is retained for flow capacity. The second (dimensional) free bore is to ensure that adequate clearance is retained for routine maintenance equipment to be used or for access to be maintained in the installed pipeline system.

NOTE 2 The maximum free bore of a renovated pipeline system is limited by the internal dimensions of the existing pipeline at the time of lining and also by the wall thickness and closeness of fit of the installed lining system, which generally varies according to the renovation technique used. For design aspects, see ISO 11295.

### 8.5 Mechanical characteristics

All elements of the installed lining system shall be able to withstand without leakage, and for the full design life, all stresses arising from operation within the system parameters and any residual stresses caused by the installation or thermal effects.

The installed system shall have sufficient stiffness and strength to resist:

- a) the external loading throughout the specified design life;
- b) the internal loading throughout the specified design life, including the effects of surge;
- c) any residual stresses caused by the installation or thermal effects.

NOTE 1 ISO 11295 provides guidance on structural design aspects of renovation.

NOTE 2 Minimum short-term ring stiffnesses of pipes are specified as a function of pipe material in the technique-related parts of ISO 11298, to provide comparable minimum levels of long-term external load-bearing capacity for all renovation technique families.

NOTE 3 The internal loading of water pipelines under pressure generally includes surge and cyclic pressures associated with frequent starting and stopping of pumps. Note that negative surge pressures can be an important component of net short-term external loading applicable to the lining system.

NOTE 4 This document is not applicable to the design issues of the calculation of any residual stresses.

For interactive liners, the lining system shall be capable of spanning holes and gaps in the wall of the existing pipeline at the rated pressure and for the design life of the system.

NOTE 5 This document is not applicable to the design issues of hole and gap spanning. For additional information, including assessment of the effects of interactive liners on the host pipe, see ISO 11295.

The system supplier shall document compliance with all relevant mechanical requirements, and also the source of any material-related surge factor proposed for design calculation purposes.