BS EN ISO 11299-3:2013

BSI Standards Publication

# Plastics piping systems for renovation of underground gas supply networks

## Part 3: Lining with close-fit pipes (ISO 11299-3:2011)

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**National foreword**

This British Standard is the UK implementation of EN ISO 11299-3:2013. It is identical to ISO 11299-3:2011. It supersedes BS EN 14408-3:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/88/3, Rehabilitation of pipeline systems using plastics piping materials and components.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.


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# EN ISO 11299-3

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English Version

## Plastics piping systems for renovation of underground gas supply networks - Part 3: Lining with close-fit pipes (ISO 11299-3:2011)

Systèmes de canalisations en plastique pour la rénovation des réseaux de gaz enterrés - Partie 3: Tubage par tuyau continu sans espace annulaire (ISO 11299-3:2011)

Kunststoff-Rohrleitungssysteme für die Renovierung von erdverlegten Gasversorgungsnetzwerken - Teil 3: Close-Fit-Lining (ISO 11299-3:2011)

This European Standard was approved by CEN on 5 February 2013.

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# Foreword

The text of ISO 11299-3:2011 has been prepared by Technical Committee ISO/TC 138 “Plastics pipes, fittings and valves for the transport of fluids” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 11299-3:2013 by Technical Committee CEN/TC 155 “Plastics piping systems and ducting systems” the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2013, and conflicting national standards shall be withdrawn at the latest by August 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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**Endorsement notice**

The text of ISO 11299-3:2011 has been approved by CEN as EN ISO 11299-3:2013 without any modification.

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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 11299-3 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*.

ISO 11299 consists of the following parts, under the general title *Plastics piping systems for renovation of underground gas supply networks*:

— *Part 1: General*

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

# Introduction

This part of ISO 11299 is 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:

— 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 (this application).

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 verification of characteristics of plastics piping systems as manufactured.

This system standard comprises a *Part 1: General* and all applicable parts relating to the renovation technique family, from the following:

— *Part 2: Lining with continuous pipes*

— *Part 3: Lining with close-fit pipes (this document)*

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

— *Part 6: Lining with adhesive-backed hoses*

The requirements for any given renovation technique family are specified in this part of ISO 11299 and are applied in conjunction with the relevant other part. For example, both ISO 11299-1 and this part of ISO 11299 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 11299, in order to facilitate direct comparisons across renovation technique families.

Figure 1 illustrates the common part and clause structure and the relationship between ISO 11299 and the system standards for other application areas.

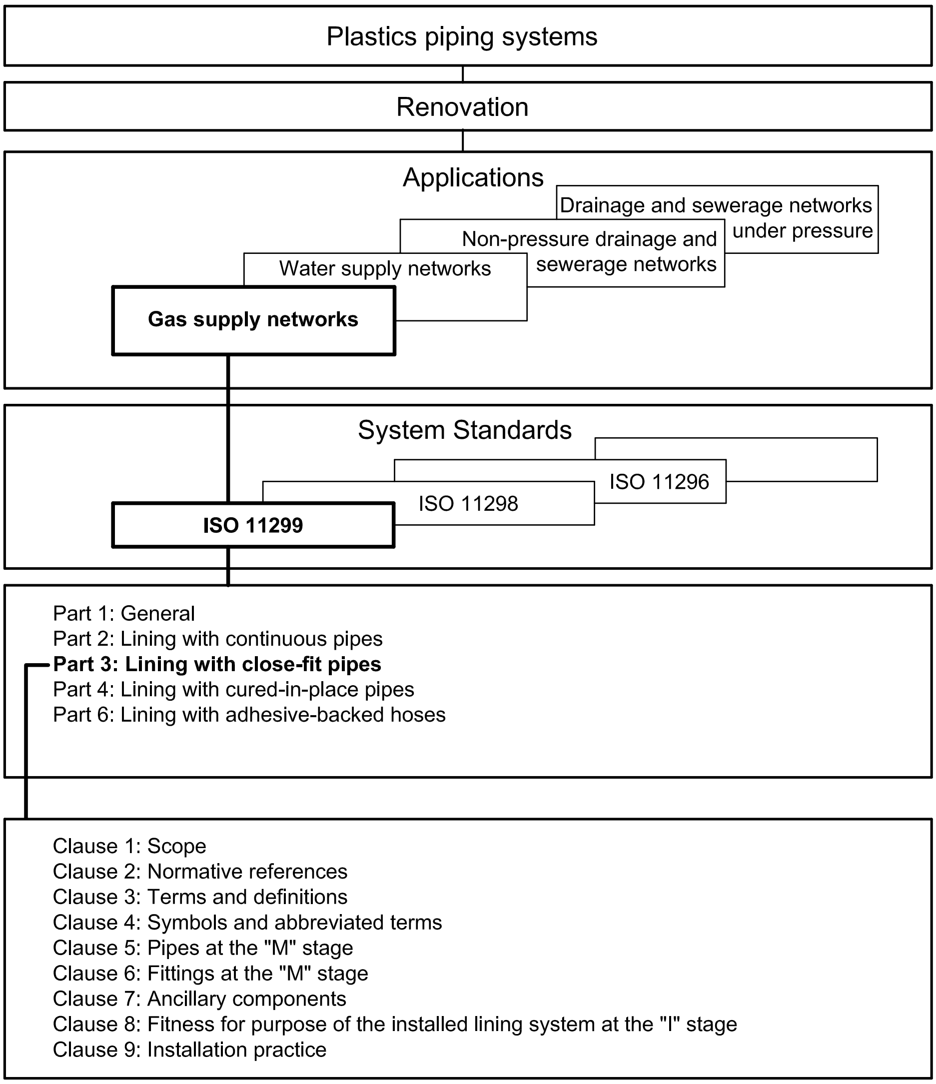


**Figure 1 — Format of the renovation system standards**

# Plastics piping systems for renovation of underground gas supply networks

## Part 3: Lining with close-fit pipes

## 1 Scope

This part of ISO 11299, in conjunction with ISO 11299-1, specifies requirements and test methods for close-fit lining systems intended to be used for the renovation of gas supply networks.

It is applicable to polyethylene (PE) pipes for both independent and interactive pressure pipe liners as well as associated fittings and joints for the construction of the lining system.

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

ISO 4437:2007, *Buried polyethylene (PE) pipes for the supply of gaseous fuels — Metric series — Specifications*

ISO 8085-3, *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 3: Electrofusion fittings*

ISO 11299-1:2011, *Plastics piping systems for renovation of underground gas supply networks — Part 1: General*

ISO 12176-1, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 1: Butt fusion*

ISO 12176-2, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 2: Electrofusion*

## 3 Terms and definitions

For the purposes of this document, the terms, definitions, symbols and abbreviations given in ISO 11299-1 and the following apply.

### 3.1 General

**3.1.1**
**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

**3.1.2**
**close-fit pipe**
continuous lining pipe of thermoplastic material reshaped or otherwise expanded after insertion to achieve a close fit to the existing pipeline

## 3.2 Techniques

No additional definitions apply.

## 3.3 Characteristics

**3.3.1**
**maximum mean outside diameter**
$d_{em,max}$
maximum value of the mean outside diameter as specified for a given nominal size

## 3.4 Materials

No additional definitions apply.

## 3.5 Product stages

No additional definitions apply.

## 3.6 Service conditions

**3.6.1**
**maximum operating pressure**
**MOP**
maximum effective pressure of the fluid in the piping system which is allowed in continuous use

NOTE 1 MOP is expressed in bar, where 1 bar = 0,1 MPa = $10^5$ Pa; 1 MPa = 1 N/mm$^2$.

NOTE 2 It takes into account the physical and the mechanical characteristics of the components of a piping system.

NOTE 3 It is calculated using the following equation:

$$\text{MOP} = \frac{20 \times (\text{MRS})}{C \times (\text{SDR} - 1)}$$

## 3.7 Joints

**3.7.1**
**electrofusion joint**
joint between a PE socket or saddle electrofusion fitting and a pipe or fitting with spigotted ends, made by heating the electrofusion fittings by the Joule effect of the heating element incorporated at their jointing surfaces, causing the material adjacent to them to melt and pipe and fitting surfaces to fuse

**3.7.2**
**butt fusion joint**
joint made by heating the planed ends of matching surfaces by holding them against a flat heating plate until the PE material reaches fusion temperature, quickly removing the heating plate and pushing the two softened ends against one another

**3.7.3**
**mechanical joint**
joint made by assembling a PE pipe to another PE pipe, or any other element of the piping system that generally includes a compression part, to provide for pressure integrity, leaktightness and resistance to end loads

NOTE A support sleeve inserted into the pipe bore can be used to provide a permanent support for the PE pipe to prevent creep in the pipe wall under radial compressive forces.

 

**3.7.4**
**fusion compatibility**
ability of two similar or dissimilar PE materials to be fused together to form a joint which conforms to the performance requirements of this part of ISO 11299

# 4 Symbols and abbreviated terms

## 4.1 Symbols

| | |
|---|---|
| $C$ | overall service (design) coefficient |
| $d_e$ | outside diameter (at any point) |
| $d_{em,max}$ | maximum mean outside diameter |
| $d_{em,min}$ | minimum mean outside diameter |
| $d_{manuf}$ | original circular outside diameter of the pipe (before processing for insertion) |
| $e_{m,max}$ | maximum mean wall thickness |
| $T$ | temperature at which stress rupture data have been determined |
| $t$ | time to occurrence of a leak in the pipe |
| $t_y$ | wall thickness tolerance |
| $\sigma_s$ | design stress |

## 4.2 Abbreviated terms

| | |
|---|---|
| LPL | lower confidence limit of the predicted hydrostatic strength |
| MFR | melt mass-flow rate |
| MOP | maximum operating pressure |
| MRS | minimum required strength |
| PE | polyethylene |
| R | series of preferred numbers, conforming to the Renard series |
| SDR | standard dimension ratio |

# 5 Pipes at the "M" stage

## 5.1 Materials

### 5.1.1 Virgin material

The virgin material used shall be in accordance with one of the PE compound designations given in Table 1.

**Table 1 — PE compound designations**

| Designation | Classification by MRS<br>MPa |
|---|---|
| PE 80 | 8 |
| PE 100 | 10 |

The compound shall conform to ISO 4437.

#### 5.1.2 Reprocessable and recyclable material

In accordance with ISO 4437, the manufacturer's own reprocessable material may be used, provided that it is derived from the same compound as used for the relevant production.

Reprocessable material obtained from external sources and recyclable material shall not be used.

### 5.2 General characteristics

#### 5.2.1 Appearance

When viewed without magnification, the internal and external surfaces of the pipe shall be smooth, clean and free from scoring, cavities and other defects which would prevent conformity to this part of ISO 11299.

#### 5.2.2 Colour

The pipes shall be yellow or orange, or black with yellow or orange identification stripes.

### 5.3 Material characteristics

The material from which the pipes are made shall conform to the requirements specified in Table 1 of ISO 4437:2007.

### 5.4 Geometric characteristics

The pipe diameter, wall thickness and shape in the "M" stage depend on the specific close-fit lining technique. "M" stage dimensions needed to obtain "I" stage dimensions (see 8.4) shall be declared, with their tolerances, by the manufacturer.

NOTE In the case of factory-folded pipes, variations in wall thickness in one cross-section can be present. This is acceptable as long as the folded pipe has properties such that it can obtain a wall thickness in accordance with 8.4 when installation is complete.

### 5.5 Mechanical characteristics

When tested in accordance with the method given in Table 2, the pipe shall conform to the requirements in the table.

**Table 2 — Mechanical characteristics of pipes**

| Characteristic | Requirement | Test parameters | | Test method |
|---|---|---|---|---|
| | | Parameters | Value | |
| Elongation at break | ISO 4437[a] | | | |
| Hydrostatic strength (80 °C, 165 h) | | | | |

[a] The pipe shall be reverted in the case of factory-folded pipes.

 

### 5.6 Physical characteristics

Physical characteristics shall conform to those specified in ISO 4437. In the case of factory-folded heat-reverted pipes, the pipe shall additionally conform to the requirement for memory ability specified in Annex A.

### 5.7 Jointing

Butt-fusion joints shall conform to ISO 4437. Butt fusion joints shall not be made between folded pipes prior to reversion.

NOTE The joining of circular pipes to form a string prior to site processing is considered part of the “M” stage.

### 5.8 Marking

Pipes shall be marked in accordance with ISO 11299-1:2011, 5.8.

Under item c) specified in ISO 11299-1:2011, 5.8, the nominal size marked shall be DN/OD.

Under item d) specified in ISO 11299-1:2011, 5.8, the dimension marked shall be SDR.

NOTE In addition, the pipe can be marked with the following optional information: MFR.

## 6 Fittings at the “M” stage

Fittings shall conform to the requirements of ISO 8085-3.

NOTE It is possible for some fittings conforming to ISO 8085-3 to not be compatible with the dimensional tolerances given in Table 3.

## 7 Ancillary components

Ancillary components shall conform to ISO 4437.

NOTE Interactive pressure pipe liners can rely on the use of technique-dependent, mechanical fittings for end connections and service connections. The mechanical fittings provide the connection between the liner, which is generally thin walled, and the rest of the pipeline system, by clamping the liner wall inside/outside. By means of a movable compression part, the fitting provides pressure integrity, leaktightness and resistance to end loads. The fitting generally includes a support sleeve, either inserted into or assembled around the liner, and can also include a grip ring. The mechanical fitting can be supplied for field assembly.

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

### 8.1 Materials

Any combination of pipes, fittings and valves for heat fusion conforming to Clauses 5, 6 and 7 respectively may be used, provided that, where applicable, fusion compatibility has been demonstrated in accordance with ISO 4437:2007, 4.6.

### 8.2 General characteristics

The internal surface of the pipe shall be smooth and free from scoring and other defects which could impair the functionality.

NOTE A feature of close-fit pipe is that the lining can conform to the surface characteristics of the existing pipe.

### 8.3 Material characteristics

There are no additional requirements for material characteristics.

## 8.4 Geometric characteristics

Samples of pipes taken from actual or simulated installations shall have wall thicknesses conforming to the requirements of Table 3, whereby relevant dimensions shall be measured according to ISO 3126 at a temperature of (23 ± 2) °C.

**Table 3 — Pipe wall thicknesses after installation**

Dimensions in millimetres

| Maximum mean outside diameter[a] $d_{em,max}$ | Standard dimension ratio[a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SDR 11 | | SDR 17 | | SDR 17,6 | | SDR 26 | |
| | Wall thickness[b] | | | | | | | |
| | $e_{min}$ | $e_{m,max}$ | $e_{min}$ | $e_{m,max}$ | $e_{min}$ | $e_{m,max}$ | $e_{min}$ | $e_{m,max}$ |
| 100 | 9,1 | 10,7 | 5,9 | 7,1 | 5,7 | 6,9 | 3,9 | 4,9 |
| 125 | 11,4 | 13,3 | 7,4 | 8,8 | 7,1 | 8,5 | 4,8 | 5,9 |
| 150 | 13,7 | 15,9 | 8,9 | 10,5 | 8,6 | 10,2 | 5,8 | 7,0 |
| 200 | 18,2 | 20,9 | 11,9 | 13,9 | 11,4 | 13,3 | 7,7 | 9,2 |
| 225 | 20,5 | 23,5 | 13,4 | 15,6 | 12,8 | 14,9 | 8,6 | 10,2 |
| 250 | 22,7 | 26,0 | 14,8 | 17,1 | 14,2 | 16,4 | 9,6 | 11,3 |
| 300 | 27,3 | 31,1 | 17,7 | 20,4 | 17,1 | 19,7 | 11,6 | 13,5 |
| 350 | 31,9 | 36,3 | 20,6 | 23,6 | 19,9 | 22,8 | 13,5 | 17,7 |
| 400 | | | 23,7 | 27,1 | 22,8 | 26,1 | 15,3 | 15,4 |
| 500 | | | 29,7 | 33,5 | 28,3 | 32,2 | 19,1 | 21,9 |
| 600 | | | | | | | 23,1 | 26,4 |

[a] Outside diameters and SDRs are examples; other sizes and SDRs are acceptable.

[b] Wall thickness requirements calculated as installed, both rounded up to the next 0,1 mm:

$e_{min} = d_{em,max}/SDR$;

$e_{m,max} = 1{,}12 e_{min} + 0{,}5$ mm.

After installation and reversion, the liner shall have attained a cross-section within the host pipe such that the curvature is positive at all points around the circumference. This is to enable connections to be made. Design considerations shall also ensure that, in the long term, the positive curvature is maintained under normal operating pressure to allow for future connections to be made. Full details of installation and future connection methodologies shall be included in the installation manual.

If required by the client, the maximum degree of deformation remaining after reversion shall be agreed and included in the project-specific installation manual.

NOTE If appropriate, a higher pressure than the operating pressure can be applied to achieve complete reversion. The system owner's installation manual provides details of this.

If the installation of connections requires the use of dedicated fittings and assembly equipment, the installation manual should provide details of these.

## 8.5 Mechanical characteristics

When tested in accordance with the methods given in Table 4 or Table 5, as applicable, pipes, taken from actual or simulated installations in accordance with 8.8, shall have mechanical characteristics conforming to the relevant table.

 

**Table 4 — Mechanical characteristics of pipes**

| Characteristics | Requirement | Test parameters[ab] | | Test method |
|---|---|---|---|---|
| | | Parameters | Value | |
| Hydrostatic strength at 20 °C (100 h) | ISO 4437 | | | |
| Hydrostatic strength at 80 °C (1 000 h) | | | | |
| Resistance to rapid crack propagation[c] | | | | |
| Resistance to slow crack growth[c] | | | | |

[a] Where the test parameters cannot be met with a particular technique (e.g. limited product range not including SDR 11), the test parameters shall be re-calculated accordingly.

[b] Where electrofusion saddles are offered as part of the lining system, the long-term integrity of the saddle/reverted pipe assembly shall be demonstrated in accordance with ISO 4437.

[c] The technique supplier shall demonstrate that the technique's own reduction/reforming process does not adversely affect this property; the test shall be done at least once on "I"-stage pipe samples.

Where liners are folded/unfolded (either in the factory or on site), there is a risk that crazing may occur at the tips of the folds, which in the long term can result in through-wall cracks and thus leakage. The possible occurrence depends on pipe material, folding technique, wall thickness and temperature. The risk of cracks increases with increasing wall thickness and decreasing temperature. The technique supplier should demonstrate that crazing would not occur with the pipe proposed when applied with his technique under the prevailing ambient conditions.

**Table 5 — Mechanical characteristics of assembly**

| Characteristic | Requirement | Test parameters | Test method |
|---|---|---|---|
| **Butt fusion joint** | | | |
| Hydrostatic internal pressure strength at 80 °C (165 h) | ISO 4437 | | |
| Tensile strength | | | |
| **Mechanical joint[a], electrofusion joint and socket fusion joint** | | | |
| Leaktightness under internal pressure | ISO 4437 | | |
| Hydrostatic strength at 80 °C (165 h) | | | |
| Leaktightness under internal pressure when subjected to bending | | | |
| External pressure test (mechanical joints only) | | | |
| Resistance to pull out | | | |

[a] Where a joint applies radial compression, a cylindrical metal sleeve shall be inserted into the pipe end, providing permanent internal support to prevent creep.

## 8.6 Physical characteristics

There are no requirements for physical characteristics of the installed pipe.

## 8.7 Additional characteristics

No additional characteristics apply.

### 8.8 Sampling

Sampling of the installed pipe shall conform to the requirements in ISO 11299-1:2011, 8.8.

NOTE For process verification testing, samples can conveniently be taken either from the exposed end of an installed liner where this emerges from the host pipe or from a section of the liner installed in a length of simulated host pipe; see ISO 11299-1:2011, 9.4.3.

## 9 Installation practice

### 9.1 Preparatory work

There are no additional requirements for preparatory work.

### 9.2 Storage, handling and transport of pipes and fittings

Precautions shall be taken to ensure that no excessive damage is caused to the lining pipe during unloading, site handling and storage. In this context, excessive damage shall mean any scratch which is more than 10 % of the wall thickness in depth or the imposition of any severe bending operation which results in a permanent kink, crease or fold.

NOTE Storing the lining pipe on reasonably level ground, free of large sharp stones, debris or litter, helps avoid potentially damaging point-loading.

In general, and in the absence of any specific handling requirements, these precautions shall include the use of webbing slings in place of wire rope or chains, and the use of spreader beams for pipe lengths in excess of 12 m. Where the system designer specifies handling requirements, these shall prevail.

The lining pipe shall be transported on a flatbed vehicle, free of nails or other projections or on a purpose-built trailer designed to carry the lining pipe as a free-standing coil or wound onto a drum. Before being loaded onto a trailer, the lining pipe shall be visually checked for any damage.

Pipe ends shall be securely sealed to prevent contamination of the pipe by moisture and/or dirt during storage, handling and transport.

For pipes of 600 mm diameter or larger, a suitable plug or other closure which also prevents ovalization or other deformation is recommended.

Pipes which do not meet the above stated specifications shall be rejected, clearly marked and removed to a separate stock.

### 9.3 Equipment

#### 9.3.1 Butt fusion and debeading equipment

Butt fusion equipment, used for inter-connecting individual pipes and fittings, shall conform to ISO 12176-1 and shall be capable of producing joints under site conditions. In addition to the heater plate, it shall include such clamping, re-rounding and trimming facilities as will ensure alignment and matching of the pipe ends and an external debeader, able to remove the bead cleanly in one continuous strip without damage to the pipe.

A shelter should be provided to avoid weld contamination from water and dust and to generally maintain a clean and warm working environment. The lining pipe string should be plugged to prevent cold air blowing through which could otherwise adversely affect the weld.

#### 9.3.2 Reduction equipment

Depending on the lining technique, a reduction of the lining pipe may take place at the site. The reduction equipment shall be operated in accordance with the technique's specification.

Reduction or deformation equipment for use on site shall be free from sharp edges that could damage the pipe during deformation.

Any lubricant used in the reduction process shall have no adverse effects on the lining material.

#### 9.3.3 Pipe skids/rollers

Depending on the technique, pipe skids or rollers shall be used. These shall minimize frictional loads and prevent damage to the pipe as it is moved during the butt fusion and installation processes.

#### 9.3.4 Winching equipment

The winching equipment shall have a means of limiting and recording, graphically or numerically, the load applied to the winch cable/rod during installation.

**DANGER — All winching operations are potentially dangerous and any exposed winch cable should be guarded.**

NOTE Attention is drawn to any national health and safety regulations applicable to winching equipment and operations.

Winching equipment normally consists of a powered winch connected to the lining pipe by a winch cable/rod and appropriate nose cone connection. The force in the winch cable/rod should be measured directly, and not inferred from the hydraulic pressure on the drive motors or by other such indirect means.

#### 9.3.5 Pipe entry guides

Guides should be used at the ends of the host pipe to prevent damage to the lining pipe during insertion.

#### 9.3.6 Reforming equipment

Any equipment used to carry out the reforming or rerounding process shall be capable of providing the required conditions of pressure and temperature and shall be in accordance with the technique's specification.

#### 9.3.7 Electrofusion equipment

Electrofusion equipment shall conform to ISO 12176-2. The power supply/controller and associated alignment and fixing clamps shall be such as to ensure fusion when following the manufacturer's guidelines for surface preparation and fusion.

### 9.4 Installation

Installation shall follow the procedures detailed in the installation manual.

The installation manual shall specify all necessary parameters and details of the method of reforming the lining pipe to achieve a close fit. If applicable, the description of the reforming method and the installation parameters shall specify, according to the requirements of the technique concerned:

a) maximum and/or minimum values of any internal pressure to be applied;

b) maximum and/or minimum values of temperatures to be reached on the inside and/or outside surfaces of the pipe;

c) maximum pulling forces; the maximum stress applied to the liner pipe during insertion shall not exceed the pipe manufacturer's stated value;

d) minimum installation bending radii;

e) permitted ambient temperature range.

The manual shall also include details of the type of fittings to be used and any special requirements for these.

Where pipes are jointed to form one string on site using butt fusion, the method of external debeading shall be specified. The method statement shall detail at least:

— how the bead is removed;

— how the bead and the related joint are identified;

— how the bead should be examined for quality control purposes and stored for future reference.

Where squeeze-off is used during the installation process, the squeezed-off section shall, if instructed by the client, be removed before the liner is put into service. Otherwise, the squeezed-off section shall be re-rounded and marked to prevent repeat squeezing of the same section.

NOTE Stainless steel support bands can be fitted, where appropriate.

For pipes expanded to fit an electrofusion coupler, a stiff internal supporting sleeve shall be installed to maintain melt pressure during fusion. The supporting sleeve shall have a design and dimensions which have been proved to give satisfactory joints, in accordance with ISO 8085-3, with the make and type of electrofusion couplers to be used.

## 9.5 Process-related inspection and testing

If required by the client, the finished liner shall be inspected internally to verify that it is continuous over the length of the installation, in accordance with ISO 11299-1:—, 9.9, and exhibits a cross-section complying with the requirements of 8.4 throughout.

Inspection shall be made at the leading end, and where possible, at other places along the installed lengths where the pipe is exposed (e.g. service connection windows), to verify that the external surface of the pipe is not scratched to a depth greater than 10 % of the wall thickness.

# Annex A
(normative)

# Factory-folded heat-reverted polyethylene (PE) pipe — Determination of memory ability

## A.1 General

A PE pipe, supplied from the factory in folded shape, is manufactured first as a circular pipe and then, in a second step of the process, folded along its length.

The memory ability of a factory-folded PE pipe, as defined by the following test, provides information on the quality of production of such a pipe.

## A.2 Principle

A sample of folded PE pipe is heated in an oven at a specified temperature and for a specified time and allowed to revert (unfold) by its memory. After cooling down, the smallest dimension $H$, indicated in Figure A.1, is measured and compared to the outside diameter of the pipe as manufactured before folding.

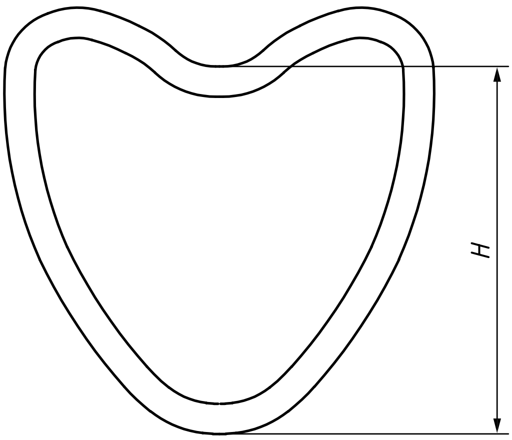


**Figure A.1 — Memory effect**

## A.3 Testing

### A.3.1 Sampling

Cut-off sections of pipe as manufactured (folded) with a length of at least 50 mm shall be taken.

### A.3.2 Procedure

Testing shall be carried out using a hot air oven. Prior to testing, the oven shall be conditioned at a temperature of (120 ± 2) °C. The test pieces shall be positioned at random in the oven and heated at a temperature of (120 ± 2) °C in accordance with Table A.1.

**Table A.1 — Test parameters**

| Pipe wall thickness | Temperature PE 80/PE 100 | Heating time |
|---|---|---|
| $e_{min} \leq 8$ mm | (120 ± 2) °C | (60 ± 1) min |
| $8 < e_{min} \leq 16$ mm | (120 ± 2) °C | (90 ± 2) min |
| $e_{min} > 16$ mm | (120 ± 2) °C | (120 ± 2) min |

On completion of the specified heating time, the test pieces shall be removed from the oven and allowed to cool to within 10 °C of ambient temperature. The smallest dimension $H$ of each test piece, as indicated in Figure A.1, shall then be measured and compared with the manufactured outside diameter, $d_{manuf}$, of the pipe.

### A.3.3 Requirements

PE 80: $H \geq 0{,}75 d_{manuf}$

PE 100: $H \geq 0{,}65 d_{manuf}$

Values for $d_{manuf}$ shall be declared by the manufacturer.

## A.4 Test Report

The test report shall include the following information:

a) reference to this part of ISO 11299, i.e. ISO 11299-3:2011;

b) complete identification of the sample;

c) the type of material;

d) the manufactured outside diameter, $d_{manuf}$, of the pipe;

e) the date of pipe production;

f) the date of sampling;

g) temperature and duration of heating of each test piece;

h) measured dimension, $H$, of the test piece after cooling;

i) any factor which may have affected the results, such as any incident or any operating detail not specified in this annex;

j) the date of testing.

 

# Bibliography

[1] ISO 3, *Preferred numbers — Series of preferred numbers*

[2] ISO 497, *Guide to choice of series of preferred number and of series containing more rounded values of preferred numbers*

[3] ISO 899-1, *Plastics — Determination of creep behaviour — Part 1: Tensile creep*

[4] ISO 11295, *Classification and information on design of plastics piping systems used for renovation*

[5] ISO 12162, *Thermoplastics materials for pipes and fittings for pressure applications — Classification, designation and design coefficient*

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