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

**Part 2:
Lining with continuous pipes**

*Systèmes de canalisations en plastique pour la rénovation des réseaux
enterrés de distribution de gaz —*

Partie 2: Tubage par tuyau continu avec espace annulaire

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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.

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*.

A list of all parts in the ISO 11299 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a part of a system standard for plastics piping systems of various materials used for renovation of existing pipelines in a specified application area. System standards for renovation dealing with the following applications are either available or under preparation:

- 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*;
- ISO 11299, *Plastics piping systems for renovation of underground gas supply networks* (this series of standards).

These system standards are distinguished from system standards 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 verification of characteristics of plastics piping systems “as manufactured”.

Each of the system standards comprises a:

- *Part 1: General*

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

- *Part 2: Lining with continuous pipes* (this document);
- *Part 3: Lining with close-fit pipes*;
- *Part 4: Lining with cured-in-place pipes*;
- *Part 6: Lining with adhesive-backed hoses*;
- *Part 11: Lining with inserted hoses*.

The requirements for any given renovation technique family are specified in Part 1, applied in conjunction with the other relevant part. For example, this document and ISO 11299-1 together specify the requirements relating to lining with continuous 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 to facilitate direct comparisons across renovation technique families.

[Figure 1](#) shows the common part and clause structure and the relationship between ISO 11299 and system standards for other applications.

[Annex A](#) of this document is normative.

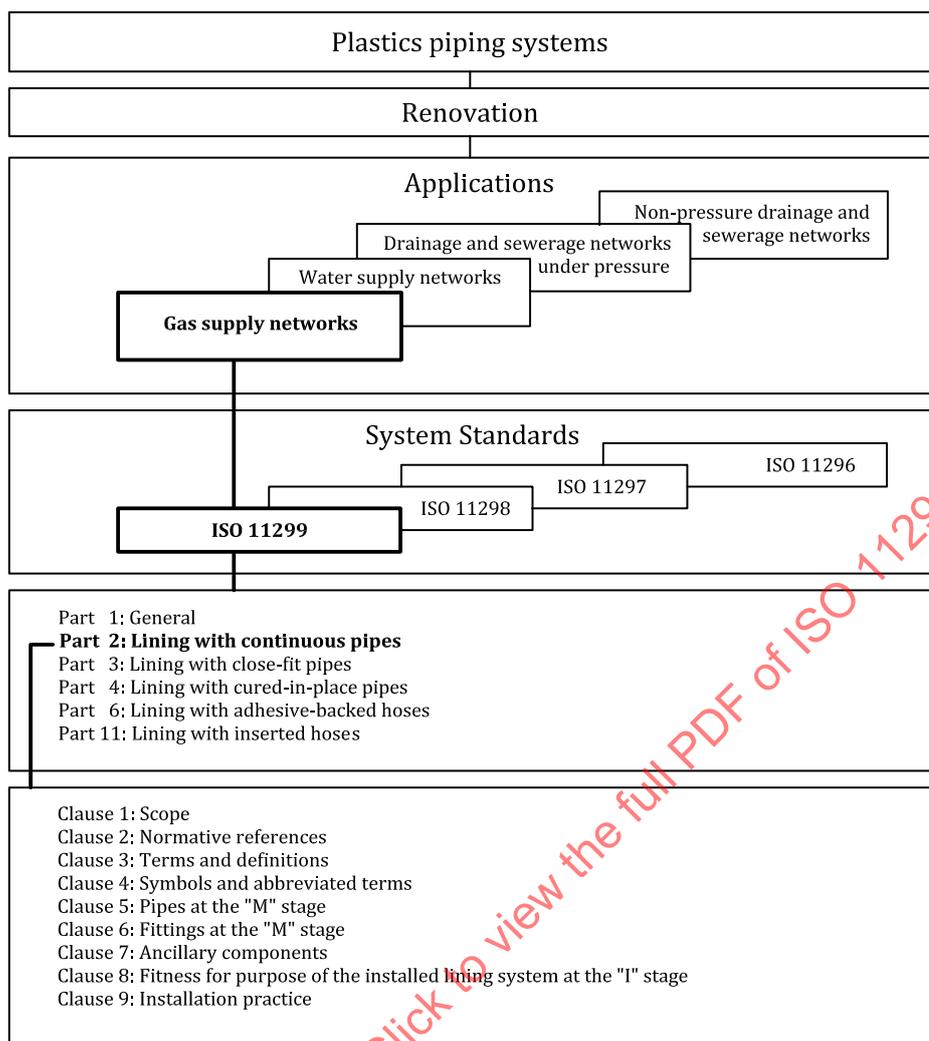


Figure 1 — Format of the renovation System Standards

Plastics piping systems for renovation of underground gas supply networks —

Part 2: Lining with continuous pipes

1 Scope

This document, read in conjunction with ISO 11299-1, specifies requirements and test methods for pipes and fittings which are part of plastics piping systems installed as continuous pipes in the renovation of underground gas supply networks. It is applicable to polyethylene (PE) pipes of three different types:

- PE solid wall single layered pipes (nominal outside diameter, d_n), including any identification stripes;
- PE pipes with co-extruded layers on either or both the outside and inside of the pipe (total outside diameter, d_n), as specified in [Annex A](#), where all layers have the same MRS rating;
- Coated PE pipes (outside diameter, d_n) having a peelable, contiguous, thermoplastics additional layer on the outside of the pipe ("coated pipe"), as described in [Annex A](#).

In addition it covers:

- jointing of pipe lengths by means of butt fusion;
- fabricated and injection-moulded fittings made of PE;

It is applicable to PE pipes, fittings and assemblies intended to be used at an operating temperature of 20 °C as the reference temperature.

NOTE For other operating temperatures, guidance is given in ISO 4437-5:2014.

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 4437-1, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 1: General*

ISO 4437-2, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 2: Pipes*

ISO 4437-3, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings*

ISO 4437-5:2014, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 5: Fitness for purpose of the system*

ISO 11299-1:2018, *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*

EN 1555-1, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 1: General*

EN 1555-2, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 2: Pipes*

EN 1555-3, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings*

EN 1555-5, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 5: Fitness for purpose of the system*

3 Terms and definitions

For the purposes of this document the terms and definitions given in ISO 11299-1 and the following 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 <https://www.iso.org/obp>

3.1 compound formulation

clearly defined homogenous mixture of base polymer with additives, e.g. anti-oxidants, pigments, stabilisers and others, at a dosage level necessary for the processing and intended use of the final product

3.2 coated pipe

pipe with a peelable, contiguous thermoplastic additional layer on the outside of the pipe

3.3 solid wall single layered pipe

pipe with smooth internal and external surface, extruded from the same compound/formulation throughout the wall

3.4 pipe with co-extruded layers

pipe with smooth internal and external surface, having co-extruded layers on either or both the outside and inside of the pipe, where all layers have the same MRS rating

3.5 out-of-roundness

difference between the measured maximum and the measured minimum outside diameter in the same cross-sectional plane of the pipe

4 Symbols and abbreviated terms

4.1 Symbols

For the purposes of this document the following symbols apply:

d_n nominal outside diameter

e_{coating} nominal thickness of the coating

4.2 Abbreviated terms

For the purposes of this document the following abbreviated terms apply:

CCTV	closed-circuit television
MFR	melt mass-flow rate
MRS	minimum required strength
OIT	oxidation induction time
PE	polyethylene

5 Pipes at the “M” stage

5.1 Materials

Pipes shall be made of PE conforming to the requirements of ISO 4437-1.

5.2 General characteristics

General characteristics of pipes shall conform to the requirements of ISO 4437-2.

5.3 Material characteristics

Material characteristics shall conform to the requirements of ISO 4437-2.

5.4 Geometrical characteristics

Geometrical characteristics of pipes shall conform to the requirements of ISO 4437-2.

5.5 Mechanical characteristics

The mechanical characteristics of pipes shall conform to the requirements of ISO 4437-2.

5.6 Physical characteristics

The physical characteristics of pipes shall conform to the requirements of ISO 4437-2.

5.7 Jointing

When pipes are assembled to each other or to components the joints shall conform to ISO 4437-2, ISO 4437-3 and ISO 4437-5. All butt fusions shall be externally de-beaded and, if required by the client, internally de-beaded.

5.8 Marking

All pipes shall be marked either in accordance with ISO 11299-1 or in accordance with ISO 4437-2. Where the pipe is coated (see [A.3](#)), the coating shall be marked to clearly distinguish the pipe from a non-coated pipe in service (e.g. by broad colour bands).

5.9 Regional requirements for pipes

In countries of the Single European Market, the parts of ISO 4437 specified as normative references in [5.1](#) to [5.8](#) (e.g. ISO 4437-1, ISO 4437-2, ISO 4437-3, ISO 4437-5) are replaced by the corresponding parts of EN 1555 (e.g. EN 1555-1, EN 1555-2, EN 1555-3, EN 1555-5).

6 Fittings at the “M” stage

6.1 Requirement for fittings

Fittings shall fulfil the requirements in ISO 4437-3.

6.2 Marking

Each fitting shall be marked either in accordance with ISO 11299-1 or in accordance with ISO 4437-3.

6.3 Regional requirements for fittings

In countries of the Single European Market, ISO 4437-3, specified as normative reference in 6.1 to 6.2, is replaced by EN 1555-3.

7 Ancillary components

This document does not cover any ancillary components.

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

Pipes and fittings shall conform to the requirements of ISO 11299-1.

Out-of-roundness of the lining system after installation (including any caused by grouting of the annular space) shall not exceed any maximum value agreed between the client and installer.

9 Installation practice

9.1 Preparatory work

The preparatory work shall conform to ISO 11299-1.

NOTE Depending on the condition of the existing pipeline, cleaning can be necessary to remove encrustation.

9.2 Storage, handling and transport

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.

When assessing damage to the pipe wall caused by scratches, the installer should be aware that further scratch damage may occur during installation.

The lining pipe shall be stored on reasonably level ground, free of large sharp stones, debris or litter, to 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 flat-bed 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 on to a drum. Before being loaded, 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 under 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.

9.3 Equipment

9.3.1 Butt fusion equipment and debanding equipment

Butt fusion equipment shall be capable of producing joints between PE pipes or PE pipes and fittings under site conditions and shall comply with ISO 12176-1.

In addition to the heater plate, the equipment shall include clamping, re-rounding and trimming systems to ensure alignment and matching of the pipe ends, and an external debander capable of removing the bead cleanly in one continuous strip without damage to the pipe surface. If an internal debander is used, this shall not cause damage to the internal pipe surface.

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

9.3.2 Pipe rollers

Pipe rollers shall be used for all pipe handling operations except by means of a crane. The rollers shall minimize frictional loads and prevent damage to the pipe as it is moved during the butt-fusion and installation processes.

9.3.3 Winching and rod-pulling equipment

Winching equipment usually consists of a powered winch connected to the lining pipe by a winch cable and appropriate nose cone connection.

Rod pulling equipment usually consists of a hydraulic ram-driven carriage, connected to the lining pipe by a string of rods which screw or hook together, and an appropriate nose cone connection.

All pulling equipment shall have a means of displaying in real time, and recording graphically or numerically, the force applied to the pipe during installation. In the case of a winch, this shall be by directly measuring the load on the winch wire. In the case of a rod puller, this shall be by directly measuring either the load applied to the rods or the load applied to the nose cone.

WARNING — All pulling operations are potentially dangerous and any exposed winch cable or puller rods should be guarded.

9.3.4 Pipe entry guides

Pipe entry guides shall be designed to prevent damage to the lining pipe during insertion.

9.3.5 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.

9.3.6 Inspection equipment

Closed-circuit television (CCTV) shall provide a full colour picture and recording/replay facilities, complete with slow motion and frame by frame replay, and shall provide a clear picture of all parts of the installed pipe. The recording shall be labelled on screen with full location, metreage, liner type, nominal size and date information.

Laser profiling equipment shall additionally report mean internal diameter and pipe ovality, with graphical images of pipe cross section, at metreage intervals of one diameter or less.

All equipment to be introduced into the installed pipe including proving pigs shall be constructed and maintained so as to prevent any damage or contamination to the installed pipe.

9.3.7 Lifting equipment

All lifting equipment shall be covered by current test certification and shall be operated only by trained personnel.

9.4 Installation

Installation shall follow the procedures detailed in the installation manual.

The installation manual shall specify the method of installation, including the use of pipe entry guides, liner termination and reconnection to the existing network and customer service pipes, inspection and testing, and all necessary parameters according to the requirements of the method described.

The manual shall also include:

- a) Maximum allowable pulling force as declared by the pipe manufacturer as a function of temperature;

NOTE The maximum pulling force is usually calculated to limit the maximum stress to not more than 50 % of the tensile yield stress of the material.

- b) Minimum allowable longitudinal bending radius during installation, as declared by the pipe manufacturer as a function of SDR and temperature, and the associated minimum length of access pit as a function of excavation depth;
- c) Details of the type of fittings to be used.

Where pipes are jointed to form one pipe string on-site using butt-fusion, a method statement for internal debearing, where required, and external debearing shall be provided and shall specify at least:

- 1) how the bead is removed;
- 2) how the bead and related joint are identified;
- 3) how the bead is to be examined for quality control purposes, and stored for future reference.

Where there is a peelable layer, this shall be removed prior to jointing.

9.5 Process-related inspection and testing

The lining pipe shall be inspected at the leading end, and where possible, at other places along the installed lengths where the pipe is exposed (e.g. at 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.

9.6 Lining termination

The ends of the lining pipe shall be anchored and sealed in such a way as to provide a leaktight connection to the existing pipeline. The method of anchoring the liner pipe ends shall take account of the maximum longitudinal force that can be safely transmitted onto the existing network pipes.

9.7 Reconnections to the existing pipeline system

Reconnections to the existing pipeline system shall conform to ISO 11299-1.