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Classification and information on design and applications of plastics piping systems used for renovation and replacement

Classification et informations relatives à la conception et aux applications des systèmes de canalisations en plastique destinés à la rénovation et au remplacement

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Foreword

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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).

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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 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 11295:2010), which has been technically revised.

This edition includes the following significant changes with respect to the previous edition:

— Clauses 3, 4, 5 and 6 have been technically revised;

— Clause 7 for the classification of replacement techniques has been added.

Introduction

This document classifies the techniques used for the renovation and trenchless replacement of existing pipelines and gives information on the design and application of plastics piping systems used for such rehabilitation.

In recent years, the rehabilitation of pipeline systems has become increasingly important and will continue to be so.

Pipeline systems are continuously required to satisfy physical, chemical, biochemical and biological demands. These demands depend on planning, material, construction, type and period of use.

When pipeline systems become operational, proper system management has to be put in place. In addition to inspection and cleaning, rehabilitation of the pipeline can be required. Rehabilitation is carried out when there is a need to restore or upgrade the performance of a pipeline system. Rehabilitation can consist of repair, renovation or replacement.

To coincide with the publication of ISO rehabilitation product standards for various application areas using methods other than renovation, the need to extend the scope of this document to include families of trenchless replacement techniques was recognized.

Classification and information on design and applications of plastics piping systems used for renovation and replacement

1 Scope

This document defines and describes families of techniques for the renovation and trenchless replacement (on or off the line of an existing pipeline) of non-pressure and pressure pipelines through the use of plastics pipes, including plastics composites formed *in situ* into pipes, fittings and ancillary components. It does not include new construction provided as network extension. For each technique family, it identifies areas of application including, but not limited to, underground drainage and sewerage, and underground water and gas supply networks.

This document provides information on the principles of, but not the detailed methodologies for, the design of plastics piping systems used for renovation or trenchless replacement of existing pipelines, covering:

— existing pipeline and site conditions;

— functions of the new pipeline;

— structural performance;

— hydraulic performance;

— installation aspects and site impact;

— other factors affecting renovation or trenchless replacement technique selection.

Necessary work on the existing pipeline prior to renovation and/or trenchless replacement is outside the scope of this document.

This document provides information needed to determine viable options and for identification of the optimal technique with regard to a given set of rehabilitation objectives.

NOTE It is the responsibility of the designer to choose and design the renovation or trenchless replacement system.

It does not specify the calculation methods to determine, for each viable technique, the required amount of lining or replacement pipe material needed to secure the desired performance of the rehabilitated pipeline.

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 1043-1, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1043-1 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 http://www.iso.org/obp

3.1 General

3.1.1
rehabilitation
measures for restoring or upgrading the performance of existing pipeline systems, including *renovation* (3.1.2), *repair* (3.1.3) and *replacement* (3.1.4)

3.1.2
renovation
work incorporating all or part of the original fabric of the pipeline, by means of which its current performance is improved

3.1.3
repair
rectification of local damage

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
network extension
new construction off the line of a pipeline or a network with the aim to expand the total capacity of the network

3.1.6
trenchless replacement
replacement (3.1.4) without opening trenches other than small excavations to provide access for the particular technique

3.1.7
maintenance
routine work undertaken to ensure the continuing performance of an asset

3.1.8
independent pressure pipe liner
liner (3.2.3) capable on its own of resisting without failure all applicable internal loads throughout its design life

3.1.9
interactive pressure pipe liner
liner (3.2.3) which relies on the existing pipeline for radial support in order to resist without failure all applicable internal loads throughout its design life

3.1.10
fully structural renovation
use of an *independent pressure pipe liner* (3.1.8) which is capable of resisting all external loads irrespective of the condition of the existing pipeline

3.1.11
semi-structural renovation
use of an *interactive pressure pipe liner* (3.1.9) which is capable of long-term hole and gap spanning at operational pressure

3.1.12
flow diversion
temporary isolation of the section of pipeline to be rehabilitated by the use of a temporary bypass or other means

3.2 Techniques

3.2.1
technique family
grouping of *renovation* (3.1.2) or *trenchless replacement* (3.1.6) techniques which are considered to have common characteristics for standardization purposes

3.2.2
lining pipe
pipe inserted for *renovation* (3.1.2) purposes

3.2.3
liner
lining pipe (3.2.2) after installation

3.2.4
lining system
lining pipe (3.2.2) and all relevant fittings inserted into an existing pipeline for the purposes of *renovation* (3.1.2)

3.2.5
lining with continuous pipes
lining with pipe made continuous prior to insertion, where the diameter of the *lining pipe* (3.2.2) remains unchanged

3.2.6
lining with close-fit pipes
lining with a continuous pipe (3.2.5) for which the cross-section is reduced to facilitate installation and reverted after installation to provide a close fit to the existing pipe

3.2.7
lining with cured-in-place pipes
lining with a flexible tube impregnated with a thermosetting resin, which produces a pipe after resin cure

3.2.8
lining with discrete pipes
lining with short lengths of pipe which are jointed to form a continuous pipe one by one during insertion

3.2.9
lining with adhesive-backed hoses
lining with a reinforced hose which relies on an adhesive bond to the host pipe to provide resistance to collapse

3.2.10
lining with spirally-wound pipes
lining with a profiled strip, spirally wound to form a continuous pipe after installation

3.2.11
lining with sprayed polymeric materials
lining with a sprayed two-part polymeric resin material that forms a continuous pipe after resin cure

3.2.12
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

3.2.13
lining with a rigidly anchored plastics inner layer
lining with a single rigid annulus of structural cementitious grout formed between a plastics layer and the host pipe, where the plastics layer is permanently anchored in the grout

3.2.14
lining with pipe segments
lining with prefabricated segments bonded to the existing pipe, which either have longitudinal joints and cover the whole of the pipe circumference, or cover only part of circumference

3.2.15
pipe bursting
on-the-line *replacement* (3.1.4) method in which an existing pipe is broken by longitudinal splitting or brittle fracture, using a mechanically applied force from within, where the pipe fragments are forced into the surrounding ground and a new pipe of the same, smaller or larger diameter, is simultaneously pulled in

3.2.16
pipe removal
on-the-line *replacement* (3.1.4) method, in which the existing pipe is removed by *pipe eating* (3.2.17) or *pipe extraction* (3.2.18) and a new pipe is installed

3.2.17
pipe eating
type of *pipe removal* (3.2.16), where the existing pipe is progressively broken up and removed along with an annulus of the ground immediately surrounding the existing pipe

3.2.18
pipe extraction
type of *pipe removal* (3.2.16), where the existing pipe is extracted by pulling or pushing and replaced with a new one, either simultaneously or as a separate step

3.2.19
horizontal directional drilling
off-the-line *replacement* (3.1.4) method in which a pilot bore is drilled using a steerable drilling head connected to flexible rods and then the bore is enlarged by reamers up to the diameter required for the pipe or pipes subsequently pulled/pushed into place

3.2.20
impact moling
off-the-line *replacement* (3.1.4) method in which pipes are pulled in behind a pneumatic powered soil displacement hammer

3.2.21
pipe jacking
off-the-line *replacement* (3.1.4) method in which pipes are pushed through the ground, and the soil inside removed either manually, mechanically or using a slurry system

3.2.22
auger boring
type of *pipe jacking* (3.2.21), where the bore is excavated by a rotating cutting head attached to an auger which continuously removes the spoil, and the pipeline is pushed independently from the auger

3.2.23
microtunnelling
type of *pipe jacking* (3.2.21) where pipes are pushed behind a steerable, small scale tunnelling machine, remotely controlled from the surface

3.2.24
grout system
cement-based grout including any fillers, reinforcement or other additives or admixtures, in specified proportions

3.3 Service conditions

3.3.1
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: For plastics piping systems conveying water, it corresponds to the maximum continuous operating pressure, expressed in bar (1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2), which can be sustained with water at 20 °C, based on the minimum design coefficient.

3.3.2
internal pressure resistance
ability to withstand internal hydrostatic pressurization

3.3.3
allowable operating pressure
PFA
maximum hydrostatic pressure that a component is capable of withstanding continuously in service

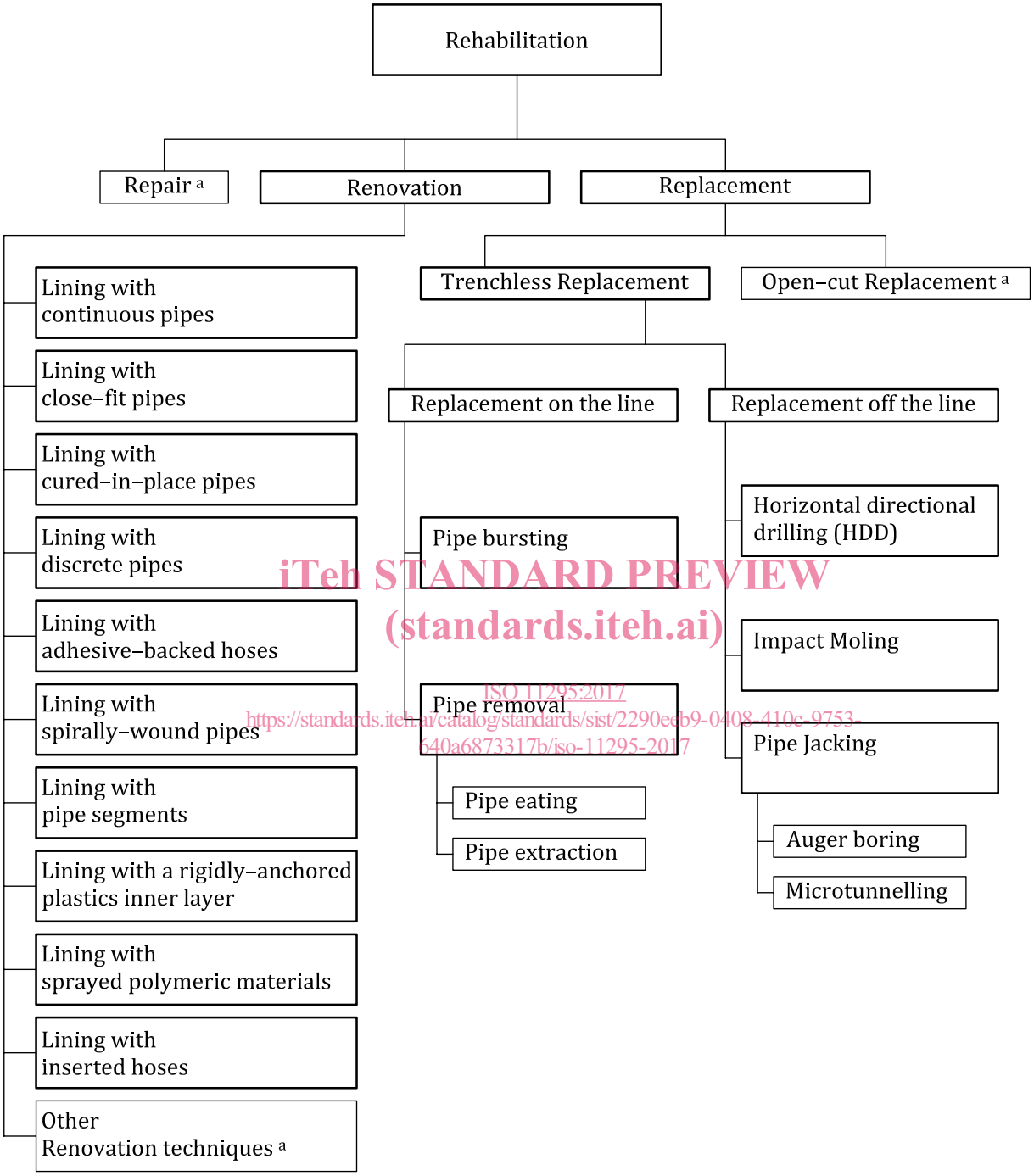
4 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO 1043-1 and the following apply.

CCTV	closed circuit television
HDD	horizontal directional drilling
EP	epoxy resin
GRP	glass-reinforced thermosetting plastics
PE	polyethylene
PP	polypropylene
PRC	polyester resin concrete
PUR	polyurethane
PVC-U	unplasticized poly(vinyl chloride)
UP	unsaturated polyester resin
VE	vinyl ester resin

5 Classification of renovation and replacement techniques

Renovation and replacement techniques within the scope of this document are classified in Figure 1.



a Outside the scope of this document.

Figure 1 — Renovation and trenchless replacement technique families using plastics pipes defined in the overall context of rehabilitation of pipeline systems

6 Classification of renovation techniques

6.1 General

Renovation technique families using plastics pipes are classified in accordance with Figure 1.

Techniques used for the renovation of continuous lengths of existing pipeline usually between two or more access points shall be classified in accordance with 6.2 to 6.11, where the different renovation technique families are defined and their respective features including materials, application, as well as geometric performance and installation characteristics are described.

NOTE 1 The pipe materials listed in 6.2 to 6.11 reflect the state-of-the-art in the technique families on the date of publication of this document. Not all technique families/material-combinations are covered by a product standard. The Bibliography gives relevant available documents.

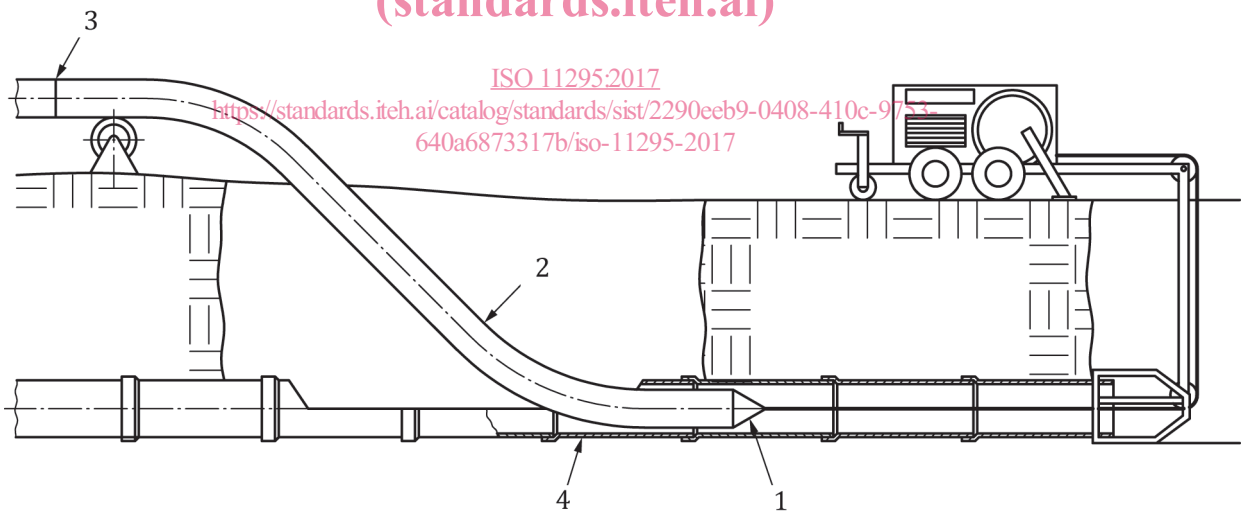
NOTE 2 The application areas covered by existing product standards include underground drainage and sewerage and underground water and gas supply networks.

NOTE 3 The maximum and minimum sizes and lengths listed for technique families are those typical at the time of publication of this document.

6.2 Lining with continuous pipes

Lining is carried out with pipes made continuous prior to insertion, where the diameter of the lining pipe remains unchanged (see Figure 2 and Table 1).

NOTE This is often referred to as slip-lining.



Key

1 pulling head
2 lining pipe
3 prior jointing of lining pipe
4 existing pipe

Figure 2 — Lining with continuous pipes

Table 1 — Features of lining with continuous pipes

Feature	Description
Relevant documents:	ISO 11296-2, ISO 11297-2, ISO 11298-2, ISO 11299-2
Materials:	PE
Applications:	— non-pressure pipes; — pressure pipes.
Geometric characteristics:	— minimum size: 100 mm; — maximum size: 1 200 mm; — maximum length: 750 m; — capable of accommodating slightly curved alignments of the existing pipe.
Performance:	— significant reduction in hydraulic (volumetric and flow) capacity; — invert grade of liner can deviate from that of existing pipeline; — structural rehabilitation is possible; — abrasion resistance depends on liner material; — chemical resistance depends on liner material.
Installation characteristics:	a) pipes manufactured or prior assembled into the continuous length required; b) insertion possible by pushing and/or pulling; c) surface working space: storage of the whole insertion length required on surface: 1) small diameters (typically ≤180 mm) can be supplied on coils, small space; 2) larger diameters: supplied in straight lengths; d) access to the existing pipeline: generally requires local excavation; e) technique does not rely on adhesion to host pipe; f) flow diversion is typically required for installation; g) the annular space can be grouted, e.g. in non-pressure applications, to fix line and level and/or prevent subsequent movement; h) live insertion is possible (but excl. drinking water applications for hygiene reasons); i) reconnection of laterals: generally requires excavation.
Installation equipment:	— rollers to support the entire length of the lining pipe string (except where pipe is inserted directly from a coil); — pushing unit, if applicable; — rollers to guide the lining pipe into the existing pipeline; — winch or rod puller to pull the lining pipe through the existing pipeline; — jointing equipment appropriate to the material; — grouting equipment, if applicable.
Surface area:	— for the lining pipe string (or coil trailer for smaller diameters) at the insertion end; — for a winch or a rod puller at the receiving end.
Excavation:	— at the insertion end: — long enough to allow the lining pipe to enter the existing pipeline, taking account of the permissible minimum bending radius; — wide enough for the guidance equipment and pushing equipment if applicable; — at the receiving end: — large enough to accommodate the lining pipe nose cone and the winch mast or rod puller, where applicable.

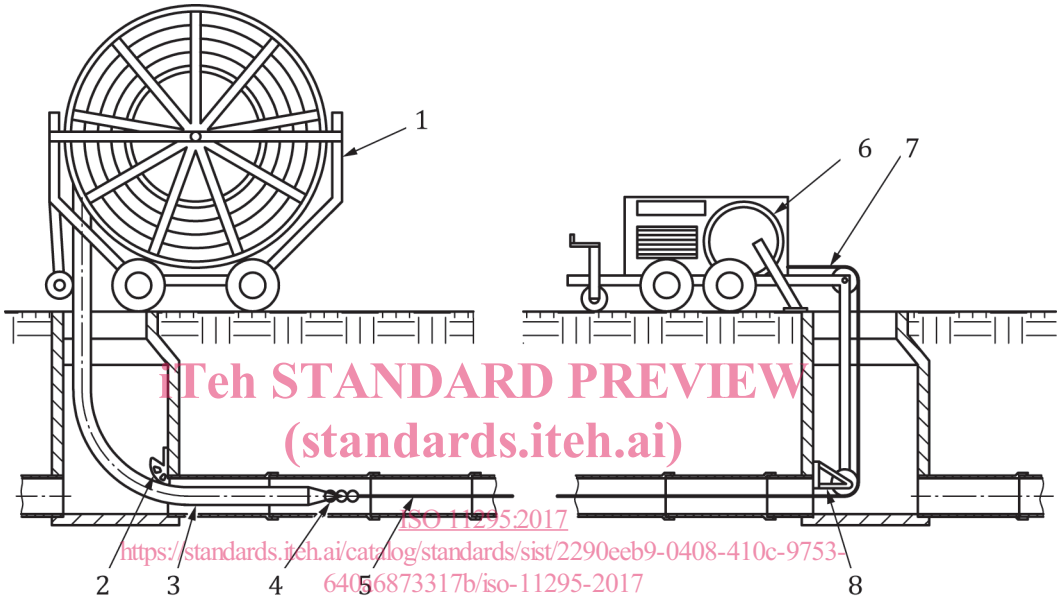
6.3 Lining with close-fit pipes

Lining is carried out with a continuous pipe for which the external dimension is reduced to facilitate installation and reverted after installation to provide a close fit to the existing pipe.

Methods of lining with close-fit pipes are shown in Figure 3 (Method A), Figure 4 (Method B) and Table 2.

a) Method A: reduction in the pipe manufacturing plant — the pipe is supplied coiled on a reel from which it is directly inserted.

b) Method B: reduction on site — the pipe is fed through diameter reduction or folding equipment and inserted.



Key

1	drum trailer	4	pulling head	7	guide pulley
2	pipe guide	5	winch cable	8	bracing
3	lining pipe (folded)	6	winch		

NOTE Pipe reverted (unfolded) after insertion by application of heat and/or pressure.

Figure 3 — Lining with close-fit pipes — Schematic representation of installation of a pipe reduced in external dimension in the pipe manufacturing plant (Method A)