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**Plastics piping systems used for  
the rehabilitation of pipelines —  
Classification and overview of  
strategic, tactical and operational  
activities**

iTeh STA (standards.iteh.ai) *Systèmes de canalisation en plastique destinés à la réhabilitation  
des réseaux enterrés — Classification et vue d'ensemble des activités  
stratégiques, tactiques et opérationnelles*

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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 of 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 [www.iso.org/iso/foreword.html](http://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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 155, *Plastics piping systems and ducting systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 11295:2017), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Title is renewed from “*Classification and information on design and applications of plastics piping systems used for renovation and replacement*” to “*Plastics piping systems used for the rehabilitation of pipelines — Classification and overview of strategic, tactical and operational activities*”;
- [Clause 5](#) has been added, describing the whole process of pipeline rehabilitation with references to the other clauses for further details;
- [Clause 6](#) has been added, dealing with the strategic and tactical activities necessary to decide whether to rehabilitate; parts of the content of the former Clause 8 are included in this new clause;
- Former Clauses 5, 6 and 7 have been combined into [Clause 7](#) with largely unchanged content;
- [Clause 8](#) has been added, outlining the further tactical and operational steps needed to specify the rehabilitation project; parts of the content of the former Clauses 8 and 9 are included;
- [Clause 9](#) still covers installation aspects but has been revised to include content on acceptance control.

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](http://www.iso.org/members.html).

## Introduction

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, they constitute a valuable asset to the network owner, requiring adequate management, including monitoring the performance of the pipeline system. For general guidelines and requirements on asset management, ISO 55000, ISO 55001 and ISO 55002 are applicable.

For the specific case of pipelines for water supply and wastewater collection, detailed information on the overall management of the networks is provided by ISO 24516-1 and ISO 24516-3.

In the case of loss of performance of a pipeline system, reactive measures initially focus on improving regular maintenance procedures, including cleaning. In case of deterioration or other serious defects, more stringent measures to rehabilitate the pipeline become necessary.

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

This document provides information on the design process when considering rehabilitation of an existing pipeline, in order of sequence:

- a) investigation and assessment of the deficiencies of current performance of the existing pipeline;
- b) determination of viable options, based on performance criteria and process-related factors;
- c) specification of the selected type of technique and the required pipe material;
- d) the installation;
- e) testing the performance.

The techniques used for the renovation and trenchless replacement of existing pipelines are classified in technique families and the typical characteristics of each are described in general terms.

# Plastics piping systems used for the rehabilitation of pipelines — Classification and overview of strategic, tactical and operational activities

## 1 Scope

This document specifies the steps of the overall process of pipeline rehabilitation, comprising:

- information on strategic and tactical activities:
  - a) investigation and condition assessment of the existing pipeline;
  - b) pipeline rehabilitation planning.
- information on and requirements for operational activities:
  - c) project specification;
  - d) applications of techniques;
  - e) documentation of the design and application process.

Definitions and classification of families of renovation and trenchless replacement techniques are provided, and their respective features described. Areas of application covered include underground drainage and sewerage networks and underground water and gas supply networks.

The following aspects are not covered by the scope of this document:

- new construction provided as network extensions;
- calculation methods to determine, for each viable technique, the characteristics of lining or replacement pipe material needed to secure the desired performance of the rehabilitated pipeline;
- techniques providing non-structural pressure pipe liners;
- techniques for local repair.

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

## 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 terminology databases for use in standardization at the following addresses:

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

### 3.1 General terms

#### 3.1.1 assessment

process, or result of this process, comparing a specified subject matter to relevant references

#### 3.1.2 design working life

assumed period for which a structure or part of it is to be used for its intended purpose with anticipated *repair* (3.1.7) and *maintenance* (3.1.11) but without *renovation* (3.1.6) or *replacement* (3.1.8) being necessary

#### 3.1.3 hazard

condition of water, or biological, chemical, physical or radiological agent with the potential to cause harm to public health

Note 1 to entry: Condition includes quantity.

[SOURCE: EN 15975-1:2011+A1:2015, 2.6; modified]

#### 3.1.4 pipeline system

interconnecting pipe network for the conveyance of fluids

[SOURCE: ISO 11298-1:2018, 3.1.1]

#### 3.1.5 rehabilitation

measures for restoring or upgrading the performance of existing *pipeline systems* (3.1.4), including *renovation* (3.1.6), *repair* (3.1.7) and *replacement* (3.1.8)

#### 3.1.6 renovation

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

#### 3.1.7 repair

rectification of local damage

#### 3.1.8 replacement

construction of a new pipeline, on or off the line of an existing pipeline, where the function of the new *pipeline system* (3.1.4) incorporates that of the old

#### 3.1.9 network extension

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

#### 3.1.10 trenchless replacement

*replacement* (3.1.8) without opening trenches other than small excavations to provide access for the particular technique



**3.1.11****maintenance**

routine work undertaken to ensure the continuing performance of a *pipeline system* (3.1.4)

**3.1.12****independent pressure pipe liner**

*liner* (3.2.3) capable on its own of resisting without failure all applicable internal loads throughout its design life

**3.1.13****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

**3.1.14****fully structural renovation**

use of an *independent pressure pipe liner* (3.1.12) which is capable of resisting all external loads irrespective of the condition of the existing pipeline

**3.1.15****semi-structural renovation**

use of an *interactive pressure pipe liner* (3.1.13) which is capable of long-term hole and gap spanning at operational pressure

**3.1.16****non-structural renovation**

use of an *interactive pressure pipe liner* (3.1.13) which is not capable of long-term hole and gap spanning at operational pressure

**3.1.17****flow diversion**

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

**3.2 Terms related to techniques****3.2.1****technique family**

grouping of *renovation* (3.1.6) or *trenchless replacement* (3.1.10) techniques which are considered to have common characteristics for standardization purposes

**3.2.2****lining pipe**

pipe inserted for *renovation* (3.1.6) 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* (3.1.6)

**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 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 the circumference

### 3.2.15

#### **pipe bursting**

on-the-line *replacement* (3.1.8) 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* (3.1.8) 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 *trenchless replacement* (3.1.10) 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 *trenchless replacement* (3.1.10) method in which pipes are pulled in behind a pneumatic powered soil displacement hammer

**3.2.21****pipe jacking**

off-the-line *trenchless replacement* (3.1.10) 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 Terms related to services conditions****3.3.1****internal pressure resistance**

ability to withstand internal fluid pressurization

**3.3.2****allowable operating pressure****PFA**

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

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

**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

DN nominal diameter

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

HDD	horizontal directional drilling
EP	epoxy resin
GRP	glass-reinforced thermosetting plastics
PE	polyethylene
PFA	allowable operating pressure
PP	polypropylene
PRC	polyester resin concrete
PUR	polyurethane
PVC-U	unplasticized poly(vinyl chloride)
RFC	resin fibre composite
UP	unsaturated polyester resin
VE	vinyl ester resin

## 5 Pipeline rehabilitation process

The overall process of pipeline rehabilitation involves several sequential steps, for which this document provides information and requirements as follows:

1) investigation of functional performance of the existing pipeline	}	<a href="#">Clause 6</a>
2) condition assessment of performance against set requirements		
3) measures to control risks / pipeline rehabilitation		
4) pre-selection of suitable types of rehabilitation techniques	}	<a href="#">Clause 7</a>
5) project specification	}	<a href="#">Clause 8</a>
6) selection of technique / installer		
7) application of rehabilitation technique	}	<a href="#">Clause 9</a>
8) acceptance control		
9) documentation of the rehabilitation process	}	<a href="#">9.7</a>

A substantial part of this document ([Clause 7](#)) is dedicated to the classification of families of techniques for pipeline rehabilitation, covering both renovation and trenchless replacement. Key features, including typical product characteristics, areas of application and process related factors are described for each technique family.

NOTE Guidance on the whole process of integrated management of drains and sewers is presented in EN 752.

## 6 Investigation and condition assessment of the existing pipeline

### 6.1 Performance criteria

#### 6.1.1 General

For every pipeline system certain objectives apply, depending on their intended functionality.

These are the basis for the performance requirements of a pipeline system. The pipeline system objectives that impact on the performance requirements of the individual pipeline, shall be identified.

For drinking water distribution networks and wastewater collection networks, detailed guidance and requirements are provided by ISO 24516-1 and ISO 24516-3 respectively. The items detailed below specifically relate to the rehabilitation process of the pipeline systems in these networks, as well as in gas supply networks.

Pipeline system objectives include at least the following:

- health and safety;
- environmental protection;
- sustainable operation.

Health and safety encompasses (depending on the function of the pipeline):

- provision of access to safe and good-quality drinking water;
- preventing spread of disease by safe disposal of wastewater;
- meeting user's needs and expectations;
- minimizing occupational health and safety risks;
- maintaining pipeline system integrity.

Environmental protection includes:

- preventing pollution and minimizing generation of pollutants;
- minimizing energy consumption;
- avoiding nuisance in construction, operation and maintenance.

Sustainable operation includes:

- providing service over many years: economic, social, environmental;
- monitoring the quality of water (sampling, surveillance, maintenance);
- minimizing mains failures and leakages.

The objectives shall be transformed to performance requirements and the resulting design criteria that ensure functionality of the pipeline system, such as: structural integrity, design working life, leak tightness, prevention of pollution, sustainability and maintenance of flow.

Objectives can be split into the following categories:

- hydraulic requirements;
- structural requirements;
- environmental requirements;
- operational requirements.

NOTE 1 In ISO 24512 'performance requirements' are recommended to be clearly specified in objective, verifiable 'Performance Indicators (PIs)', allowing for a clear comparison with the targeted objectives.

NOTE 2 In EN 752, 'performance requirements' are for the status quo. When any predicted changes in time are taken into account, they become 'design criteria'.

### 6.1.2 Hydraulic requirements

The following hydraulic requirements shall be considered:

- a) sufficient capacity, allowing for foreseeable increases in flow over the design working life of the pipeline system;
- b) ensuring operation of the pipeline system to be safe and economically efficient;
- c) leak tightness in accordance with national or local testing requirements;
- d) in the case of water supply pipelines, national or local regulations can additionally require:
  - safeguarding of water quality;
  - sufficient pressure, flow rate and continuity of supply;
  - prevention of back flow (via valves and wash outs);
  - minimization of stagnation to avoid possible deterioration of water quality;
  - requirements for firefighting (hydrants) to follow requirements of national legislation;
  - prevention of contamination at pumping stations.
- e) in the case of non-pressure drainage and sewerage networks,
  - national or local regulations or the relevant authority can specify requirements for limitation of surcharge or flooding.

### 6.1.3 Structural requirements

The following shall apply:

- a) structural integrity over the design working life of the pipeline system;

The pipeline system shall be able to withstand the loads without defects which can:

- lead to risk of loss of structural integrity;
- impair the function of the pipeline system.

### 6.1.4 Environmental requirement

The following shall apply:

- a) protection of groundwater;
- b) sustainable use of products and potential re-use through recycling;
- c) minimization of the use of energy over the design working life of the pipeline system;
- d) prevention of odours and toxic, explosive and corrosive gases.

### 6.1.5 Operational requirements

The following shall apply:

- a) trouble-free operation of the pipeline system, without interruptions of service;
- b) minimization of the risk of failures: collapses (non-pressure pipelines) or bursts (pressure pipelines);
- c) maintenance to be carried out safely and without risks to the health of personnel;

- d) adequate access and working space;
- e) prevention of noise and vibration;
- f) not endangering adjacent structures and utility services.

## 6.2 Investigation of performance

### 6.2.1 General

Prior to the actual investigation, the following basic information about the existing pipeline shall be collected:

- a) location;
- b) pipe material;
- c) actual internal diameter or other non-circular section dimensions;
- d) wall thickness (especially in the case of pressure pipelines where interactive lining is considered);
- e) fluid transported;
- f) accessibility and section lengths between access points;
- g) frequency and location of any lateral connections, branches and/or valves;
- h) depth of cover;
- i) height of ground water table (both mean long-term and peak short-term);
- j) flow quantity;
- k) failure and repair records;
- l) historical operating pressure regimes;
- m) traffic or other surface loads;
- n) proximity of adjacent buried services and structures.

NOTE 1 Some of this information can be ascertained from records and plans.

If available, the following additional information shall be acquired additionally:

- year of installation;
- pipe class (e.g. crushing strength, stiffness or pressure class);
- joint type;
- bedding and backfill of the original construction.

Methods for determining the condition of the existing pipeline affecting functional performance differ in some respects for non-pressure and pressure applications and as a function of material, section size and shape.

In the case of non-pressure pipelines, the initial investigation shall be carried out by visual inspection in the form of a CCTV survey and/or profiling equipment and/or by person-entry, and should be recorded systematically such that the exact location of each feature, condition and defect is known and an assessment of its severity can be made.

In the case of pressure pipelines, the initial investigation shall be carried out by non-flow-interrupting techniques, such as via sonar/acoustic sensors, tracer gas leak detection and ground penetrating radar