SLOVENSKI STANDARD
oSIST prEN 12889:2020

01-julij-2020

Izvedba in preskušanje kanalov in drenaž brez izkopa

Trenchless construction and testing of drains and sewers

Grabenlose Verlegung und Prüfung von Abwasserleitungen und -kanälen

Mise en oeuvre sans tranchée et essais des branchements et collecteurs d'assainissement

Ta slovenski standard je istoveten z: prEN 12889

ICS:

91.140.80	Drenažni sistemi	Drainage systems
93.030	Zunanji sistemi za odpadno vodo	External sewage systems

oSIST prEN 12889:2020 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 12889

May 2020

ICS 23.040.05; 93.030

Will supersede EN 12889:2000

English Version

Trenchless construction and testing of drains and sewers

Mise en oeuvre sans tranchée et essais des branchements et collecteurs d'assainissement

Grabenlose Verlegung und Prüfung von Abwasserleitungen und -kanälen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 165.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. prEN 12889:2020 E

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European foreword

This document (prEN 12889:2020) has been prepared by Technical Committee CEN/TC 165 “Waste water engineering”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12889:2000.

1 Scope

This document is applicable to the trenchless construction, trenchless replacement techniques and testing of new drains and new sewers in the ground usually operating as gravity or pressure pipelines, formed using prefabricated pipes and their joints.

Renovation techniques for existing pressure and non-pressure systems are not covered by this document.

Methods of trenchless construction include:

— manned and unmanned techniques;

— steerable and non-steerable techniques.

Mining or tunnelling (e.g. *in situ* construction or the use of prefabricated segments) are not covered by this document although some parts may apply to these methods.

Requirements for associated pipeline installation work other than trenchless construction, e.g. for manholes and inspection chambers, are not covered by this document and are specified in EN 1610. This also applies to pipes that are subsequently installed within entry and exit shafts/pits.

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.

EN 476, *General requirements for components used in drains and sewers*

EN 752, *Drain and sewer systems outside buildings – Sewer system management*

EN 805, *Water supply – Requirements for systems and components outside buildings*

EN 1295-1, *Structural design of buried pipelines under various conditions of loading – Part 1: General requirements*

EN 1610:2015, *Construction and testing of drains and sewers*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
cutting head
tool or system of tools on a common support, which excavates at the face of a bore

Note 1 to entry: The term usually applies to mechanical methods of excavation.

3.2
expander
tool which enlarges a bore by displacement of the surrounding ground rather than by excavation

3.3
gravity pipeline
pipeline where flow is caused by the force of gravity and where the pipeline is designed usually to operate partially full

3.4
overbreak
extent by which the excavated void including accidental ground losses initially exceeds the outside dimension of the pipe

3.5
overcut
annular space around the pipe deliberately created by using a cutting head or shield of greater dimension than the outside dimension of the pipe

3.6
pipe jacking
system of directly installing pipes behind a cutting head and/or shield, by hydraulic jacking from a drive shaft, such that the pipes form a string in the ground

3.7
reamer
cutting head attached to the end of a drill string or pilot rod to enlarge the pilot diameter during a pull-back or pushing operation, to enable a pipe or pipes to be installed

3.8
renovation
work incorporating all or part of the original fabric of the pipeline by means of which its current performance is improved

[SOURCE: EN 15885:2018, 3.2]

3.9
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

[SOURCE: EN 15885:2018, 3.4]

3.10
spoil
material excavated and removed in the course of installation

3.11
trenchless construction technique
technique for constructing pipelines in the ground without opening trenches

3.12
manned technique
technique involving the use of personnel working in the excavated bore during installation

3.13
unmanned technique
technique avoiding the use of personnel working in the excavated bore during installation

4 General

4.1 Technical principles

Pipelines, manholes and inspection chambers are engineering structures in which the combined performance of construction components, bedding and fill or the surrounding ground constitutes the basis for stability and safety in operation. The pipes, fittings and components for jointing supplied, together with the work carried out at site, are all important factors in achieving a structure with adequate performance over the intended service life.

The network owner and the planner shall coordinate the extent and the requirements of the engineering services to be rendered for the individual case.

The pipeline and any associated structures shall be designed during planning in accordance with EN 1295-1 and EN 752 as applicable to ensure it is capable of carrying all foreseeable imposed and operational loads with a sufficient level of safety.

A procedure shall be established for the resolution of technical questions, agreement and recording of changes to design decisions made during construction.

Additionally other local or national regulations may apply, e.g. concerning health and safety, pavement installation, tolerances for deviation in line and level and requirements for leaktightness testing.

4.2 Safeguarding design decisions

In the execution of the work it shall be ensured that the decisions made in the design are complied with or adapted to changed conditions.

The design decisions may be affected by variation of any of the following which should be checked during installation:

— pipe support;

— soil conditions and soil types;

— construction traffic and assumptions concerning temporary loads;

— ground water level;

— existing infrastructure in the same proximity (e.g. pipelines, cables, structures);

— settlement and heave;

— deflection;

— deviation from line;

— pipe type, strength or class.

NOTE The above list is not exhaustive.

5 Construction components and materials

5.1 General

Construction components and materials shall conform to European Standards. In the absence of these, the components and materials shall comply with design requirements and EN 476.

All written instructions of the manufacturer shall be complied with.

5.2 Pipes and joints

Installation shall not commence before the following criteria have been agreed between the designer and installer. These may be obtained from appropriate product standards or from the pipe manufacturer:

— internal pipe diameter;

— external pipe diameter;

— pipe length;

— tolerances on dimensions;

— permissible jacking load or pulling force;

— type and performance of joints;

— longitudinal flexibility (acceptable bending radius or angular deflection).

5.3 Manholes and inspection chambers

Manholes and inspection chambers shall comply with the design. Prefabricated components shall be assembled and installed according to the instructions of the manufacturer and the designer.

5.4 Delivery, handling and transportation on site

Construction components and materials shall be inspected on delivery to ensure that they are appropriately marked and comply with the design requirements.

Any handling or transportation instructions from the manufacturer shall be complied with.

Products shall be examined both on delivery and immediately prior to installation to ensure that they are free from damage and in accordance with the relevant product standard.

5.5 Storage

Any instructions from the manufacturer and the requirements of the appropriate product standards shall be complied with.

Construction components and materials should be stored in such a manner to keep them clean and avoid contamination or degradation, for example elastomeric jointing components should be kept clean and be protected from sources of ozone (e.g. electrical equipment), sunlight and oil, where necessary.

Pipes shall be secured to prevent rolling. Excessive stacking heights should be avoided so that pipes in the lower part of the stacks are not overloaded. Stacks of pipes shall not be placed close to open trenches.

Pipes with protective coatings shall be stored where necessary, on supports which keep them clear of the ground to avoid damage to coatings and joints. All pipes should be stored on supports in very cold weather to avoid freezing to the ground.

5.6 Other materials

The mechanical and environmental impact of other materials used during the construction process on:

— pipeline,

— surrounding soil,

— surface water and groundwater

shall be considered by the designer.

Consideration shall also be given to the following:

— production/origin;

— treatment and storage;

— leaching;

— cleanliness.

6 Techniques

6.1 Classification

Pre-fabricated pipes are jacked or pulled into the ground between the starting pit and the target pit. The soil is either displaced and/or excavated at the working face and is mechanically, hydraulically or pneumatically transported to the starting or target pit or in some techniques may be removed from the pipe as an earth core after completion. It is distinguished between manned and unmanned processes. With reference to the required accuracy, non-steerable or steerable jacking processes are selected.

The selection of the process depends on:

— the planned/given jacking pipe;

— the required positional precision; the client/ planner shall define it;

— the proximity to neighbouring utility services and sewers and other structures and systems;

— the external diameter;

— the jacking distance;

— the subsoil conditions;

— the groundwater conditions;

— the minimum depth of cover and

— the clear dimensions necessary for employing personnel inside the pipe string.

A schematic classification of trenchless techniques is given in Figure 1, representing techniques available at the time of publication of this European Standard.

The techniques are described and illustrated in 6.2 and 6.3.

Planning information for the application of different systems are given in Annex B, Table B.1.

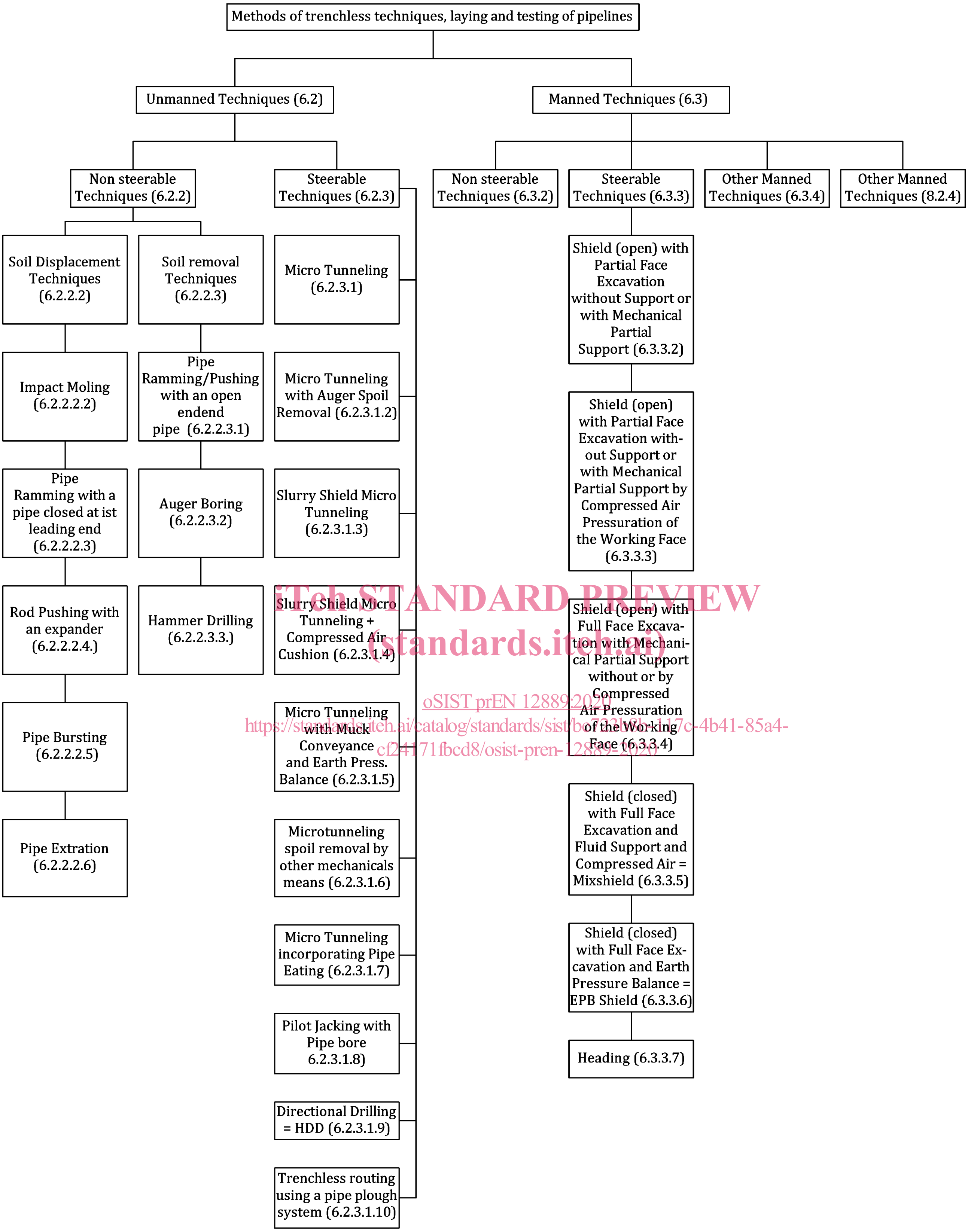


Figure 1 — Classification of trenchless techniques

6.2 Unmanned techniques

6.2.1 General

Unmanned techniques do not require employment of personnel inside the pipe string and in the jacking station for jacking. Steerable Horizontal Directional Drilling methods (HDD) as well as methods for trenchless replacement of pipelines on the same line represent unmanned techniques that are related to pipe jacking. The prerequisite for a temporary employment of personnel inside the pipe string are described in 7.2.4.

6.2.2 Non-steerable techniques

6.2.2.1 General

The accuracy of non-steerable techniques in new construction is influenced by the subsoil (e.g. soil type), intrusions and stratifications, the type of pipe joint, the external pipe diameter and the pipe wall thickness and other things, and decreases disproportionately with the jacking distance. Therefore the use of these methods for pipelines that require an exact position is restricted because of operational reasons. Damage to adjacent systems has to be excluded by ensuring sufficient clearance. Thus, during new construction suitable methods should be used to determine the position during jacking.

For use in water-bearing strata, additional measures such as groundwater retention may become necessary.

Table C.1 contains empirical values for the area of application of the listed unmanned, non-steerable techniques. The *in situ* subsoil conditions and project-specific boundary conditions shall always be taken into consideration.

6.2.2.2 Soil displacement techniques

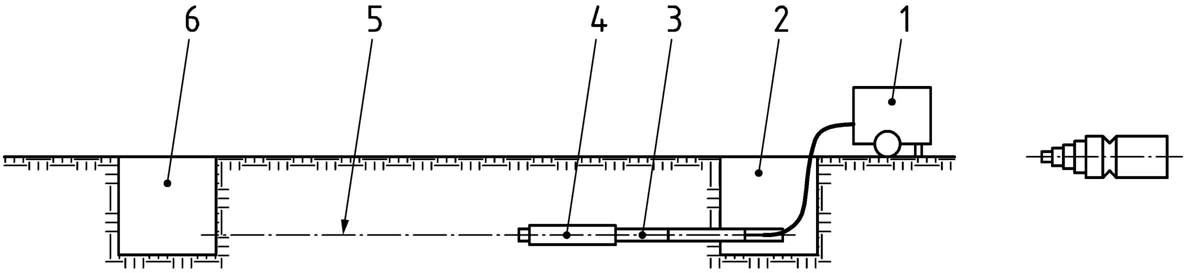
6.2.2.2.1 General

All listed techniques require soil that is displaceable.

6.2.2.2.2 Impact moling

Impact moling is a technique, generally considered to be non-steerable, using a pneumatic powered torpedo shaped device, known as a mole (see Figure 2). This incorporates a reciprocating internal hammer impacting on the back of a nose cone which in some cases can move independently of the main body. The friction between the main body and the ground enables the nose cone to move forward at each hammer blow, while the length of the main body keeps the mole on line. There are several designs of nose cone, which claim to give better penetration, or to be less susceptible to being pushed off line by lumps of stone.

Because the excavated material has to be forced out into the surrounding ground, this technique is confined to small pipe diameters. The pipe is generally pulled in behind the mole, or can be pulled back as the mole is reversed out. The piping is either done simultaneously or in a sufficiently stable soil by subsequent pulling or pushing in. A shrinking of the excavated diameter of the cavity by 5 % to 15 % has to be taken into account. Up to an external diameter of 63 mm, the technique can be used in a steerable manner.



Key

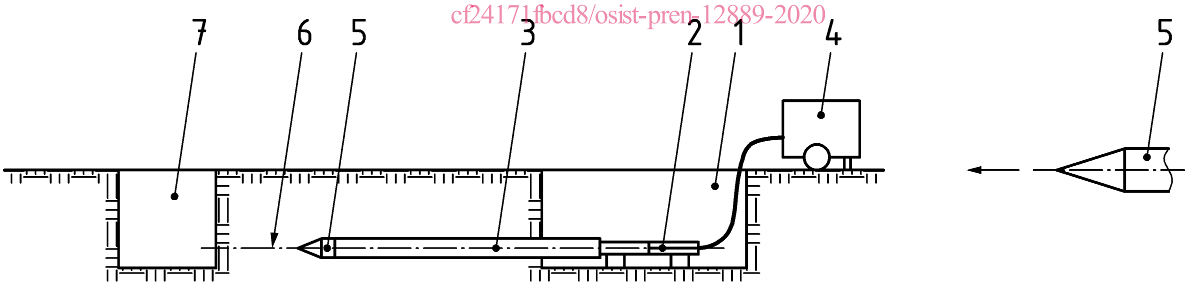
1 air compressor
2 starting pit
3 new (discrete) pipe
4 impact mole
5 planned route
6 target pit

Figure 2 — Example of impact moling

6.2.2.2.3 Pipe ramming with a pipe closed at its leading end

Pipe ramming with a pipe closed at its leading end is a technique of forming a bore by driving a steel casing with a closed end using a percussive hammer (see Figure 3). The soil is displaced by the leading closed pipe end.

When dimensioning the pipes for trenchless installation with pipe ramming, additional dynamic loads have to be taken into account. Product pipes with cement mortar lining and/or cement mortar coating shall not be installed by pipe ramming.



Key

1 starting pit
2 ramming hammer
3 pipe
4 air compressor
5 end cone
6 planned route
7 target pit

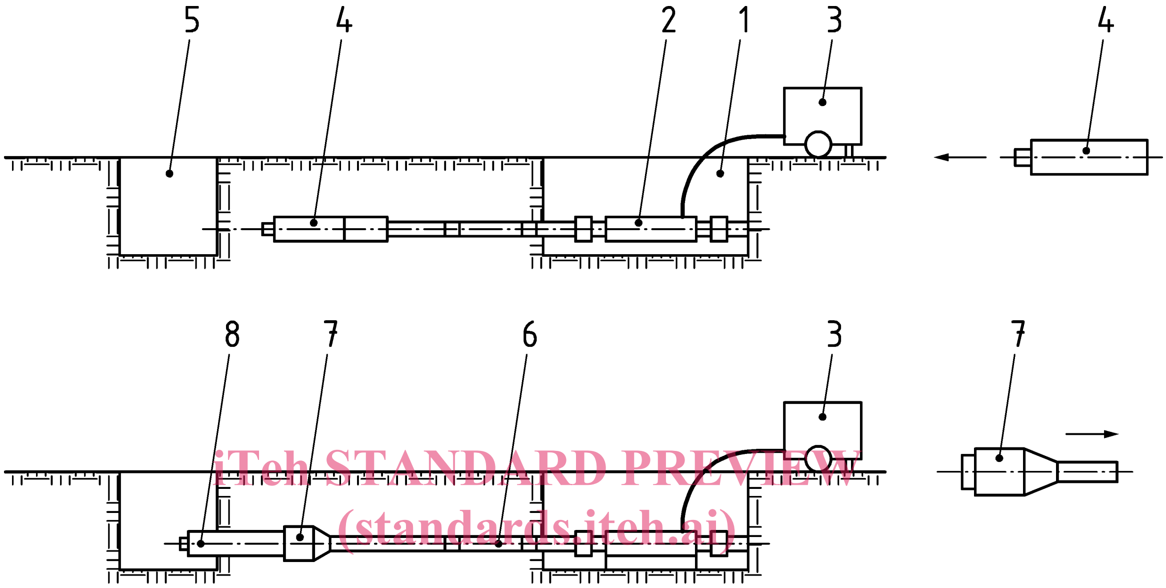
Figure 3 — Example of pipe ramming with a pipe closed at its leading end

6.2.2.2.4 Rod pushing with an expander

Pushing a pilot rod displaces the soil. After having arrived in the target pit, the rod is connected to a conical pushing head or a soil displacement hammer, which is also connected to the host or product pipes. Afterwards, the entire string is pulled back (see Figure 4).

The upper part of Figure 4 shows the installation of pilot rod and initial displacement of soil. The lower part shows the installation of the pipe and further displacement of soil.

The expander may be in the form of a displacement cone or a reamer.



Key

1 starting pit
2 ram system
3 hydraulic pump
4 pilot rod
5 target pit
6 rod
7 expander
8 pipe

Figure 4 — Example of the process of rod pushing with an expander

6.2.2.2.5 Pipe bursting

Replacement is done by bursting or splitting the existing pipe, and displacing it into the surrounding ground, while simultaneously pulling in a new continuous or discrete pipe, of the same or larger diameter.

A bursting head with a cone with or without fixed blades is generally used for brittle pipe materials such as clay, grey cast iron or fibre cement, whereas a splitting head with cutting discs is generally used for non-brittle pipe materials such as ductile iron, steel or plastics. Both types of head embody an expansion cone to displace the existing burst or split pipe into the surrounding ground and form a bore for the new pipe.

Additional measures may become necessary in water-bearing soils. The new pipe shall be dimensioned in accordance with the structural calculation.

Methods used are static pipe bursting (see Figure 5) or dynamic pipe bursting (see Figure 6).