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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

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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 European Standard was approved by CEN on 5 September 2022.

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

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EN 12889:2022 (E)**European foreword**

This document (EN 12889:2022) has been prepared by Technical Committee CEN/TC 165 “Waste water engineering”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by April 2023, and conflicting national standards shall be withdrawn at the latest by April 2023.

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

This document supersedes EN 12889:2000.

In comparison with the previous edition, the following changes have been made:

- a) editorial and technical revision of the complete document;
- b) modification of terms and definitions;
- c) adaptation of the description of all methods of trenchless techniques and installation of pipelines;
- d) Clause 7 “Requirements of planning and construction” was added.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

1 Scope

This document is applicable to the trenchless construction, trenchless replacement techniques and testing of new drains and new sewers in the ground and 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.

NOTE 1 Mining or tunnelling techniques for permanent structures (e.g. *in situ* construction or the use of prefabricated segments) are not covered by this document although some parts can apply to these methods.

NOTE 2 Trenchless insertion using a pipe plough system is a common method for installing small pipes and cables. The method does not exactly cope with the scope of this document. Therefore, it is described in the informative Annex D.

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, *Construction and testing of drains and sewers*

EN 1997-2, *Eurocode 7: Geotechnical design - Part 2: Ground investigation and testing*

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 <https://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.

EN 12889:2022 (E)**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**

half of the difference of borehole diameter and external pipe diameter (ideally, an even annular space around the pipeline)

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 each 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 that they are 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 can 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 can be affected by a variation of any of the following which should be checked during installation:

- pipe support;
- ground 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.

EN 12889:2022 (E)**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 shall 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 shall be stored in such a manner to keep them clean and avoid contamination or degradation, for example elastomeric jointing components shall 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 shall 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 can be removed from the pipe as an earth core after completion. There is a distinction between manned and unmanned processes. Non-steerable or steerable jacking processes are selected depending on the required accuracy of installation.

The selection of the process depends on:

- the planned/given jacking pipe;
- the required positional precision; this shall be defined by the client/ planner;
- the proximity to neighbouring utility services and sewers and other structures and systems;
- the external diameter;
- the jacking distance;
- the ground conditions;
- the groundwater conditions;
- the minimum depth of cover and
- the clear dimensions necessary for employing personnel inside the pipe string.

NOTE 1 The above list is not exhaustive.

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

The techniques are described and illustrated in 6.2 and 6.3.

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

NOTE 2 The list presented in Figure 1 is not exhaustive. Other techniques and combinations exist and can be used.

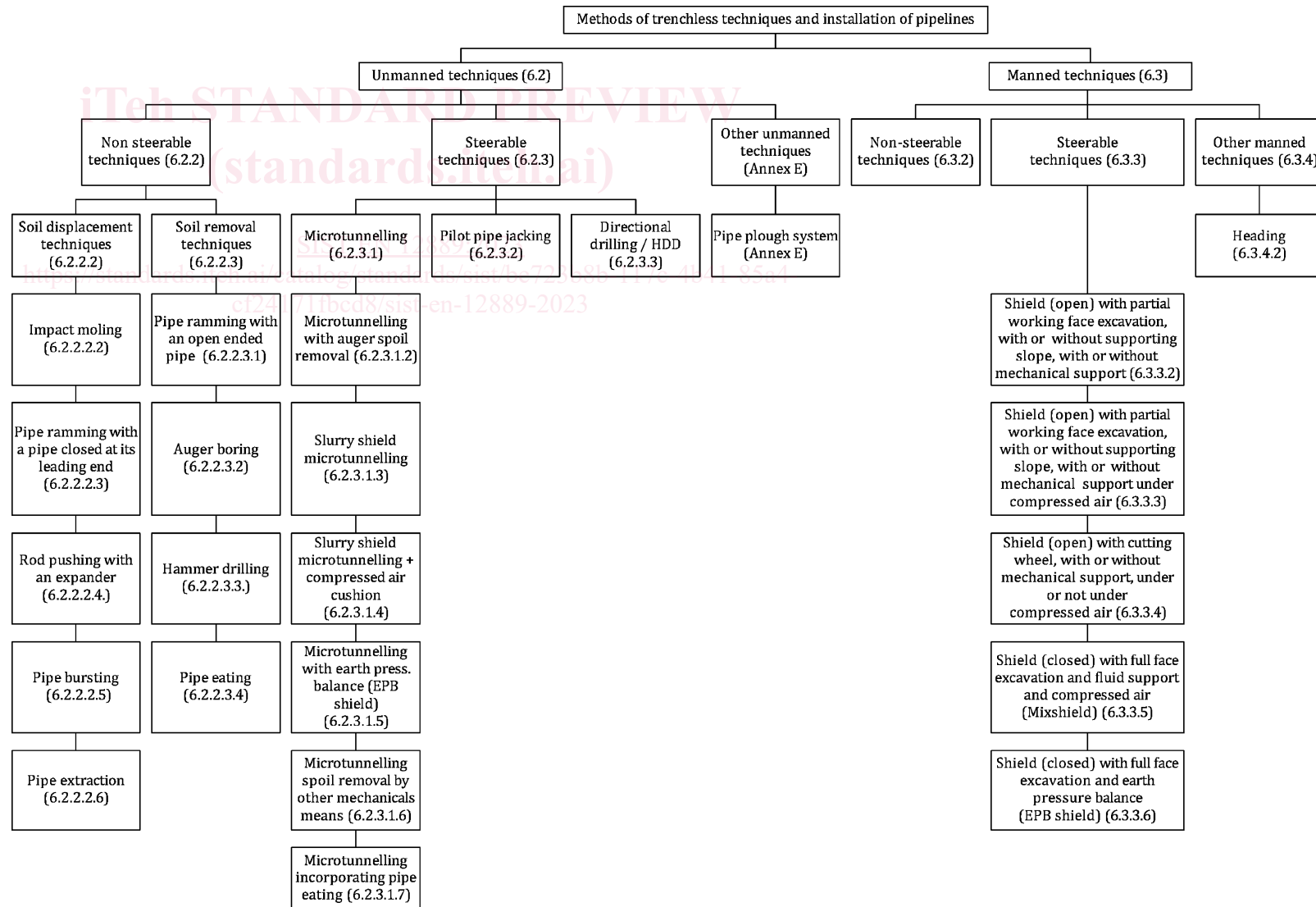


Figure 1 — Classification of trenchless techniques

6.2 Unmanned techniques

6.2.1 General

Unmanned techniques do not require employment of personnel inside the pipe. 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 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 ground (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 overproportionally to the jacking distance. Therefore, the use of these methods for pipelines that require an exact position is restricted for operational reasons. Damage to adjacent systems has to be excluded by ensuring sufficient clearance. 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 can become necessary.

Table B.1 contains empirical values for the area of application of the listed unmanned, non-steerable techniques. The *in situ* ground 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

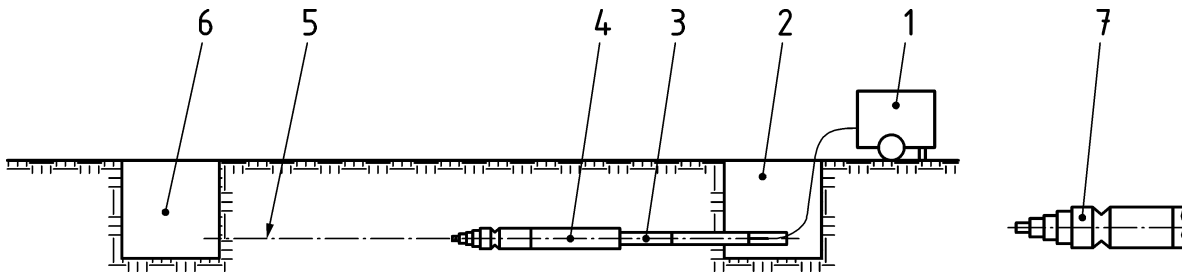
All listed techniques require soil that is displaceable.

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, whilst 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 soil 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 pipe installation is either done simultaneously or, in a sufficiently stable soil, by subsequent pulling or pushing in. A shrinking of the bore diameter of the cavity by 5 % to 15 % has to be taken into account.

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**Key**

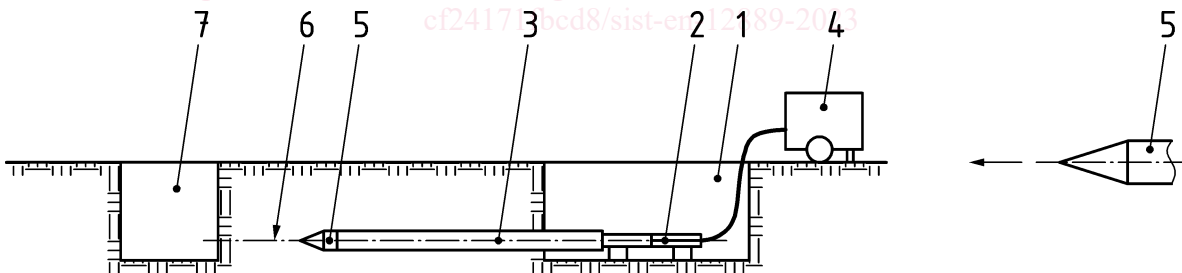
- 1 air compressor
- 2 starting pit
- 3 new (discrete) pipe
- 4 impact mole
- 5 planned route
- 6 target pit
- 7 typical nose cone

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 directly 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

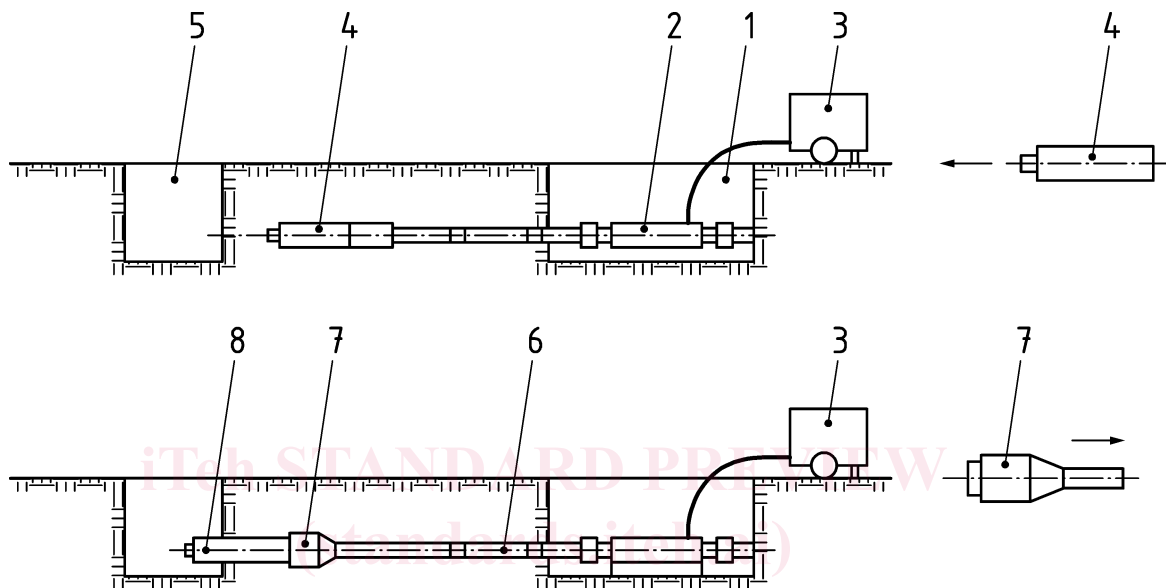
Figure 3 — Example of pipe ramming with a pipe closed at its leading end

6.2.2.4 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 can be in the form of a displacement cone or a reamer.



Key

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

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

6.2.2.5 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 blades or 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 can 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).

NOTE There are other systems known where the expander cone is hydraulically expandable.