BS EN 1610:2015

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Construction and testing of drains and sewers

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National foreword

This British Standard is the UK implementation of EN 1610:2015. It supersedes BS EN 1610:1998 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/505, Wastewater engineering.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Construction and testing of drains and sewers

Mise en oeuvre et essai des branchements et canalisations d'assainissement

Einbau und Prüfung von Abwasserleitungen und -kanälen

This European Standard was approved by CEN on 24 July 2015.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 1610:2015) has been prepared by Technical Committee CEN/TC 165 “Wastewater 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of an identical text or by endorsement, at the latest by March 2016, and conflicting national standards shall be withdrawn at the latest by March 2016.

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

This document supersedes EN 1610:1997.

The main changes with respect to the previous edition are listed below:

— updating of references and their associated requirements;

— addition of requirements for the soil-pipe-system.

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

1 Scope

This European Standard is applicable to the construction and related testing of drains and sewers usually buried in the ground and usually operating under gravity but up to 0,5 kPa when surcharged.

The construction of pipelines operating under pressure is covered by this European Standard together with EN 805 as appropriate (e.g. for testing).

This European Standard is applicable to drains and sewers installed in trenches, under embankments or above ground. For trenchless construction EN 12889 applies. Additionally, other local or national regulations may apply, e.g. concerning health and safety, pavement reinstatement and requirements for tightness testing.

NOTE Further information is given by reference to national documents listed in Annex D.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 476:2011, *General requirements for components used in drains and sewers*

EN 752, *Drain and sewer systems outside buildings*

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*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. The same definitions apply for trenches with vertical or sloping sides and for pipes laid below embankments. Some of these terms are illustrated in Figure 1.

3.1
bedding
part of the construction which supports the pipe between the trench bottom and the sidefill or initial backfill

Note 1 to entry: The bedding consists of upper and lower bedding. In the case of the pipe laid on natural trench bottom, the trench bottom is the lower bedding.

3.2
compaction layer thickness
thickness of each new layer of fill material prior to its compaction

3.3
depth of cover
vertical distance from the top of the pipe barrel to the surface

3.4
embedment
fill around the pipe including bedding, sidefill and initial backfill

3.5
initial backfill
layer of fill material immediately above the crown of the pipe

3.6
main backfill
fill between the top of the embedment and the level of the ground, top of embankment or, when applicable, the bottom of the road or railway construction

3.7
minimum trench width
minimum distance needed for safety and construction between the trench walls at the top of the lower bedding or when applicable between the trench support systems at any level

3.8
native soil
soil from the excavation of the trench

3.9
nominal size
DN
numerical designation of size of component, which is a convenient integer approximately equal to a manufacturing dimension in mm

Note 1 to entry: This may apply to either the internal diameter (DN/ID) or the external diameter (DN/OD).

[Source: EN 476:2011]

3.10
pipeline
assembly of pipes, fittings and joints between manholes or other structures

[SOURCE: EN 16323:2014, definition 2.2.3.6, modified]

3.11
prefabricated component
product manufactured separately from the installation process, generally in circumstances where a product standard applies and/or a manufacturer's quality control is in place

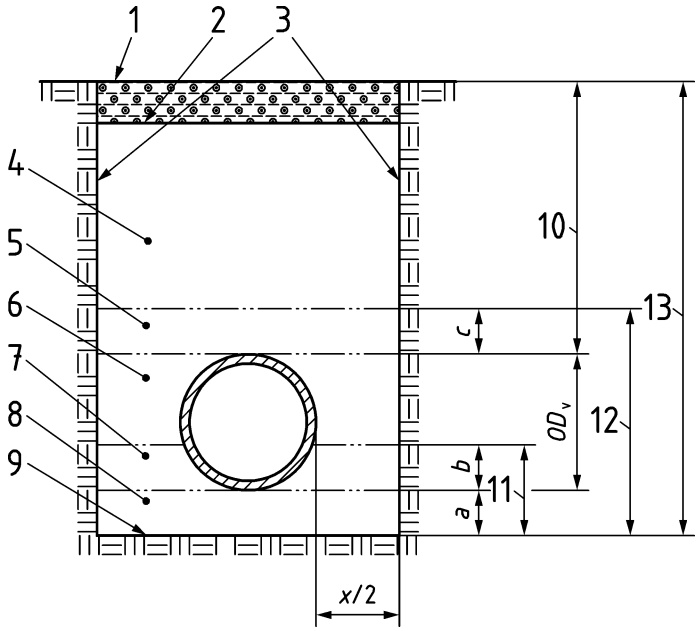
3.12
sidefill
material between bedding and initial backfill

3.13
trench depth
vertical distance from the bottom of the trench to the surface

3.14
minimum working space
***x*/2**
horizontal distance from the pipe outside wall to the side wall of the trench, or when applicable, between the trench support systems on the top of the lower bedding

Note 1 to entry: See Figure 2.

3.15
trench support system
construction to stabilize trench and to protect people in the trench



Key

1	surface	9	trench bottom
2	bottom of road or railway construction, if any	10	depth of cover (3.3)
3	trench walls	11	depth of bedding (3.1)
4	main backfill (3.6)	12	depth of embedment (3.4)
5	initial backfill (3.5)	13	trench depth (3.13)
6	sidefill (3.12)	a	thickness of lower bedding
7	upper bedding, *b*	b	thickness of upper bedding
8	lower bedding, *a*	c	thickness of initial backfill
		OD_V	is the vertical outside diameter

NOTE 1 For minimum values of a and c see Clause 7.

NOTE 2 The bedding angle is not the bedding reaction angle used in structural design.

Figure 1 — Illustration of definitions

4 General

4.1 Technical principles

Pipelines and manholes are engineering structures in which the combined performance of construction components, embedment, initial and main backfill and native soil constitute the basis for stability and safety in operation. The pipes, fittings and joint materials supplied, together with the work carried out at site, such as the pipe bedding, the jointing of pipes, the sidefilling and backfilling 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 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 (including construction loads, that may be determinant for dimensioning) 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.

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:

— trench width (see 6.3);

— trench depth;

— trench support system and the effect of its removal (see 11.5);

— degree of compaction of the embedment;

— degree of compaction of main backfill;

— pipe support and trench bottom conditions;

— construction traffic and assumptions concerning temporary loads;

— soil types (e.g. subsoil, trench walls, initial and main backfill);

— shape of trench (e.g. stepped trench, trench with sloping walls);

— ground and soil condition (e.g. affected by frost and thaw, rain, snow, flooding);

— ground water table;

— additional pipelines in the same trench;

— existing infrastructure (e.g. pipes, cables, structures);

— pipe type, strength or class.

NOTE The above list is not exhaustive.

4.3 Short sections of trench

Particular attention should be paid to:

— foundation conditions, construction steps and transition;

— shear load bearing capacity of the joints and bedding, e.g. meeting the hardening times in the case of concrete bedding;

— responding to soil changes in the trench bottom;

— securing of the initial and main backfill from the previous section;

— continuous measurement and adjustment of the laser setup, if required;

— adapting any dewatering.

5 Construction components and materials

5.1 General

Construction components and materials shall conform to national standards transposing European Standards as available, or to European technical approvals. In the absence of these, the components and materials shall comply with the requirements of the designer and EN 476.

All written instructions of the manufacturer shall be complied with.

5.2 Materials used for embedment

5.2.1 General

The materials used for embedment shall comply with the appropriate subclauses of 5.2 in order to be capable of providing permanent stability and load bearing capacity for the pipeline buried in the ground. Such materials shall not be detrimental to the pipe or pipe materials, manholes, the groundwater or soil.

Frozen materials shall not be used unless specific requirements are in place defining the conditions of use.

Materials used for embedment may be either native soil (see 5.2.2) if proved to be suitable or imported materials (see 5.2.3). Materials for bedding should contain no particles with sizes above

— 22 mm for DN ≤ 200;

— 40 mm for DN > 200 up to DN ≤ 600;

— 60 mm for DN > 600.

— For DN < 100 all written instructions of the manufacturer shall be complied with.

5.2.2 Native soil

Re-use of native soil shall meet all the following requirements:

— it is permitted by the works specification/design;

— it complies with any compactability requirements in the works specification/design;

— it is free from materials detrimental to the pipe (e.g. "oversized" particles, tree roots, waste, organic material, snow and ice) and any clay lumps larger than 75 mm.

Native soil meeting the requirements of 5.2.3.2 or 5.2.3.4 is considered suitable.

5.2.3 Imported materials

5.2.3.1 General

The following materials which may include recycled materials are suitable. Environmental consequences should be considered.

5.2.3.2 Granular materials

Granular materials include:

— single size granular material;

— graded granular material;

— sand;

— all-in aggregates;

— crushed aggregates.

5.2.3.3 Bonded materials

Bonded materials can include:

— soil cement;

— stabilized soil (e.g. with cement, calcium carbonate);

— light weight concrete;

— lean concrete;

— unreinforced concrete;

— reinforced concrete;

— self-compacting filling materials.

They shall be as specified in the design.

5.2.3.4 Other materials

Compactable materials other than those described in 5.2.3.2 to 5.2.3.3 may be used for embedment if their suitability as defined under 5.2.1 is proved. Natural or artificial substances which may cause damage to the pipeline and manholes are unsuitable.

When using industrially manufactured aggregates (e.g. moulding sand) and recycled construction materials, their environmental impact on pipeline construction and surrounding soil and water as well as their soil mechanical properties shall be considered by the designer.

Special attention shall be paid to the following:

— production/origin;

— treatment and storage;

— impact on groundwater and on soil;

— impact on components;

— volume stability;

— leaching;

— particle strength;

— particle size distribution;

— particle shape;

— compactability;

— cleanliness.

5.3 Materials used for main backfill

Materials used for main backfill shall conform to the design requirements.

Most materials specified in 5.2 may be used for main backfill. Some materials, e.g single size rounded material, may not be suitable for all conditions.

The maximum size of stones in excavated material used for main backfill should be 300 mm or the thickness of the initial backfill or half of the compaction layer thickness, whichever is the smallest. The maximum size may be further limited depending on application area (e.g. under roads), soil conditions, groundwater and pipe material. Special conditions may be specified for rocky areas.

6 Construction of trench

6.1 General

6.1.1 Introduction

When constructing trenches, the interdependency of the following shall be taken into account:

— the materials used for embedment and main backfill;

— the compaction of materials used for embedment and main backfill;

— the installation and removal of the trench support system;

— the structural effects in the components to be installed;

— the adherence to positional height and side position;

— the creation of surfaces and their intended utilisation.

6.1.2 Working space and soil compaction

Creating the structurally required bearing angle and the compaction of the spaces on either side of the bottom half of the pipe by using appropriate equipment requires the width of the working space to be defined as part of the design. The designer shall define the working space according to 6.3 for the necessary works, according to national safety rules.

The bedding and initial and main backfill shall be in accordance with the structural design (e.g. thickness and the degree of compaction in each layer).

The embedment and the main backfill should be compacted against the trench sides.

6.1.3 Transmission of load between trench support system and soil

The trench support system shall completely support the native soil, the end of any previously backfilled trench and old trenches of other pipelines crossing the excavation. Subsidence of the lateral soil and the

adjacent surfaces shall be avoided. The structural design shall take into account that the trench support system possibly interacts with the soil compaction of the embedment, the main backfill and the native soil. The structural design and construction works shall be consistent.

6.1.4 Installing and removing the trench support system

The trench support system shall be installed and removed in such way that the safety of the workers is always secured and that there are no adverse effects on existing infrastructure (e.g. pipes, cables, structures). The trench shall be secured in all directions including ends.

When removing the trench support system, the following shall be taken into account:

— the removal shall conform to the conditions of the structural design;

— positional changes to the sewer shall be avoided;

— the soil below the structure and the embedment may only be loosened to an extent that was taken into consideration in the structural design and does not affect the necessary support of the pipeline;

— soil and groundwater conditions shall be taken into account in particular regarding possible loosening of the compacted soils during removal;

— the need to monitor settlement;

— the stability and usability of adjacent buildings, pipelines and other systems or traffic areas shall be safeguarded by appropriate installation and removal of a trench support system.

6.2 Trenches

Trenches shall be designed and excavated in such a way as to ensure correct and safe installation of pipelines. If construction access is required to the outside face of underground structures, e.g. manholes, the minimum working space shall be 0,50 m wide for trench depths up to 2,5 m and 0,7 m wide for trenches deeper than 2,5 m, if not specified nationally.

Where two or more pipes are laid in the same trench or below a future embankment, horizontal working space shall be maintained between the pipelines. If not specified nationally, the horizontal working space shall be 0,35 m for pipes ≤ DN 700 mm and 0,50 m for pipes > DN 700 mm. The same working space should be provided between pipelines and any other service or structures. Where necessary, appropriate safety measures shall be observed for other supply pipelines, drains and sewers, temporary or permanent structures and surfaces, to protect these against detrimental effects. National regulations should be checked for compliance.

6.3 Trench width

6.3.1 Maximum trench width

The trench width shall not exceed the maximum width specified in the structural design.

If this is not possible, the matter shall be referred to the designer.

6.3.2 Minimum trench width

The minimum trench width shall ensure a minimum working space overall as the greater of the values taken from Tables 1 and 2, except as provided in 6.3.3. National regulations should be checked for compliance.

Table 1 — Minimum trench width depending on the nominal diameter (DN) of the pipe

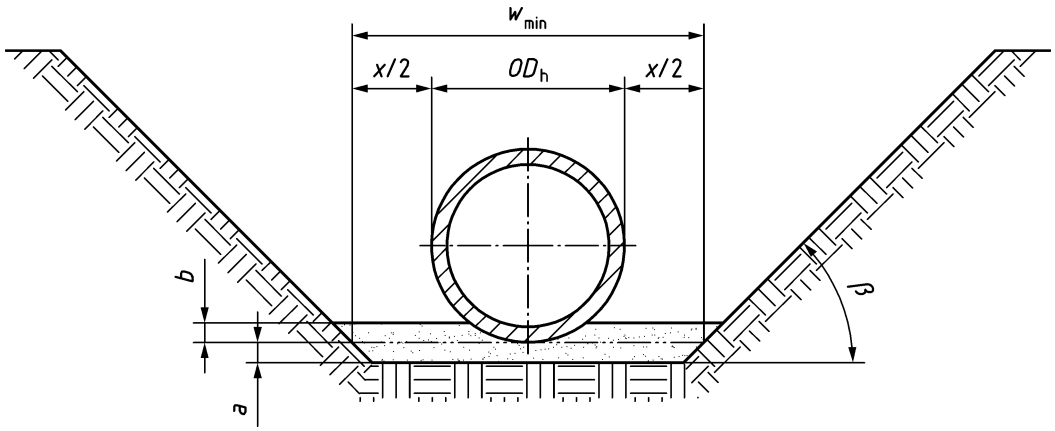
DN	**Minimum trench width ($OD_h + x$)** m		
	Supported trench	**Unsupported trench**	
		$\beta > 60°$	$\beta \leq 60°$
≤ 225	$\mathbf{OD_h}$ + 0,40	$\mathbf{OD_h}$ + 0,40	
> 225 to ≤ 350	$\mathbf{OD_h}$ + 0,50	$\mathbf{OD_h}$ + 0,50	$\mathbf{OD_h}$ + 0,40
> 350 to ≤ 700	$\mathbf{OD_h}$ + 0,70	$\mathbf{OD_h}$ + 0,70	$\mathbf{OD_h}$ + 0,40
> 700 to ≤ 1 200	$\mathbf{OD_h}$ + 0,85	$\mathbf{OD_h}$ + 0,85	$\mathbf{OD_h}$ + 0,40
> 1 200	$\mathbf{OD_h}$ + 1,00	$\mathbf{OD_h}$ + 1,00	$\mathbf{OD_h}$ + 0,40

NOTE In the values $OD_h + x$, $x/2$ equals the minimum working space between the pipe and the trench wall or the support if present.

Where

OD_h is the horizontal outside diameter, in metres

β is the angle of unsupported trench side measured to the horizontal (see Figure 2)



Key

w_{min} minimum trench width

a thickness of lower bedding

b thickness of upper bedding

Figure 2 — Minimum working space next to the pipe ($x/2$) and angle β of unsupported trench wall

Table 2 — Minimum trench width depending on the trench depth

Trench depth[a] m	**Minimum trench width** m
< 1,00	no minimum width required
≥ 1,00 ≤ 1,75	0,80
> 1,75 ≤ 4,00	0,90
> 4,00	1,00
[a] Maximum depth of unsupported trench see 6.4.	

6.3.3 Determination of trench width

It can be necessary to define a trench width greater than the minimum defined in 6.3.2 for reasons of construction technique (e.g. necessary space for compacting and testing equipment, trench support systems, simultaneous installation of connecting pipes and support of adjacent pipes). The working space, on the side of the pipes and manholes to be built, shall be available for all works without any restriction. For pipes ≥ DN 600 laid in supported trench or unsupported trench where mechanical compaction of bedding and sidefill is required, working space $x/2$ should be at least 0,5 m. In this case the minimum trench width should be $OD_h + 1{,}00$.

It can be necessary to define a trench width narrower than the minimum defined in 6.3.2 e.g. in the following circumstances:

— where personnel access to enter the trench is forbidden;

— where personnel will never be required to enter the trench or the space between a pipeline and trench wall, e.g. automated laying techniques;

— in unavoidable constricted situations; e.g. because of difficult localized conditions on site;

— when using self-compacting filling materials.

In each of these cases special measures including safety precautions are required in design and construction to ensure the protection of workers in the trench and national regulations should be checked. In the event of deviations from the trench widths defined in the structural design of the pipes, the structural design shall be checked or revised (see 4.2).

6.4 Trench stability

Stability shall be ensured either by means of a trench support system, by battering the trench sides to a stable slope which can be maintained during the works or by other suitable means.

The maximum depth of unsupported trenches with vertical trench walls shall be limited according to national regulations and in any case less than 1,4 m.

6.5 Trench bottom

The gradient of the trench bottom and the trench bottom material shall comply with the design specifications. For the trench bottom, at least the original load bearing capacity of the native soil is required. Trench bottom material should not be disturbed. If it is disturbed, its original bearing capacity shall be restored, e.g. by excavating to undisturbed ground and replacing with appropriate compacted material.

Any shallow localised quantity of soft ground below trench bottom shall be removed and replaced with suitable bedding material. If more extensive quantities are encountered a re-evaluation of the structural design should be undertaken.

Protection and securing measures shall be taken to maintain the load bearing capacity and an acceptable profile at all times.

Where pipes are to be laid directly on the trench bottom, this shall be trimmed to the required gradient and shape to provide support to the barrel of the pipe. Socket holes shall be provided in the lower bedding or trench bottom as appropriate.

In freezing conditions it may be necessary to protect the trench bottom so that frozen layers are not left under or around the pipeline.

Where the trench bottom is unstable or the soil has low bearing capacity, suitable precautions shall be taken (see 7.1 and 7.3).

6.6 Dewatering

During installation work, excavations should be kept free from water, e.g. groundwater, rainwater, seepage water, spring water or water from leaks from pipelines. Methods of dewatering shall not affect embedments and pipelines (see also Annex A).

Precautions shall be taken to prevent loss of fine material during dewatering.

The influence of dewatering on groundwater movement and stability of surrounding area shall be taken into account.

On completion of dewatering any temporary drains shall preferably be removed, or otherwise be adequately sealed.

7 General principles of embedment and support

7.1 General

Materials, bedding, support, embedment layer thickness and compaction shall be in accordance with the design requirements. The embedment material and its grading together with any support shall be selected with regard to the:

— size of the pipe;

— pipe material and pipe wall thickness;

— nature of the soil.

The bedding shall ensure that loads are distributed evenly under the pipe in the bearing area. The same bedding construction type shall be used for the length of at least one pipe.

The width of the bedding shall be the width of the trench unless otherwise specified. For pipelines laid within embankments the width of the bedding shall be four times OD_h unless otherwise specified.

Minimum thickness c (see Figure 1) of the initial backfill shall be 150 mm above barrel and 100 mm above joint. When using materials described in 5.2.3.3 and 5.2.3.4, c shall be as specified in the design.

7.2 Bedding construction types

7.2.1 Bedding construction type 1

Bedding construction type 1 (Figure 3) may be used in all types of embedment, providing support for the pipes over their whole barrel length, using the layer thickness requirements for *a* and *b*. This includes any size and shape of pipes e.g. circular, non-circular, flat based.

Unless specified otherwise, the thickness of the lower bedding *a*, measured under the barrel, shall not be less than:

— 100 mm in usual soil conditions and 150 mm in rock or hard soil conditions.

The thickness *b* of upper bedding shall be as specified in the structural design.

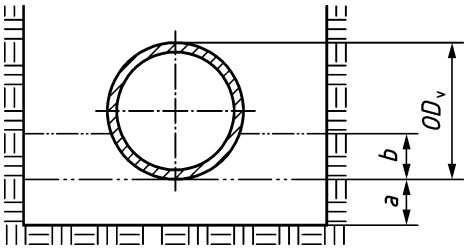


Figure 3 — Bedding construction type 1

7.2.2 Bedding construction type 2

Bedding construction type 2 (Figure 4) may be used in uniform relatively soft fine grained soil providing support for the pipes over their whole barrel length. Pipes may be laid directly on the shaped, trimmed bottom of the trench.

The thickness *b* of upper bedding shall be as specified in the structural design.

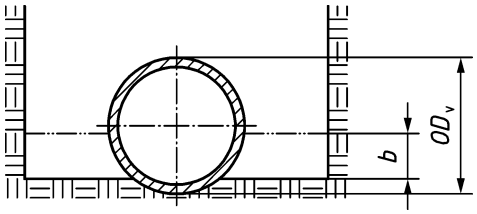


Figure 4 — Bedding construction type 2

7.2.3 Bedding construction type 3

Bedding construction type 3 (Figure 5) may be used in uniform relatively soft fine grained soil providing support for the pipes over their whole barrel length. Pipes may be laid directly on the trimmed bottom of the trench.

The thickness *b* of upper bedding shall be as specified in the structural design.

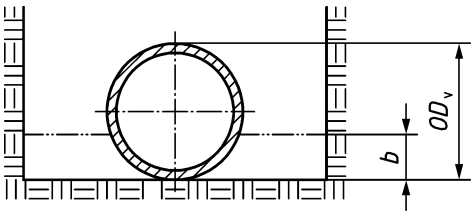


Figure 5 — Bedding construction type 3

7.3 Special methods of bedding or support

Where the trench bottom has low bearing strength, special construction measures are necessary. This is likely to occur in unstable soils, e.g. peat, running sand. Geotextiles can be used to stabilise the bedding.

Examples of possible measures include replacement of soil with other materials, e.g. sand, gravel and bonded materials, or supporting the pipeline on piled structures, e.g. using cross beams or cradle support, longitudinal beams or reinforced concrete slabs spanning the piles.

Consideration should also be given, during design and installation, to the transition from one ground condition to another with different settlement properties.

Special methods of bedding or pipeline support shall only be used if their suitability has been confirmed by structural design calculations.

NOTE Pipelines laid on piles below ground can be subjected to extremely high loads.

8 Installation

8.1 General

Reference to "pipes" includes also "fittings and other pipeline components (see 3.10)" unless stated otherwise.

8.2 Setting out

Prior to setting out, a sufficient survey shall be conducted to locate pipes, cables or other underground works. If the results show a conflict with the construction of the drain or sewer the designer shall be notified.

The pipe centreline and, if required, the trench width shall be set out, marked and recorded on the top of the trench.

Temporary bench marks should be established in stable positions where they are unlikely to be disturbed.

8.3 Delivery, handling and transportation on site

Pipes, pipeline components and jointing accessories 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.

8.4 Storage

Any storage instructions from the manufacturer and the requirements of the appropriate product standards shall be adhered to.

All 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.

8.5 Lifting of components

Components shall be lifted safely using suitable equipment and methods that avoid damage; the relevant Product Standard shall be taken into account.

8.6 Laying

8.6.1 General

Pipe laying should start at the downstream end, the pipes being usually laid with the sockets upstream.

The ends of pipes should be temporarily plugged when work is significantly interrupted to prevent the ingress of debris and vermin. Any debris that does enter the pipe shall be removed. Any protective end-caps should not be removed until immediately prior to jointing.

Where a particular orientation of the pipes is necessary, e.g. a mark indicating top of pipe, this shall be complied with.

8.6.2 Line and level

The pipes shall be laid true to the line and level within tolerances specified by the design. Any necessary adjustments to level shall be made by raising or lowering the bedding, always ensuring that the pipes are finally provided with support along their whole length. Adjustment to level and position shall not be made by local packing.

8.6.3 Jointing

Protective end caps shall be removed immediately prior to jointing. The parts of the pipe surface coming into contact with the jointing materials shall be undamaged, clean and, if necessary, dry. Sliding joints shall be lubricated using the lubricants and methods recommended by the manufacturers.

When pipes cannot be jointed manually, appropriate jointing equipment shall be used. Where necessary the ends of the pipes shall be protected. The pipes should be jointed by means of an axial force applied progressively without overstressing the components. Alignment shall be verified and corrected if necessary after jointing.

Where a gap is specified between the ends of pipes within a joint, it shall be within the tolerances indicated by the manufacturer.

8.6.4 Socket holes

Where necessary, socket holes shall be provided to allow sufficient space for proper assembly of the joint and to prevent the pipe from resting on the joint. The socket hole should not be larger than necessary to accomplish proper joint assembly.

8.6.5 Pipe cutting

Cutting shall be performed with the correct tools and as recommended by the pipe manufacturer. Cuts shall ensure adequate performance of the ensuing joint. Damage to coatings and linings shall be repaired in accordance with the manufacturer's instructions.

8.6.6 Provisions for future connections

Pipe ends or branches, to which future connections are to be made after backfilling, shall be provided with adequate watertight seals and suitable anchorage where appropriate. Their positions shall be measured and recorded.

8.6.7 Other instructions

Any supplementary laying instructions primarily from other relevant standards and then from the pipe manufacturer shall be complied with.

8.7 Special forms of constructions

8.7.1 Pipelines above ground

Individual design and construction is required for pipelines above ground (e.g. on support or suspended). Pipelines should be protected against any detrimental effects of the environment.

8.7.2 Pipelines within protective pipes

Under certain conditions, e.g. in water protection areas or on industrial premises, it can be necessary to construct pipelines within protective pipes. The protective pipes and the pipeline shall both be separately tested. The protective pipe should be tested before the installation of the pipeline.

When the pipe is laid in a duct, the leaktightness test of the duct shall be in accordance with the design.

8.7.3 Brick and in situ concrete sewers

Individual design and construction is required for brick and in situ concrete sewers.

8.7.4 Pipelines through, under or close to structures

Where pipelines pass through structures, including manholes and inspection chambers, flexible joints shall be incorporated within the wall or as close as is feasible to the outside faces of the structures except where the pipeline and the structure are an integral construction on a rigid foundation. Where pipelines pass under or close to structures similar precautions should be considered.

Additional flexibility may be introduced by inserting short length pipes close to the structures to allow for angular deflection due to differential settlements. The length of those pipes and the design detail should be related to the diameter and type of pipes and the design of the joints. For pipes passing through a structure a sleeve or lintel may be required.

8.8 Supporting and anchoring

Where there is a risk of flotation during installation, pipelines shall be secured by appropriate loading or anchoring. Such forces can reach significant levels. In the case of pressure pipelines, if fittings and valves are installed without positive locking in the longitudinal direction, they shall be secured so that the forces occurring can be resisted. For further details see EN 805.

For the testing of leaktightness it can be necessary to anchor fittings securely.

Additional forces such as can occur with suspended pipelines and steeply sloping sections, should be allowed for in the design, e. g. by forming concrete bedding, by a concrete casing or a barrier which at

the same time provides protection against washout or drainage effects of the bedding. If necessary, soil analyses shall be carried out.

8.9 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.

Embedment and main backfill of pipelines connected to manholes or inspection chambers shall be done in accordance with Clauses 7 and 8. Filling around manhole or inspection chambers shall take into account the need to equalize the compaction all around them. Where necessary, measures should be taken to prevent washout of materials around manholes and inspection chambers and subsequent loss of soil compaction.

9 Connection to pipes and manholes

9.1 General

Connections to pipes and manholes shall be made according to the design preferably by using prefabricated components taking into account manufacturers' instructions.

Where connections are made to pipes and manholes:

— the load bearing capacities of the connected pipelines shall not be impaired;

— the pipe to be connected shall not project beyond the inside surface of the pipe or manhole to which it is to be joined;

— the connection shall be leaktight in accordance with Clauses 8 and 13.

In order to fulfil the above conditions it can for example be necessary to reinforce the pipeline in the region of the connection, or to replace the pipe section with a new structure, e.g. a manhole.

The methods to be used for connection are given under 9.2, 9.3, 9.4 and 9.5. The choice depends on user's requirements, pipe size and pipe material.

Other methods for connection may be used provided they ensure the same quality of the connection.

9.2 Connection by junctions

The junction should be fixed at the appropriate angle to receive the incoming pipeline. Where a pipe junction is to be inserted in an existing line of pipes, it can be necessary to disturb or remove one or more pipes depending on the material of the pipes, their length, joint types and bedding. In order to maintain pipe continuity, only sufficient length of pipe should be removed to enable the junction to be inserted in the pipeline. The operation may involve the insertion of a short length of pipe in addition to the junction. Whether socketed or sleeved joints are used, they shall be appropriate to the pipeline, ensure accurate line and position and provide effective seals.

9.3 Connection by connecting fittings

Connecting fittings are components which fit into circular holes drilled into the wall of a pipe in such a way as to form a leaktight joint.

The pipe is cut with a drilling device to obtain a circular hole appropriate to the connecting fitting, taking care to prevent any undesirable materials from entering the pipe.

Connecting fittings should be positioned on the upper half of the pipe. Connecting fittings should generally be positioned between 45° and 0° to the vertical plane through the longitudinal axis of the pipe. For man entry pipes, connections should be made at a position that is safe for operations.

For details of assembling connecting fittings, refer to the manufacturers' instructions.

9.4 Connection by saddle fittings

Saddle fittings are components with leaktight joints between the outside surface of a pipe and the inner surface of the flange of the saddle. The hole in the wall of the existing pipe fits with the saddle fitting to be used and is cut by drilling or trepanning or, where practicable, by the use of a suitable saw and purpose made template, taking care to prevent debris from entering the pipe.

Saddle fittings should be positioned on the upper half of the pipe. Saddle fittings should generally be positioned between 45° and 0° to the vertical plane through the longitudinal axis of the pipe. For man entry pipes, connections should be made at a position that is safe for operations.

For details of assembling saddle fittings, refer to the manufacturers' instructions.

9.5 Connection by welding

When connections are to be made by welding the relevant standards and instructions of the pipe manufacturer shall be followed.

9.6 Connection to manholes and inspection chambers

Methods described under 9.3, 9.4 and 9.5 can be in part applicable for connection to manholes and inspection chambers. The position of the connection shall be as given in the design.

Connections to manholes and inspection chambers shall be created in such way that they are able to take up movements caused by subsidence securely without the occurrence of leakage in the connection area and impermissible pipe strain.

10 Testing during construction

The inspections/tests as given in Clause 13 can be used during construction if required.

Where initial leaktightness testing is required it should be applied before any sidefill is placed around the joints.

Sidefill, initial and main backfill compaction (see 11.2) should be controlled as work proceeds.

11 Backfilling

11.1 General

The placement of initial and main backfill shall only be commenced when the pipe joints, bedding and sidefill are in a condition to permit loading.

Backfilling including placing of the embedment and main backfill, removal of trench support system and compaction shall be carried out in such a way as to ensure the load bearing capacity of the pipeline meets the design requirements.

11.2 Compaction

Where compaction is specified in the structural design of the pipeline it shall be controlled by a method specification related to the particular equipment used or, where required, by testing.

NOTE In the absence of European Standards, national standards or local guidelines can apply.

The initial backfill directly above the pipe should be compacted by hand where required. Mechanical compaction of the main backfill directly above the pipe should not be commenced until there is a total depth of cover of at least 300 mm above the top of the pipe. The total depth of the cover directly above

the pipe before mechanical compaction is commenced depends on the type of compaction device. The choice of compaction equipment, the number of passes and the thickness of layer to be compacted shall take account of the material to be compacted and the pipe to be installed.

Compaction by saturating the initial and main backfill or sidefill is permissible only in exceptional cases and then only in suitable, non-cohesive soils.

11.3 Embedment and initial backfill

The embedment should be installed in such a way so as to prevent the migration of existing soil into embedment or embedment material into the existing soil. In some circumstances the use of a geotextile or graded filter may be necessary to contain the pipe embedment, particularly where groundwater is present.

Where the flow of groundwater can transport fine soil particles or lower the groundwater level, suitable precautions shall be taken such as lining the trench with appropriate geotextile or placing stanks (waterstops) across the trench.

Bedding, sidefilling and initial backfilling shall be carried out in accordance with the design and specification. The embedment should be protected against any foreseeable change of its load bearing capacity, stability or position that could be caused by:

— removal of trench support system;

— groundwater or rainwater influences;

— other adjacent excavation work.

When parts of a pipeline need anchoring or strengthening, this shall be done before placement of the embedment.

During placement of the embedment special attention should be given to the:

— avoidance of displacement of the pipeline from line and level;

— placement of upper bedding to ensure that the voids under the pipe are filled with compacted material;

— hardening process of bonded materials.

11.4 Main backfill

Main backfill shall be placed in layers and compacted in accordance with design and specification limiting settlement at the surface. Special attention should be given to the removal of the trench support system.

11.5 Removal of trench support system

Removal of trench support system should be carried out progressively during placement of the embedment.

NOTE Removal of trench support system, at the level of or below the embedment, after the main backfill is placed, can lead to serious consequences for load bearing capacity, line and level.

Where removal of trench support system is impractical before completion of backfilling (e.g. sheet piling, trench box), special measures are necessary, for example:

— special structural design;

— leaving parts of trench support system in the ground;

— special selection of material for embedment.

11.6 Surface reinstatement

On completion of backfilling, surfaces shall be reinstated as specified in the design.

12 Final inspection and/or testing of pipelines and manholes after backfilling

12.1 General

After completion of the installation appropriate inspections and tests shall be carried out in accordance with 12.2 to 12.4. In the event of failures, defects shall be rectified and those parts of the pipeline reinspected and retested.

12.2 Visual inspection

Visual inspection includes:

— line and level;

— joints;

— damage or deformation;

— connections;

— linings and coatings.

Coding of observation should be in accordance with EN 13508-2.

12.3 Leaktightness

Leaktightness of all the sections of the new installation, including pipelines, connections (see Clause 9), manholes and inspection chambers shall be tested according to Clause 13 or Clause 14 as appropriate.

12.4 Embedment and main backfill

12.4.1 General

The adequacy of embedment and main backfill shall be verified by checking compaction or pipe deformation.

12.4.2 Compaction

When the degree of compaction of bedding, sidefill, initial and main backfill is specified, it shall be checked for compliance with the required values given in the structural design.

12.4.3 Pipe deformation

The vertical change in diameter of flexible pipes shall be checked for compliance with the required values given in the structural design.

13 Procedures and requirements for testing gravity pipelines

13.1 General

Initial testing may be applied before any sidefill is placed. For final acceptance the line shall be tested after backfilling and removal of trench support system. The test shall be performed according to the method specified by the owner of the network or the designer.

Testing for leaktightness of pipelines, shall be conducted either with air (method "L") or water (method "W"), as given in Figures 6 and 7.

If groundwater level is present above the crown of the pipeline during testing, a specific procedure (e.g. an infiltration test or testing with higher test pressure) shall be established in the design.

Manholes and inspection chambers should be tested with water (method "W"). Air testing of manholes and inspection chambers (method "L") can be dangerous for the personnel. If not forbidden by national regulations, manholes with nominal diameter less than or equal to 1250 and inspection chambers may be tested by air with test method LA or LB only.

Separate testing of pipes and fittings, manholes and inspection chambers, e. g. pipes with air and manholes with water may be undertaken. The number of corrections and re-tests following failure is unrestricted.

13.2 Testing with air (method "L")

The testing times for pipelines excluding manholes and inspection chambers are given in Table 3 in relation to pipe size and testing methods (LA; LB; LC; LD). Test shall be performed according to the method specified by the owner of the network or the designer. Suitably shaped plugs shall be used in order to avoid errors arising from the test equipment not being airtight.

Air testing can be dangerous for the personnel. The choice of the test pressure shall take into account the risk induced by the test, for personnel as well as the pipelines under test. National safety regulations shall be considered.

An initial pressure approximately 10 % in excess of the required test pressure, p_o, shall first be held for approximately 5 min. The pressure shall then be adjusted to the test pressure shown in Table 3 related to testing method LA, LB, LC or LD. If the pressure drop measured after the testing time is less than Δp given in Table 3 then the pipeline complies.

The equipment used for measuring the pressure drop shall allow a measurement with an accuracy of 10 % of Δp. The accuracy of measurement of time shall be ± 2,5 s.

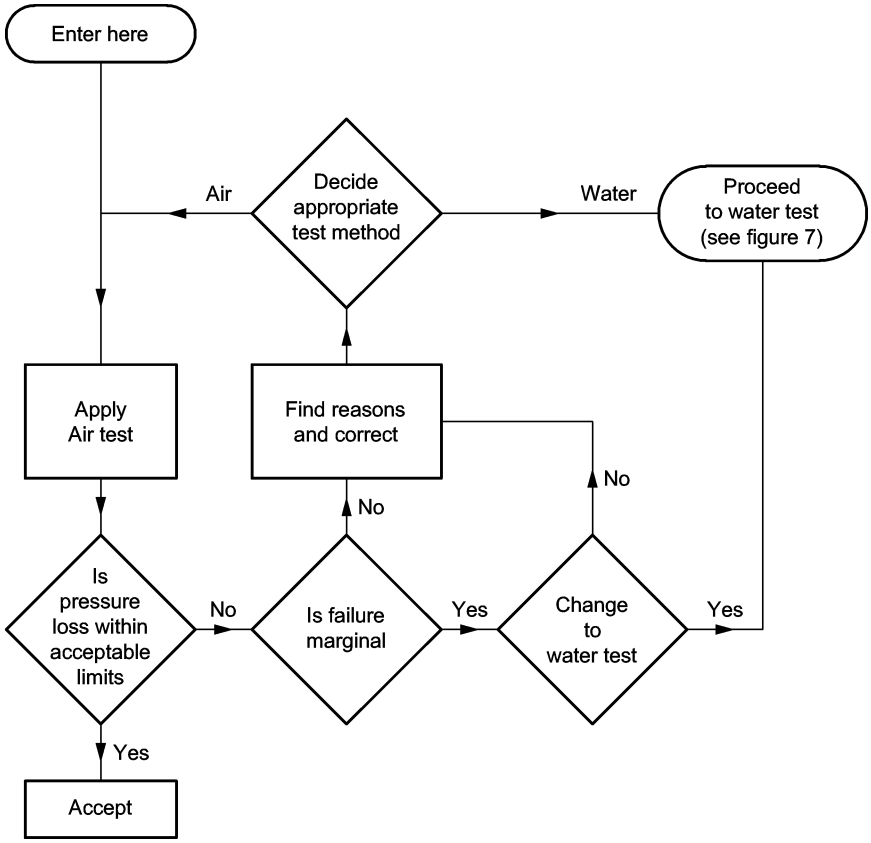


Figure 6 — Flow diagram method "L"

Table 3 — Test pressure, pressure drop and testing times for testing with air

Material	Test method	p_0[a]	Δp	Testing time min						
		mbar (kPa)		DN 100	DN 200	DN 300	DN 400	DN 600	DN 800	DN 1000
Unsoaked concrete pipes	LA	10 (1)	2,5 (0,25)	5	5	5	7	11	14	18
	LB	50 (5)	10 (1)	4	4	4	6	8	11	14
	LC	100 (10)	15 (1,5)	3	3	3	4	6	8	10
	LD	200 (20)	15 (1,5)	1,5	1,5	1,5	2	3	4	5
K_p-values[b]				0,058	0,058	0,053	0,040	0,0267	0,020	0,016
Soaked concrete pipes and all other materials	LA	10 (1)	2,5 0,25)	5	5	7	10	14	19	24
	LB	50 (5)	10 (1)	4	4	6	7	11	15	19
	LC	100 (10)	15 (1,5)	3	3	4	5	8	11	14
	LD	200 (20)	15 (1,5)	1,5	1,5	2	2,5	4	5	7
K_p -values [b]				0,058	0,058	0,040	0,030	0,020	0,015	0,012

a Pressure above atmospheric pressure

b $$t = \frac{1}{K_p} \cdot \ln \frac{p_0}{p_0 - \Delta p}$$

For unsoaked concrete pipes $K_p = 16/DN$ with maximum 0,058.

For soaked concrete pipes and all other materials $K_p = 12/DN$ with maximum 0,058.

With t rounded to the nearest 0,5 minute when $t \leq 5$ min, to the nearest minute when $t > 5$ min.

For non-circular pipes substitute nominal sizes shall be calculated.

In the event of a single or continued air test failure, recourse to a water test is allowed and the result of the water test alone shall be decisive.

For manholes and inspection chambers testing time shall be half the time for an equivalent diameter pipeline. The test conditions shall be adapted in accordance with Table 3.

Negative air pressure testing may be used, if a specific procedure is established in the design.

13.3 Testing with water (method "W")

13.3.1 Test pressure

For the pipeline, excluding manholes and inspection chambers, the test pressure shall be the pressure equivalent to or resulting from filling the test section up to the ground level of the downstream or upstream manhole, as appropriate, with a maximum pressure of 50 kPa[1)] and a minimum pressure of 10 kPa measured at the invert of the pipe.

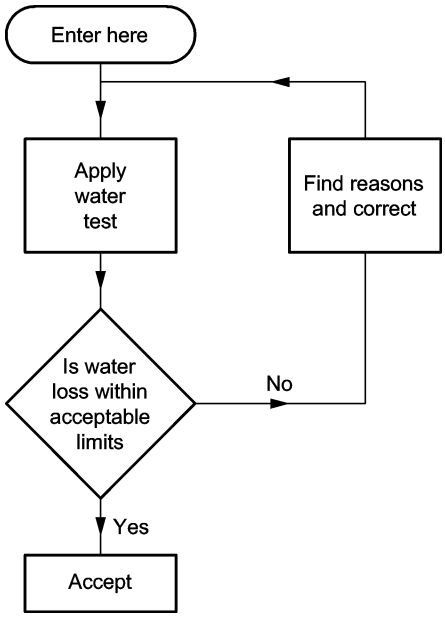
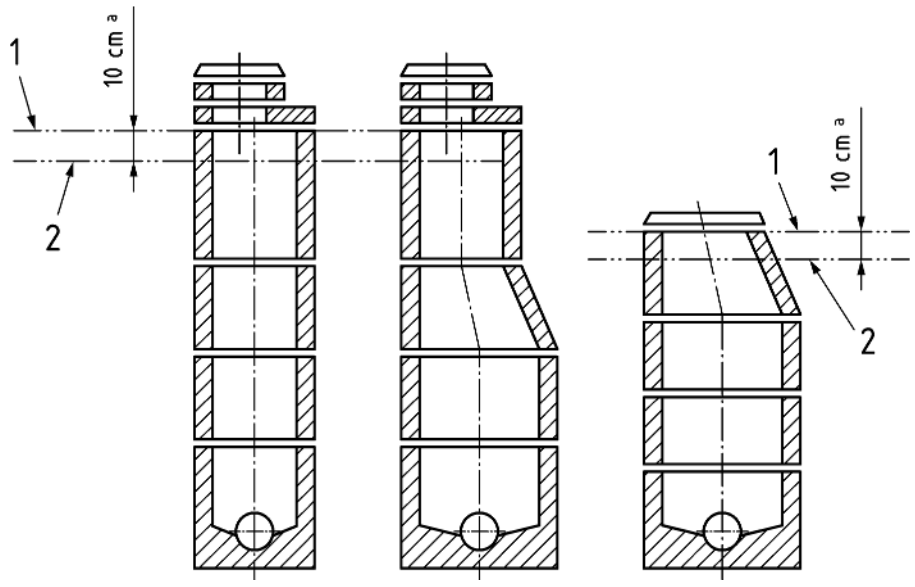


Figure 7 — Flow diagram for water tightness test

Unless specified otherwise by the designer the reference level to test manholes and inspection chambers is the top edge of the taper or of the chamber unit below cover slab. Test pressure shall correspond to a filling height to approximately 10 cm below this reference level (see Figure 8).

1) 1 kPa = 0,01 bar approximately equal to 0,1 m head of water



Key

1 reference level for W test

2 filling height for W test

Figure 8 — Reference level for test method "W" for manholes and inspection chambers

Higher test pressures may be specified for pipelines which are designed to operate under permanent or temporary surcharge (see EN 805).

13.3.2 Conditioning time

After the pipelines and/or manholes are filled and the required test pressure applied, conditioning may be necessary.

NOTE Usually 1 h is sufficient. A longer period can be needed for example for dry climatic conditions in the case of concrete pipes, manholes and inspection chambers.

13.3.3 Test requirements

Pressure shall be maintained within 1 kPa of the test pressure defined in 13.3.1, e.g. by adding water.

The variation of volume of water during the test shall be measured with an accuracy of 0,1 l and recorded with the head of water at the required test pressure.

The test requirement is satisfied if the variation of volume of water during the test is not greater than:

— 0,15 l/m^2 during 30 min for pipelines;

— 0,20 l/m^2 during 30 min for pipelines including manholes;

— 0,40 l/m^2 during 30 min for manholes and inspection chambers.

NOTE m^2 refers to the wetted internal surface.

13.3.4 Testing time

The testing time shall be (30 ± 1) min.

Test may be stopped if the total amount of water allowed to be added during 30 min is exceeded.

13.4 Testing individual joints

Unless specified otherwise, testing of individual joints instead of testing the whole pipeline can be accepted for pipelines, usually larger than DN 1000.

For individual pipe joints to be tested, the surface area for test "W" is taken as that represented by 1 m length of pipe, if not specified otherwise. Test requirements shall be as given in 13.3.3 and 13.3.4 with a test pressure of 50 kPa at the invert of the pipe.

The conditions for test "L" shall follow the principles given in 13.2 and be specified individually.

14 Testing of pressure pipelines

Pressure pipelines shall be tested as specified in EN 805 or other methods required by the designer.

15 Qualifications

The following factors concerning qualifications shall be taken into account:

— suitably trained and experienced personnel are employed for the supervision and execution of the construction project;

— suitably trained and experienced personnel are employed for final inspection and testing;

— contractors appointed by the employer possess the qualifications necessary for the execution of the work;

— employers satisfy themselves that the necessary qualifications are held by the contractors;

— see Annex B.

Annex A
(informative)

Dewatering

A.1 General

If there is any reason to suspect that groundwater can exist in the proximity of the trench, at a level higher than the intended trench bottom, then a sufficient site investigation should be undertaken to establish a suitable method for groundwater control as well as trench support. The various temporary works associated with groundwater control (dewatering) can influence the design of the permanent work. The design assumptions should be conveyed to the installer either through the work specification or drawings.

The design of dewatering systems is complex and specialist advice should be sought before a method is selected. Dewatering can reduce groundwater levels over a considerable distance and can affect abstraction for other uses. Lowering groundwater can be subject to local or national regulations.

Some of the available methods of groundwater control are listed below with the factors which affect their selection. The operating ranges of permeability are given as an indication only and will vary slightly with different equipment specifications and local circumstances.

A.2 Sump pumping from trench bottom

This is the simplest means of groundwater control and comprises pumping away water which has entered the trench. In soils where there is a risk of fine particles being drawn from the ground by the passage of water it can be necessary to take additional measures to reduce the rate of flow. This can be achieved by driving close trench support system to a depth below the trench bed. The pipeline designer shall decide whether it is necessary to leave the trench support system in place as part of the permanent work. The cost of the trench support system left in and the toe in depth required, effectively limit the method to situations where either the soil is cohesive or the depth below groundwater level is small.

The depth range can be increased by using specialist additional means such as ground freezing or grout injections to limit the flow of groundwater in the vicinity of the excavation.

A.3 Deep wells

This method involves a deep well typically 250 mm to 600 mm diameter and installing a liner with a filter section or a perforated wall near its base. The incoming water is removed using a borehole type submersible pump. The filter is necessary to prevent loss of fines and shall be selected to suit the local soil grading. They are most effective in soils where the vertical and horizontal permeabilities are similar and lie within the range of 10^{-3} m/s to 1 m/s. The successful application of deep wells to soil of permeability as low as about 10^{-5} m/s can be achieved by capping the well and attaching a vacuum pump to it. In this case the submersible pump will have an additional head to pump against.

This system is more widely used in the construction of basements and pumping chambers than for pipelines.

A.4 Vertical well points

Well points are tubes perforated over the lower part of their length which are inserted into the ground by jetting (pumping water down the tubes). A valve in the bottom end allows water to exit the tube during jetting but prevent water entering through the end during dewatering. The well point is generally surrounded with a coarse sand to act as a graded filter. Where required, sand is installed during the jetting process. Well points are usually installed along a line parallel to the line of the proposed trench and are typically at 0,6 m to 3,0 m intervals depending upon soil and groundwater conditions. They can be used on one or both sides of the trench.

After installation the tops of the well points are connected to a vacuum pump. Groundwater enters the well points through the perforations. The well points may be of a disposable variety which avoids the possibility of ground movement during and following withdrawal and the difficulties associated with attempting to fill and compact the deep, narrow hole which would be created.

Well points are generally limited to soils with permeabilities 10^{-6} m/s to 10^{-3} m/s. The maximum depth of trench which can be de-watered by a single stage of well pointing is around 6,5 m.

A.5 Horizontal pipe dewatering

A perforated plastic pipe can be inserted into the ground using a trenching machine or a trenchless method such as directional drilling. The system is installed along a line parallel to the proposed trench, on one or both sides and at a level below the proposed trench bottom. The ends of such pipes are connected to vacuum pumps in the same way as for vertical well points. The range of operation is similar to vertical well points (10^{-6} m/s to 10^{-3} m/s).

The principal advantages of horizontal well points are the absence of temporary pipework at ground level and speed of installation.

A.6 Eductor well pointing

The eductor well pointing system involves sinking a well with a filter section near its base and installing a pressure feed pipe, venturi and riser pipe. High pressure water is supplied to the pressure pipe and the pressure drop in the venturi section is used to draw in water from the well which passes up to the riser pipe to be discharged to the collection pipework at the surface. As with deep wells great depths are possible (up to 45 m) but only comparatively low flows can be achieved in each one. This limits the range of permeabilities which can be dealt with to those where the flow would be small (typically less than 10^{-5} m/s). As with deep wells eductor wells require both vertical and horizontal permeabilities to be comparable in order to operate effectively in drawing down the groundwater level. The high installation cost and restrictive range of suitable operating conditions generally limit their use to fixed sites such as basement or pumping station sites.

Annex B
(informative)

Abstract from DIRECTIVE 2014/25/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors and repealing Directive 2004/17/EC (Text with EEA relevance)

Subsection 1

Qualification and qualitative selection

Article 77

Qualification systems

1) Contracting entities which so wish may establish and operate a system of qualification of economic operators.

Contracting entities which establish or operate a system of qualification shall ensure that economic operators are at all times able to request qualification.

2) The system under paragraph 1 may involve different qualification stages.

Contracting entities shall establish objective rules and criteria for the exclusion and selection of economic operators requesting qualification and objective criteria and rules for the operation of the qualification system, covering matters such as inscription in the system, periodic updating of the qualifications, if any, and the duration of the system.

Where those criteria and rules include technical specifications, Articles 60 to 62 shall apply. The criteria and rules may be updated as required.

3) The criteria and rules referred to in paragraph 2 shall be made available to economic operators on request. Those updated criteria and rules shall be communicated to interested economic operators.

Where a contracting entity considers that the qualification system of certain other entities or bodies meets its requirements, it shall communicate to interested economic operators the names of such other entities or bodies.

4) A written record of qualified economic operators shall be kept; it may be divided into categories according to the type of contract for which the qualification is valid.

5) When a call for competition is made by means of a notice on the existence of a qualification system, specific contracts for the works, supplies or services covered by the qualification system shall be awarded by restricted procedures or negotiated procedures, in which all tenderers and participants are selected among the candidates already qualified in accordance with such a system.

6) Any charges that are billed in connection with requests for qualification or with updating or conserving an already obtained qualification pursuant to the system shall be proportionate to the generated costs.

Annex C
(informative)

Manufacturer's Instructions

If special properties of a pipe material are to be taken into account, the manufacturer should provide supplementary and detailed instructions. It should contain the following information where applicable:

— delivery;

— loading and unloading;

— transport at the construction site;

— storage;

— lifting of components;

— construction;

— building in to structures;

— connection to an existing sewer/existing drain;

— support and anchoring;

— bedding support;

— bedding (materials, compacting);

— cover (minimum depth of cover, materials, compacting);

— positional stabilization;

— lubricant (type, function, application);

— creating the pipe joint;

— information regarding the permissible distance of the end faces;

— information regarding weldability;

— information on the adherence to permissible bed drops;

— fastening and loosening the end closures;

— shortening pipes and re-treating the cut face;

— creating later connections;

— tests;

— construction (type, auxiliary means, devices);

— supervision.

Annex D
(informative)

Additional national public documents

D.1 France

Cahier des clauses techniques generals fascicule no 70.

Ouvrages d'assainissement -

Titre 1: Réseaux

Arrêté du 22 juin 2007 relatif à la collecte, au transport et au traitement des eaux usées des agglomérations d'assainissement ainsi qu'à la surveillance de leur fonctionnement et de leur efficacité, et aux dispositifs d'assainissement non collectif recevant une charge brute de pollution organique supérieure à 1,2 kg/j de DBO5.

D.2 Germany

DIN 4124, Excavations and trenches - Slopes, planking and strutting breadths of working spaces

DINV 1201, Concrete pipes and fittings, unreinforced, steel fibre and reinforced for drains and sewers - Type 1 and Type 2 - Requirements, test methods and evaluation of conformity

ATV-DVWK A 127, Structural design of drain and sewers

DWA-A 139, Installation and testing of drains and sewers

D.3 The Netherlands

NPR 3218 "Drainage and sewerage gravity systems outside buildings – Installation and maintenance"

D.4 Austria

ÖNORM B 2503 , Kanalanlagen - Planung, Ausführung, Prüfung, Betrieb (En: Drain and sewer systems — Design, construction, testing, operation)

ÖNORM B 5012 “Statische Berechnung erdverlegter Rohrleitungen für die Wasserversorgung und die Abwasser-Entsorgung“ / „Structural design of buried water and sewerage pipelines“

ÖNORM B 5016, Erdarbeiten für Rohrleitungen des Siedlungs- und Industriewasserbaues - Qualitätssicherung der Verdichtungsarbeiten (En: Earthworks for water and sewage pipelines for community systems and industry - Quality assurance of compaction works)

ÖNORM B 2538,Transport-, Versorgungs- und Anschlussleitungen von Wasserversorgungsanlagen - Ergänzende Bestimmungen zu ÖNORM EN 805 (En: Long-distance, district and supply pipelines of water supply systems - Additional specifications concerning ÖNORM EN 805; which is also applicable for sewer pressure pipelines)

RVS, Richtlinien und Vorschriften für das Straßenwesen (En: Austrian Technical Rules for the Construction and Maintenance of Roads)

Arbeitnehmerschutzverordnung
En: Austrian Worker Protection Ordinance

Bauarbeitnehmerschutzverordnung
En: Austrian Safety Ordinance for Construction Workers

Österreichische Güteanforderungen für Erzeugnisse im Siedlungswasserbau, Teil 2: Qualitätssicherung bei Ingenieur- und Bauleistungen, Jänner 2009 (En: Austrian Quality Requirements for Components for Water and Wastewater Pipelines, Part 2: Quality Assurance regarding Design and Construction Services, January 2009)

Maß- und Eichgesetz, BGBl. Nr. 152/1950, in der derzeit gültigen Fassung

D.5 Switzerland:

SIA 190 “Kanalisationen”

D.6 Sweden

AMA/RA/MER from Svensk Byggtjänst.

D.7 UK

Highways

Manual of contract documents for Highway Works (MCHW)

Vol 1 specification for highway works	Series 0500 Drainage and service ducts
Vol 3 Highway Construction Details	F Series Drainage

www.standardsforhighways.co.uk

Building Regulations

England Approved Document H “Drainage and waste disposal”

www.gov.uk

Wales Approved Document H “Drainage and waste disposal”

www.gov.wales

http://gov.wales/topics/planning/buildingregs/publications/?lang=en

http://gov.wales/topics/planning/buildingregs/publications/part-h-drainage/?lang=en

Scotland Technical Handbook, Environment Section

Domestic - http://www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks/th2013domenvironment

Non-Domestic - http://www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks/th2013ndenvironment

www.gov.scot

Northern Ireland Technical Booklet N “Drainage”

www.dfpni.gov.uk

http://www.buildingcontrol-ni.com/regulations/technical-booklets

Sewerage

United Kingdom	Civil Engineering Specification for the Water Industry 7th Edition 2011
England and Wales	Sewers for Adoption 7th Edition 2012
Scotland	Sewers for Scotland 3rd Edition April 2015
Northern Ireland	Sewers for Adoption Northern Ireland – 1st Edition August 2010

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