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Plastics piping systems for non-pressure underground drainage and sewerage – Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) – Part 3: Guidance for installation

Systèmes de canalisations en plastique pour les branchements et les collecteurs d'assainissement sans pression enterrés – Systèmes de canalisations à parois structurées en poly(chlorure de vinyle) non plastifié (PVC-U), polypropylène (PP) et polyéthylène (PE) – Partie 3: Guide pour la pose

Kunststoff-Rohrleitungssysteme für erdverlegte Abwasserkanäle und –leitungen – Rohrleitungssysteme mit strukturierter Wandung aus weichmacherfreiem Polyvinylchlorid (PVC-U), Polypropylen (PP) und Polyethylen (PE) – Teil 3: Empfehlungen für die Verlegung

This draft Technical Specification is submitted to CEN members for formal vote. It has been drawn up by the Technical Committee CEN/TC 155.

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

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Foreword

This document prCEN/TS 13476-3:2002 has been prepared by Technical Committee CEN /TC 155, "Plastics piping systems and ducting systems", the secretariat of which is held by NEN.

This document is currently submitted to the Formal Vote.

This Technical Specification is a Part of a System Standard for plastics piping systems of a particular material for a specified application. There are a number of such System Standards.

System Standards are based on the results of the work undertaken in ISO/TC 138 "Plastics pipes, fittings and valves for the transport of fluids", which is a Technical Committee of the International Organisation for Standardisation (ISO).

They are supported by separate standards on test methods to which references are made throughout the System Standard.

The System Standards are consistent with general standards on functional requirements and on recommended practice for installation.

The 13476 series consists of the following Parts, under the general title *Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE)*

- *Part 1: Specifications for pipes, fittings and the system*
- *Part 2: Guidance for the assessment of conformity* (CEN/TS)
- *Part 3: Guidance for installation (this technical specification)*

Annexes A and B are normative.

This document includes a Bibliography.

1 Scope

This Technical Specification together with ENV 1046[5] and EN 1610 provides a set of guidelines for the installation of piping system according to prEN 13476-1[1].

Any national or local regulations, which are relevant will be taken into account.

This Technical Specification is applicable to piping systems made of poly(vinyl chloride) (PVC-U, polypropylene (PP) and polyethylene (PE) in the field of non-pressure underground drainage and sewerage outside the building structure (application area code "U") and for non-pressure underground drainage and sewerage for both buried in ground within the building structure (application area code "D") and outside the building structure. This is reflected in the marking of products by "U" and "UD".

2 Normative references

This Technical Specification incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this Technical Specification only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

EN 1401-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride) (PVC-U) — Part 1: Specifications for pipes, fittings and the system.*

EN 1610:1997, *Construction and testing of drains and sewers.*

EN 1852-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Polypropylene (PP) — Part 1: Specifications for pipes, fittings and the system.*

prEN 12666-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Polyethylene (PE) — Part 1: Specifications for pipes, fittings and the system.*

prEN 13476-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride), (PVC-U), polypropylene (PP) and polyethylene (PE) — Part 1: Specifications for pipes, fittings and the system.*

3 Choice of stiffness (SN) series

3.1 General

Structured-wall pipes conforming to prEN 13476-1[1] are flexible pipes.

Flexible pipes installed in the ground deflect during installation by the forces exerted to it, as well as after installation by the further settlement of the soil. The amount of deflection reached after installation depends to a great extent on the quality of workmanship, and to a lesser extent to the pipe stiffness.

The increase of the pipe deflection after installation is fully depending on the amount the soil can settle after installation. When the soil around the installed pipe is well compacted, very limited increase of pipe deflection will occur. When the soil has reached a low compaction degree at installation, pipe deflection will increase and follows the soil settlement.

Traffic load, do not affect pipe deflection other than increasing the rate of settlement of the soil.

3.2 Procedure for pipes

Pipe deflection can best be controlled by prescribing a certain workmanship level. It has been proven that this parameter is by far the most influencing parameter determining the deflection.

If however the installation procedure is considered as fixed, then the choice of stiffness class (SN) shall be made based on the following:

a) when reference situations exists: the same class of pipe used under similar or more severe conditions has shown to be acceptable;

b) or based on the Design Graph, (see annex A);

c) or based on structural design (see annex B).

3.3 Procedure for fittings

Generally fittings conforming to prEN 13476-1[1] should have the same stiffness class as the pipes to which they are connected.

Fittings conforming to EN 1401-1[2], EN 1852-1[3] or prEN 12666-1[4] are often used in combination with pipes conforming to prEN 13476-1[1]. Because these fittings are classified by their wall thickness series, their actual stiffness is higher than a pipe with the same wall thickness. Such fittings are used as shown in Table 1.

Table 1 — Minimum fitting classes recommended for use with structured wall pipes

Pipe stiffness	Fittings according to:			
	prEN 13476-1	EN 1401-1	EN 1852-1	prEN 12666-1
SN 2	SN 2	SDR 51	S 20	S 16
SN 4	SN 4	SDR 51	S 20	S 16
SN 8	SN 8	SDR 41	S 16	S 12,5
SN 16	SN 16	SDR 34	S 11,2	S 10

Where fittings of equal or higher stiffness than the pipe(s) are not available, fittings of lower stiffness may be used. In such case guidance from the manufacturer should be sought.

4 Installation limitations

Pipes and fittings buried in ground either within the building structure or less than 1 m from the building structure and connected to the building shall be marked "UD".

NOTE UD marked pipes and fittings are available in dimensions ≤ 400 mm.

5 Storage

Storage in direct sunlight and/or high temperatures for long periods can cause excessive deformations affecting installation.

To avoid this risk the following is recommended:

a) to shield the stacks of pipes from continuous and direct sunlight and arrange to allow the free passage of air around the pipes;

b) to store the fittings in boxes or sacks manufactured so as to permit the free passage of air;

c) to protect elastomeric sealing rings against direct sunlight.

6 Handling and installation at low temperatures

Experience has shown that even at substantial sub zero temperatures, structured wall pipes can be satisfactorily handled and laid when adequate care is taken.

A special marking on structured wall pipes "❄" (ice crystal) shows that the pipe conforms to additional impact test requirements for pipes that may be installed at temperatures below –10 °C.

7 Jointing

7.1 Push fit jointing (elastomeric sealing ring joints)

Jointing shall always be carried out in accordance with the manufacturer's instructions. However in the absence of instructions the following is recommended:

a) when the sealing ring is positioned in the socket the spigot end shall be chamfered or deburred;

b) only sealing rings and lubricants supplied by the manufacturer of pipe or fitting shall be used;

c) for pipes cut on site the cut shall be square and when relevant be positioned in an appropriate cutting zone. After cutting the end shall be chamfered or deburred to produce a finish equivalent to that of the pipe supplied by the manufacturer;

d) the pipe end, the socket and the sealing ring groove shall be clean and the sealing ring shall be seated correctly in its location;

e) the lubricant shall be applied over the whole chamfered end, in the socket area or on the fixed sealing ring as appropriate;

f) the spigot shall be carefully aligned with the adjoining socket and pushed to the required insertion depth. When a lever is used on the pipe to push the joint, a block of wood should be inserted between the lever and the end of the pipe to prevent damage to the pipe.

7.2 Welded and fused joints

Welded and fused joints should always be carried out by qualified personnel and in accordance with the manufacturer's instructions.

7.3 Jointing with short sockets

When a pipe or fitting is marked "SHORT SOCKET" the manufacturers installation instructions shall always be carefully followed in order to avoid angular deflections in the joint, minimise soil settlements after installation and avoid any other imperfection influencing the jointing function.

8 Deviation from straightness

It is the normal practice in sewerage and drainage that pipes are installed in straight lines. However as structured wall pipes in many cases are longitudinally flexible it is possible to bend them if required by the installation. In such cases the manufacturers advice should be followed.

Care may be necessary to avoid any extra stress in the joint itself.

The largest permitted angular deflection in the joint is as follows:

— 2° for $d_e < 315$ mm;

— 1,5° for $315 \leq d_e \leq 630$;

— 1° for $d_e > 630$.

Larger angular deflections are permitted in case of joints specifically designed for large angular deflections. In such case the manufacturer shall declare the permitted angular deflection.

9 Connection to existing pipes

For structured wall pipelines connection to an existing pipeline, or a structured wall pipeline of a different design, can be made in a manner similar to that of making a repair (see clause 11) when an appropriate fitting is used.

In cases where a saddle connection is to be established the manufacturer's instructions should be followed.

10 Connection to rigid structures

Special fittings for this purpose are available. In such cases the manufacturer's instructions should be followed.

11 Repairs

Slip couplers or purpose designed fittings are available from manufacturers for effecting repairs. Because designs vary, it is necessary to follow individual manufacturer's instructions.

However, it is recommended that the following general points should all be adopted, where applicable:

a) the full extent of the damaged or failed section shall be identified and removed;

b) the cut pipe ends should be square and prepared for push fit jointing as described in item c) of 7.1;

c) repair or slip couplings should be placed in position. The replacement pipe length should then be laid on the suitably prepared bed and the slip couplings moved to their final positions (see Figure 1);

d) the embedment should then be replaced to give compaction values approximately equal to those immediately adjacent to the repair.

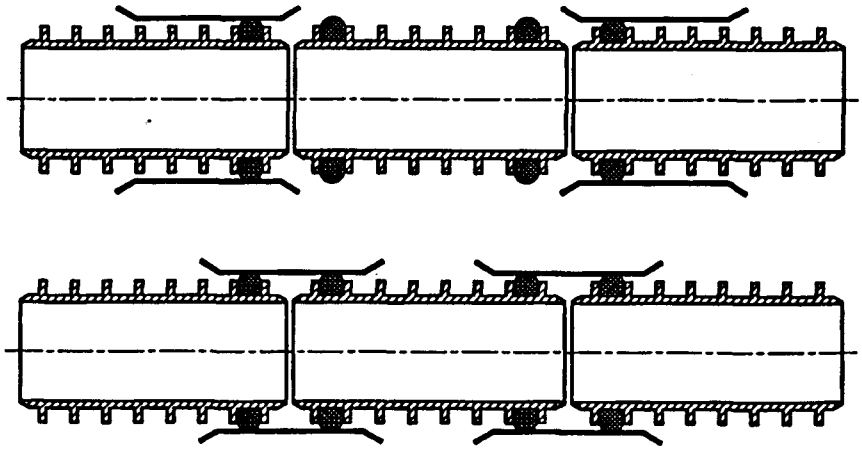


Figure 1 — Example of repair using slip couplers

12 Testing

Structured wall gravity drains and sewers are tested according to the procedure described in clause 13 of EN 1610:1997. As there is no loss of water or air through the pipe wall, the following modifications of parameters and requirements are proposed in order to be able to detect leaks in joints.

Testing with air:

a) test method: LC

b) test pressure: 100 mbar (10 kPa)

c) maximum Pressure drop 5 mbar (0,5 kPa)

d) testing time: 3 min for DN < 400 mm
0,01 × DN for DN ≥ 400 mm

Testing with water:

Maximum permissible loss of water:

a) 0,04 l/m^2 during 30 min for pipelines;

b) 0,05 l/m^2 during 30 min for manholes and inspection chambers of plastics.

If control of the deflection is carried out it is recommended that the peak deflection does not exceed 15 % of d_e unless otherwise agreed (see 3.2).

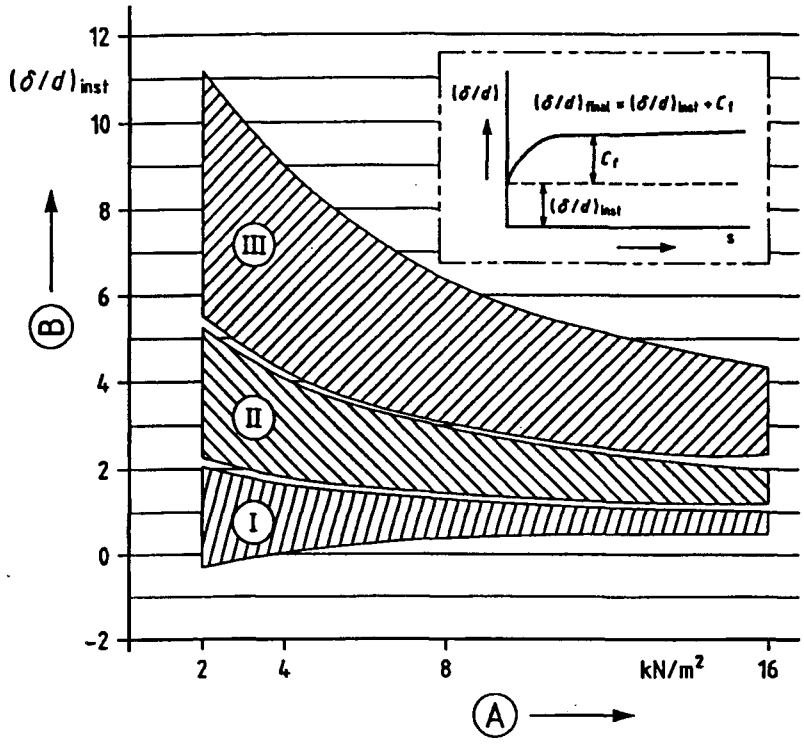
Annex A
(normative)

Installation types and related consolidation deformation

A.1 Design graph

An intensive study of the deflection history of pipes installed under different conditions up to 25 years ago has resulted in experience as presented in the graph shown in Figure A.1.

NOTE The average deflections immediately after installation are represented by the lower boundary of each area, and the maximum values by the upper boundaries.



Key
A is the axis for ring stiffness
B is the axis for pipe deflection
I is well compacted
II is moderate compaction
III is no compaction, not recommended

Figure A1 — Pipe deflection after installation

A.2 "Well" compaction, $C_f = 1,0$

The embedment soil of a granular type is placed carefully in the haunching zone and compacted, followed by placing the soil in shift of maximum 30 cm, after which each layer is compacted carefully. The pipe shall at least be covered by a layer of 15 cm. The trench is further filled with soil of any type and compacted. Typical values for the proctor are above 94 %.

A.3 "Moderate" compaction, $C_f = 2,0$

The embedment soil of a granular type is placed in shifts of maximum 50 cm, after which each layer is compacted carefully. The pipe shall at least be covered by a layer of 15 cm. The trench is further filled with soil of any type and compacted. Typical values for the proctor density are in the range of 87 % to 94 %.

A.4 "None" compaction in granular soil, $C_f = 3,0$

The embedment soil of a granular type is added without compaction.
Such type of installation is NOT recommended.

A.5 "None" compaction in clay, $C_f = 4,0$

The embedment soil of a cohesive type is added without compaction.
Such type of installation is NOT recommended.

A.6 Validity of the design graph

The design graph is valid under the following conditions:

a) depth between 0,8 m and 6 m, both included;

b) depth/diameter ratio at least above 2,0;

c) designers first need to establish allowable deflections, average and maximum (National requirements, product standards etc.);

d) pipes fulfil the requirements listed in prEN 13476-1, prEN 12666-1, EN 1852-1 or EN 1401-1, as applicable;

e) installation categories "well", "moderate" and "none" should reflect the workmanship on which the designer can rely;

f) sheet piles shall be removed before compaction, in accordance with the recommendations in EN 1610. If however the sheet piles are removed after compaction one shall realise that the "well" or "moderate" compaction level will be reduced to the "none" compaction level;

g) pipes with outside diameter up to 1100 mm;

h) deflections are unlikely to be exceeded in practice for the circumstances described;

i) for the deflection mentioned in the graph, the strain will be far below the design limit, and does not need to be given attention to in the design.

Annex B
(normative)

Structural design

In general structural design of a pipeline construction by applying analytical or numerical methods is not needed. Any calculated prediction of the pipe behaviour and reality is strongly depending on that the installation conditions used for the calculation are the same as used for the installation. Therefore it is important that effort is put in controlling the input values by extensive soil surveys and monitoring of the installation. In many cases practical information, e.g. as reflected in annex A, are available and results in a good prediction of the pipe performance.

However, when structural design is required, e.g. in cases where no other information exists, then a method as defined in EN 1295-1 shall be used. As far as input values for the pipes are required, the values given in Table B.1 are recommended.

Table B.1 — Input values for pipes

Material	PVC-U	PP	PE	Remarks
E-modulus (MPa)	3500	1250	1000	Modulus of elasticity
(-)	0,37	0,4	0,4	Poisson ratio
(mm/mm.K^{-1})	$8x10^{-5}$	$13x10^{-5}$	$13x10^{-5}$	Linear expansion coefficient

Unless otherwise agreed between the specifier and the system owner it is recommended that the calculated average deflection values do not exceed the values given in Table B.2, for reason of serviceability.

Table B.2 — Recommended design deflection limits.

Stiffness class SN	Average initial deflection	Average LT deflection
SN 2	5 %	8 %
SN 4, 8, 16	8 %	10 %

Bibliography

[1] ENV 1046, *Plastics piping and ducting systems — Systems outside building structures for the conveyance of water or sewerage — Practices for installation above and below ground*