
Cevi za daljinsko ogrevanje - Projektiranje in vgradnja toplotno izoliranih spojenih eno- in dvocevni sistemov za neposredno zakopana vročevodna omrežja - 2. del: Vgradnja (vključno z dopolnilom A1)

District heating pipes - Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks - Part 2: Installation

Fernwärmerohre - Auslegung und Installation von gedämmten Einzel- und Doppelrohr-Verbundsystemen für direkt erdverlegte Heißwasser-Fernwärmenetze - Teil 2: Installation

Tuyaux de chauffage urbain - Conception et installation des systèmes bloqués de tuyaux monotubes et bitubes isolés thermiquement pour les réseaux d'eau chaude enterrés directement - Partie 2: Installation

Ta slovenski standard je istoveten z: **EN 13941-2:2019+A1:2021**

ICS:

23.040.07	Cevovodi za daljinsko ogrevanje in njihovi deli	Pipeline and its parts for district heat
91.140.10	Sistemi centralnega ogrevanja	Central heating systems

SIST EN 13941-2:2019+A1:2022**en,fr,de**

**iTeh STANDARD
PREVIEW
(standards.iteh.ai)**

SIST EN 13941-2:2019+A1:2022

[https://standards.iteh.ai/catalog/standards/sist/d6d091b5-
e7de-454f-bdd6-0e694313677d/sist-en-13941-2-
2019a1-2022](https://standards.iteh.ai/catalog/standards/sist/d6d091b5-e7de-454f-bdd6-0e694313677d/sist-en-13941-2-2019a1-2022)

EUROPEAN STANDARD

EN 13941-2:2019+A1

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2021

ICS 23.040.07; 23.040.10; 91.140.10

Supersedes EN 13941-2:2019

English Version

District heating pipes - Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks - Part 2: Installation

Tuyaux de chauffage urbain - Conception et installation des systèmes bloqués de tuyaux monotubes et bitubes isolés thermiquement pour les réseaux d'eau chaude enterrés directement - Partie 2 : Installation

Fernwärmerohre - Auslegung und Installation von gedämmten Einzel- und Doppelrohr-Verbundsystemen für direkt erdverlegte Heißwasser-Fernwärmenetze - Teil 2: Installation

This European Standard was approved by CEN on 14 December 2018 and includes Amendment 1 approved by CEN on 15 October 2021.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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, Turkey and United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword.....	6
Introduction	7
1 Scope.....	8
2 Normative references.....	8
3 Terms and definitions and symbols	11
3.1 Terms and definitions	11
3.2 Symbols.....	11
3.3 Abbreviations.....	11
4 Procurement.....	11
4.1 Manufacturer of thermal insulated pipe elements.....	11
4.2 Performing assembly of casing joints and PE-welding on casings.....	11
5 General requirements.....	12
6 Required information	12
6.1 Documents from the design phase.....	12
6.2 Documents from the manufacturers.....	12
6.3 Existing construction and underground systems	13
6.3.1 General.....	13
6.4 Wiring design diagram.....	13
7 Quality control	13
7.1 General.....	13
7.2 Installation and approval.....	14
8 Site preparation.....	15
8.1 General.....	15
8.2 Liason with Authorities and other parties concerned.....	16
8.3 Site access	16
8.4 Equipment and material.....	16
9 Trenching.....	17
9.1 General.....	17
9.2 Groundwater extraction.....	17
9.3 Installation of pipelines crossing or parallel with other constructions and existing conduits.....	18
9.4 Excavations crossing or parallel to existing district heating pipelines, reducing of soil cover, etc.....	18
10 Transport and storage of pipe elements, pipe components and other materials	18
10.1 General.....	18
10.2 Transport and delivery	18
10.2.1 Loading and unloading	18
10.2.2 Checking of the delivery	19
10.3 Storage	19
10.3.1 General.....	19
10.3.2 Storage of pipe assemblies	19
10.3.3 Storage of fitting and valve assemblies.....	20
10.3.4 Storage of joint casing systems and other materials	20

11	Pipe laying.....	20
11.1	General.....	20
11.2	Installation in the trench.....	21
11.3	Welding and testing of welds.....	21
11.3.1	Welding of the steel service pipe and testing of the welds.....	21
11.4	Venting and Draining.....	30
11.5	Test for leak tightness and strength.....	34
11.5.1	General.....	34
11.5.2	Visual test with $\overline{A_1}$ overpressure $\overline{A_1}$ by air.....	34
11.5.3	Visual test below atmospheric pressure by air.....	35
11.5.4	Hydrostatic test.....	35
11.6	Joint Casing.....	39
11.6.1	General.....	39
11.6.2	Joints.....	39
11.6.3	Site prepared components.....	39
11.7	Surveillance system.....	42
11.8	Expansion cushions.....	43
11.9	Electrical and telecommunication cable of the systems.....	45
11.10	Requirements for horizontal directional drilling (HDD).....	45
11.11	Requirements for critical locations.....	45
11.11.1	Wall penetrations.....	45
11.11.2	Connections to other pipe systems.....	46
11.11.3	Pipe laying in protection tubes.....	46
11.11.4	Protection against external impact for above ground installations.....	46
11.12	Position of pipeline.....	46
12	Backfilling.....	47
12.1	General.....	47
12.2	Bedding material and composition.....	48
13	Commissioning.....	49
14	Operation.....	49
15	Documentation.....	49
15.1	Information on operation and maintenance.....	49
15.1.1	Range of application.....	49
15.1.2	Documentation — aims and uses.....	49
15.1.3	Technical documentation.....	50
15.1.4	Drawings of the technical documentation.....	54
15.1.5	As-built documentation.....	58
15.2	Documentation under the scope of the PED.....	58
Annex A	(informative) Venting and Draining.....	59
A.1	General.....	59
A.2	Venting and draining devices.....	59
A.3	Draining devices for large pipeline dimensions.....	61
A.4	Venting of new pipe sections.....	62
A.4.1	Venting by house connection pipeline.....	62
A.4.2	Venting by venting cabinets.....	63
Annex B	(informative) Recommendations for HDD.....	65
B.1	General.....	65

EN 13941-2:2019+A1:2021 (E)

B.2	Depth under roads.....	65
B.3	Minimum intermediate distances.....	66
B.4	Casing and casing field joints.....	66
B.5	Drilling fluid composition.....	66
B.6	Drilling fluid pressures.....	66
B.7	Borehole dimensions and borehole stability.....	67
B.8	Ballasting	67
B.9	Installation of pipe bundles	68
B.10	Determination of position and route corrections.....	68
B.11	Registration and control of HDD	69
B.12	Drilling Tolerances.....	69
B.13	Verification of design and methodology for the pullback operation	70
B.14	As-Built information	70
Annex C	(informative) Qualification of fitters installing joints in pre-insulated bonded pipe networks	71
C.1	Knowledge and skills.....	71
C.2	Background for training and testing.....	71
C.3	Subjects for training and testing	71
C.3.1	General.....	71
C.3.2	Casing of polyethylene (PE)	72
C.3.2.1	Important construction characteristics and properties.....	72
C.3.2.2	Technological behaviour of PE.....	72
C.3.2.3	Mechanical properties of PE	72
C.3.2.4	Conditions for casing elements under load.....	73
C.3.3	Surveillance	73
C.3.4	PUR-foam system	73
C.3.4.1	PUR-foam as a two component material	73
C.3.4.2	Insulation procedures on job site	73
C.3.5	Joint types/jointing systems	74
C.3.5.1	General.....	74
C.3.5.2	Shrink sleeve joint with mastic/adhesive sealing	74
C.3.5.3	Welded joints/systems	74
C.3.6	Installation of joints.....	75
C.3.6.1	General.....	75
C.3.6.2	Installation of surveillance system.....	75
C.3.6.2.1	General.....	75
C.3.6.2.2	Preparation of installation	75

C.3.6.2.3	Installation of surveillance systems and their components	76
C.3.6.2.4	Measurements after insulation.....	76
C.3.6.3	Sealed joints	76
C.3.6.4	Welded joints	77
C.3.6.4.1	Joint face forms and welding procedures in accordance with joint types described in C.3.4.2	77
C.3.6.4.2	Training and testing.....	77
C.3.6.5	Insulation of joints	77
C.3.6.5.1	Special factors of influence to job site conditions.....	77
C.3.6.5.2	On-site foaming work.....	77
C.3.6.5.3	Prefabricated joint insulation installation work	78
C.3.6.6	Documentation.....	78
Annex D (informative)	Quality control program and documentation.....	79
Annex E (normative)	Commissioning.....	92
E.1	Commissioning.....	92
E.1.1	General	92
E.1.2	Filling with water for initial operation.....	93
E.1.3	Surveillance system.....	93
Annex F (informative)	Operation.....	94
Bibliography	95

[SIST EN 13941-2:2019+A1:2022](https://standards.iteh.ai/catalog/standards/sist/d6d091b5-e7de-454f-bdd6-0e694313677d/sist-en-13941-2-2019a1-2022)

[https://standards.iteh.ai/catalog/standards/sist/d6d091b5-
e7de-454f-bdd6-0e694313677d/sist-en-13941-2-
2019a1-2022](https://standards.iteh.ai/catalog/standards/sist/d6d091b5-e7de-454f-bdd6-0e694313677d/sist-en-13941-2-2019a1-2022)

EN 13941-2:2019+A1:2021 (E)**European foreword**

This document (EN 13941-2:2019+A1:2021) has been prepared by Technical Committee CEN/TC 107 “Prefabricated district heating and district cooling pipe systems”, the secretariat of which is held by DS.

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 June 2022, and conflicting national standards shall be withdrawn at the latest by June 2022.

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 A1 EN 13941:2019 A1.

This document includes Amendment 1 approved by CEN on 15 October 2021.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

EN 13941, *District heating pipes — Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks* consists of the following parts:

- Part 1: Design;
- Part 2: Installation.

A1 In comparison to EN 13941-2:2019, the following changes have been made:

- a) minor corrections throughout the document. A1 [SIST EN 13941-2:2019+A1:2022](https://standards.iteh.ai/catalog/standards/sist/d6d091b5-67dc-494e-bdd6-0004313671d8/sist-en-13941-2-2019a1-2022)

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, Turkey and the United Kingdom.

Introduction

This document has been prepared by CEN/TC 107/WG 13 „Prefabricated district heating and district cooling pipe system“.

According to the scope of CEN/TC 107:

- the task of CEN/TC 107/WG 13 is to specify rules for design, calculation and installation for factory made thermal insulated bonded single and twin pipe systems for directly buried hot water networks;
- CEN/TC 107/WG 13 also contributes to rules for functional tests for thermal-insulated bonded pipe systems for underground hot water networks;

When use is made of the standard, the different sections of which it is made up are to be interpreted as being interdependent and, because of this, cannot be dissociated.

The revision of EN 13941:2009+A1:2010 involves the subdivision of the document in two separate documents:

- EN 13941-1, *District heating pipes — Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks — Part 1: Design*;
- EN 13941-2, *District heating pipes — Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks — Part 2: Installation*.

This volume (Part 2) consists of a main part and six annexes.

Annex E is normative. Annexes A, B, C, D, and F are informative.

This standard contains a number of requirements aimed at ensuring the sound execution of distribution networks for district heating.

The requirements contained in this document should be assessed and applied in compliance with the intentions of the standard and in due consideration of the development taking place in the field it concerns. It is therefore assumed that the user of the standard has the requisite technical insight and that the user of the standard has adequate knowledge of legal and other external regulations that are of consequence to the practical application of the document.

NOTE Some paragraphs of this standard are possibly covered by national regulations in some countries which naturally apply instead of this standard.

EN 13941-2:2019+A1:2021 (E)**1 Scope**

This document specifies requirements for design, calculation and installation of factory made thermal insulated bonded single and twin pipe systems for buried hot water networks for continuous operation with treated water at various temperatures up to 120 °C and occasionally peak temperatures up to 140 °C for maximum 300 h/a, and maximum internal pressure 2,5 MPa.

Flexible pipe systems according to the EN 15632 series are not under the scope of this standard.

The standard EN 13941, *Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks* consists of two parts:

- a) EN 13941-1: *Design*;
- b) EN 13941-2: *Installation*.

The requirements in this part, EN 13941-2, form a unity with those of EN 13941-1.

The principles of the standard may be applied to thermal insulated pipe systems with pressures higher than 2,5 MPa, provided that special attention is paid to the effects of this higher pressure.

Adjacent pipes, not buried, but belonging to the network (e.g. pipes in ducts, valve chambers, road crossings above ground etc.) may be designed and installed according to this standard.

This standard presupposes the use of treated water, which by softening, demineralization, de-aeration, adding of chemicals, or otherwise has been treated to effectively prevent internal corrosion and deposits in the pipes.

NOTE For further information on water qualities to be used in district heating pipe systems, see bibliographic entry [8].

This document is not applicable for such units as:

- a) pumps; <https://standards.iteh.ai/catalog/standards/sist/d6d091b5-e7de-454f-bdd6-0e694313677d/sist-en-13941-2-2019a1-2022>
- b) heat exchangers;
- c) boilers, tanks;
- d) systems behind domestic substations.

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 253, *District heating pipes — Bonded single pipe systems for directly buried hot water networks — Factory made pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene*

EN 448, *District heating pipes — Preinsulated bonded pipe systems for directly buried hot water networks — Fitting assemblies of steel service pipes, polyurethane thermal insulation and outer casing of polyethylene*

EN 488, *District heating pipes — Preinsulated bonded pipe systems for directly buried hot water networks — Steel valve assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene*

EN 489, *District heating pipes — Preinsulated bonded pipe systems for directly buried hot water networks — Joint assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene*

EN 10204, *Metallic products — Types of inspection documents*

EN 13018, *Non-destructive testing — Visual testing - General principles*

EN 13480-5, *Metallic industrial piping — Part 5: Inspection and testing*

prEN 13941-1, *District heating pipes — Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks — Part 1: Design*

EN 14419:2009, *District heating pipes - Preinsulated bonded pipe systems for directly buried hot water networks - Surveillance systems*

EN 15698 (all parts), *District heating pipes — Bonded twin pipe systems for directly buried hot water networks*

EN 17248, ^{A1} deleted text ^{A1} *District heating and district cooling pipe systems — Terms and definitions*

EN ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles (ISO 3452-1)*

EN ISO 3834-1, *Quality requirements for fusion welding of metallic materials — Part 1: Criteria for the selection of the appropriate level of quality requirements (ISO 3834-1)*

EN ISO 3834-3, *Quality requirements for fusion welding of metallic materials — Part 3: Standard quality requirements (ISO 3834-3)*

EN ISO 3834-4, *Quality requirements for fusion welding of metallic materials — Part 4: Elementary quality requirements (ISO 3834-4)*

EN ISO 5579, *Non-destructive testing — Radiographic testing of metallic materials using film and X- or gamma rays — Basic rules (ISO 5579)*

EN ISO 5817:2014, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2014)*

EN ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels (ISO 9606-1)*

EN ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel (ISO 9712)*

EN ISO 9934-1, *Non-destructive testing — Magnetic particle testing — Part 1: General principles (ISO 9934-1)*

EN ISO 10675-1, *Non-destructive testing of welds — Acceptance levels for radiographic testing - Part 1: Steel, nickel, titanium and their alloys (ISO 10675-1)*

EN ISO 11666, *Non-destructive testing of welds — Ultrasonic testing — Acceptance levels (ISO 11666:2018)*

EN ISO 14731:2006, *Welding coordination — Tasks and responsibilities (ISO 14731:2006)*

EN ISO 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732)*

EN 13941-2:2019+A1:2021 (E)

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1)*

EN ISO 15609-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 2: Gas welding (ISO 15609-2)*

EN ISO 15610, *Specification and qualification of welding procedures for metallic materials — Qualification based on tested welding consumables (ISO 15610)*

EN ISO 15613, *Specification and qualification of welding procedures for metallic materials - Qualification based on pre-production welding test (ISO 15613)*

EN ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1)*

EN ISO 16810, *Non-destructive testing — Ultrasonic testing — General principles (ISO 16810)*

EN ISO 17636-1, *Non-destructive testing of welds — Radiographic testing — Part 1: X- and gamma-ray techniques with film (ISO 17636-1)*

EN ISO 17636-2, *Non-destructive testing of welds — Radiographic testing - Part 2: X- and gamma-ray techniques with digital detectors (ISO 17636-2)*

EN ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints (ISO 17637)*

EN ISO 17638, *Non-destructive testing of welds — Magnetic particle testing (ISO 17638)*

EN ISO 17640, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment (ISO 17640)*

EN ISO 23277, *Non-destructive testing of welds — Penetrant testing — Acceptance levels (ISO 23277)*

EN ISO 23278, *Non-destructive testing of welds — Magnetic particle testing — Acceptance levels (ISO 23278)*

A1 deleted text **A1**

HD 308 S2, *Identification of cores in cables and flexible cords*

3 Terms and definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 17248 apply.

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

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

3.2 Symbols

For the purposes of this document, the symbols and indices given in EN 13941-1 apply.

3.3 Abbreviations

For the purposes of this document, the abbreviations given in EN 13941-1 apply.

4 Procurement

4.1 Manufacturer of thermal insulated pipe elements

For the quality control program and documentation for suitable thermal insulated pipe elements see Annex D.

NOTE For the quality control of factory made thermal insulated pipe elements see for example EHP 001 [1] and EHP 003 [15].

4.2 Performing assembly of casing joints and PE-welding on casings

For the assembly of casing joints and PE-welding on casings the following points need to be considered:

- a) the work shall be performed only by qualified fitters and PE-welders:
 - An example for a scheme for the required knowledge and skills for fitters and PE welders is given in Annex C).

NOTE Other qualification schemes for fitters and PE welders may exist at national level

- b) Experienced and qualified management personnel as foreman and quality inspector:

The Supervising personnel and quality inspection personnel shall be trained as fitter and PE-welder;

- c) Appropriate and serviceable tools, equipment and machinery.

For the quality control program and service life documentation for assembling of joints and PE-welding on the casing, see Table D.6 and Table D.8.

EN 13941-2:2019+A1:2021 (E)**5 General requirements**

Any pipe installation shall be made on basis of design documentation that is sufficiently detailed to ensure execution of the project presupposed quality.

The installation of a pipe system shall be done

- in accordance with the installation plan and the instructions of the manufacturers of either the system or the pipe and components, as applicable,
- in accordance with the design documentation so to ensure the adequate safety of fitters and other personnel on-site as well as any third persons,
- that installation and operation do not harm to other structures or construction works, e.g. roads.

Project classes including the required design documentation shall be determined according to EN 13941-1.

For the installation and assembly of pipe elements and pipe components only materials and methods, which meet the specified instructions and standards shall be used.

Pipeline sections, which cannot be installed in compliance with this standard such as other than pipe sections with pipe elements, e.g. bridge crossings, water course crossings, protection pipes should be installed by skilled personnel according to the project drawings and corresponding other standards, and codes.

If changes are made during installation, the design documentation shall be changed accordingly. The constructive and static consequences of any changes that may become necessary shall be examined.

The risk assessment of the pipe system is being described in EN 13941-1.

The environmental requirements according to the legislators have to be followed. These requirements can differ from place to place and are depending on the authority in charge.

It is permissible to use alternative rules from the notes given in this standard, provided that it is shown that the alternative rule accords with the relevant principles and it is at least equivalent with regard to the resistance, serviceability and durability achieved by the system.

6 Required information**6.1 Documents from the design phase**

A full set of updated data, in accordance with EN 13941-1 shall be available at the construction site, The information shall include at least the latest information about the local situation, vertical cover, dimensions of all existing and planned underground systems, including related facilities, such as shafts.

It shall be checked that the expansion cushions, as delivered at the construction site, comply with the requirements of EN 13941-1.

6.2 Documents from the manufacturers

The following documents shall be provided by the manufacturer on request:

- a installation manual.

In the installation manual, the manufacturer shall provide instructions about how to install the pipe elements and the pipe components. It should also give recommendation about handling, storage on-site, welding, jointing, backfilling in accordance with Clauses 10, 11 and 12.

6.3 Existing construction and underground systems

6.3.1 General

A full set of all detail plans of existing underground systems, like route plans, shaft drawings, detail and manufacturing drawings as well as static calculations should provide all information to prevent damage to existing underground systems.

National and local regulations and requirements on the location of service conduits, ducts and associate installations shall be complied with.

NOTE At works in the earth there is always the danger that existing underground systems get damaged. To the most important underground systems rank among:

- district heating pipelines;
- gas and water pipelines;
- electric cable;
- telecommunication cable;
- sewerages and rainwater pipelines;
- underground railway;
- and other ones.

6.4 Wiring design diagram

To locate any deviation as precisely as possible, a technical documentation according to EN 14419 is required.

During installation a wiring design diagram for each measuring section is required, consisting of:

- drawing with legend;
- wiring diagram including all measuring elements, all connected branches and their respective destination;
- drawing showing the location of connection points, etc.

7 Quality control

7.1 General

For basics of quality control see EN 13941-1.

The range of documented information shall be defined in relation to the kind of the work and the project class.

All components and materials and all activities carried out (e.g. civil engineering work, pipe installation, assembling of joints, testing and evaluating of test results) shall be documented in an appropriate manner.