BRITISH STANDARD

BS EN 14419:2009

District heating pipes — Preinsulated bonded pipe systems for directly buried hot water networks — Surveillance systems

ICS 23.040.01

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 14419:2009. It supersedes BS EN 14419:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/9, Insulated underground pipelines.

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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Tuyaux de chauffage urbain - Systèmes bloqués de tuyaux préisolés pour les réseaux d'eau chaude enterrés directement - Systèmes de surveillance

Fernwärmerohre - Werkmäßig gedämmte Verbundmantelrohrsysteme für erdverlegte Fernwärmenetze - Überwachungssysteme

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

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Contents

Foreword

This document (EN 14419:2009) has been prepared by Technical Committee CEN/TC 107 “Prefabricated District Heating 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of an identical text or by endorsement, at the latest by September 2009, and conflicting national standards shall be withdrawn at the latest by September 2009.

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 14419:2003.

This second edition cancels and replaces the first edition (EN 14419:2003), which has been technically revised.

Annexes A, B and F are informative. Annexes C, D, E, G and H are normative.

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The first edition of EN 14419 was approved in 2003. The main areas of the current revision are:

— testing procedures have been changed in order to include pipe elements with diffusion barriers according to revised version of EN 253:2009;

— testing procedures have been changed in order to include pipe elements for twin pipes according to EN 15698-1;

— pipe elements produced according to standard for preinsulated flexible pipe systems with bonded metal service pipes EN 15632-4 and standard for twin pipes EN 15698-1 have been added to the definitions of pipe elements suitable for instalment of measuring wires for surveillance systems;

— the text regarding testing (cf. 6.4 and 7.1) has been put in agreement with the text in 6.6 (all elements shall be tested);

— the term “moisture” has been deleted as a specific term and replaced by a note to the term “detection of moisture”;

— the term "QM-Programme" has been changed to "Quality control programme" in order to standardize the wording to other standards under TC 107.

This standard is a supplement to:

— EN 253, *District heating pipes – Preinsulated bonded pipe systems for directly buried hot water networks – 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 13941, *Design and installation of preinsulated bonded pipe systems for district heating*

— EN 15632-1, *District heating pipes – Pre-insulated flexible pipe systems – Part 1: Classification, general requirements and test methods*

— EN 15632-4, *District heating pipes – Pre-insulated flexible pipe systems – Part 4 : Bonded system with metal service pipes; requirements and test methods*

— EN 15698-1, *District heating pipes – Preinsulated bonded twin pipe systems for directly buried hot water networks – Part 1: Twin pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene*

These are all standards for preinsulated bonded pipe systems for directly buried hot water networks.

1 Scope

This European Standard specifies basic functional requirements for surveillance systems for district heating pipe systems, specific requirements for measuring elements and their installation within preinsulated bonded pipes, valves and fittings, and the field assembly of these measuring elements in pipe joints.

This standard specifies requirements for the manufacture of measuring elements, for the manufacture of preinsulated bonded pipe elements with measuring elements and for the assembly of the measuring elements in the field.

All requirements and recommendations described in this standard are based on the experience gained with existing surveillance systems and their principal function, cf. Annex A.

The specific requirements given are only valid for electrical wire based surveillance systems forming an integral part of the pipes, valves, fittings and joints.

2 Normative references

The following referenced documents are indispensable for the application 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 – Preinsulated bonded pipe systems for directly buried hot water networks – 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 15632-4, *District heating pipes – Pre-insulated flexible pipe systems – Part 4: Bonded system with metal service pipes; requirements and test methods*

EN 15698-1, *District heating pipes – Preinsulated bonded twin pipe systems for directly buried hot water networks – Part 1: Twin pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene*

EN 61557-2, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 2: Insulation resistance (IEC 61557-2:2007)*

3 Terms and definitions

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

3.1
pipe element
preinsulated pipes, valves and fittings manufactured according to EN 253, EN 448, EN 488, EN 15632-4 and EN 15698-1

3.2
pipe system
complete pipe installation, including joints, branches, accessories, etc. and adjacent pipes based on pipe element (cf. 3.1) and joints manufactured and assembled in accordance with EN 489

3.3
surveillance system
system that consists of measuring sections and measuring instruments for surveillance of pipe systems.

NOTE The principal parts of a measuring section of a surveillance system are given in Annex B.

3.4
system characteristics
electrical parameters used by the individual surveillance system for surveillance purpose or for test of functionality

3.5
measuring instrument
electrical instrument used for indicating of deviations and disorders, which are sensed by the measuring elements in a measuring section

3.6
measuring section
pipe section with continuously connected measuring elements terminating at the connection points

NOTE Main pipes and branches can be part of the same measuring section.

3.7
measuring element
all elements built-in to the pipe systems that enable the detection of moisture

NOTE This can be measuring wires or various measuring sensors.

3.8
measuring wire
electrical wire used for detection of moisture and/or for transport of electrical signals relevant for the surveillance system

NOTE 1 Depending on the system several measuring wires for different purposes can be used.

NOTE 2 The measuring wires can be bare or insulated, straight or twisted two and two.

3.9
measuring sensor
component that changes system characteristics when exposed to moisture

NOTE A sensor is a component only operating at a specific point.

3.10
detection of moisture
detection of moisture-related parameters with measuring instruments

NOTE 1 Only moisture in the insulation due to defects or bad workmanship is relevant

NOTE 2 The parameters could be electrical resistance and/or impedance.

3.11
deviation
result of comparing the values for moisture-related parameters measured by the surveillance system with the values given in the technical documentation

3.12
multiple deviations
two or more deviations that are present at the same time in a measuring section

3.13
disorder
electrical interruption and/or short circuit in a measuring section

3.14
location of moisture
procedure to find the position of moisture related parameters

3.15
location of disorder
procedure to find the position of a disorder

3.16
installation of measuring elements
process of installation of the measuring elements into the district heating pipes during pipe element production

3.17
assembly of measuring elements
process where a fitter during assembly of pipe elements connects measuring elements into a measuring section

3.18
connection point
accessible place outside the pipe system where a measuring instrument can be connected to a measuring section

NOTE The place could be in a shaft, in a house connection, in a measuring post, in a cabinet, etc.

3.19
longitudinal water tightness
ability to prevent water spread in longitudinal direction of the pipe, valve, fitting or joint

3.20
maintenance free
when no maintenance or service is required on a component in order to retain full functionality of the component during its service life

3.21
service life
span of time during which the component is expected to function, given normal maintenance and operation conditions

4 Basic functional requirements

4.1 Dependency of Manufacturer of pipe elements

The function of a surveillance system with similar measuring elements shall be independent of any Manufacturer of pipe elements and of any Manufacturer of joints for pipe systems.

4.2 Performance

The surveillance system shall be able to perform:

— detection of moisture;

— detection of deviations;

— detection of multiple deviations;

— detection of disorders;

— location of moisture;

— location of disorders.

NOTE The measuring system and type of technology used can vary provided the performance requirements listed can be achieved.

5 Manufacture of measuring elements

5.1 General requirements

Measuring elements shall be part of a surveillance system that fulfils the basic functional requirements given in Clause 4.

5.2 Installation, assembly and operation

Measuring elements shall be suitable for installation, assembly and operating conditions with respect to thermal, mechanical and chemical conditions in pipe systems.

5.3 Characteristics

Measuring elements of a specific surveillance system shall have uniform system characteristics.

5.4 Reliability

Measuring elements shall have at least the same service life as a pipe system.

5.5 Maintenance

Measuring elements and other parts of the surveillance system for installation in the ground shall be maintenance free.

5.6 Longitudinal tightness

Measuring elements shall not influence the longitudinal water tightness of the pipe insulation negatively.

5.7 Marking of measuring elements

If the measuring elements are marked to indicate different functions, the marking shall be durable under normal operating conditions for pipe systems during the service life of the system.

5.8 Technical documentation

5.8.1 General

The following documents shall be available on request:

5.8.2 For installation of measuring wires within pipe elements

— Documents given in Annex C, Table C.1 positions No 1-6.

5.8.3 For assembly of measuring elements in the field

— Documents given in Annex C, Table C.2 positions No 1-7.

5.8.4 For operation of a surveillance system

— Documents given in Annex C, Table C.3 positions No 1-3.

6 Manufacture of pipe elements with measuring elements

6.1 General requirements

Measuring elements to be installed within pipe elements shall fulfil all the requirements given in Clause 5.

6.2 Compatibility test

6.2.1 Before series production

Before series production of pipe element with measuring elements a compatibility test shall be made in order to ensure that system characteristics made available by the Manufacturer of measuring elements (cf. 5.8.2) are fulfilled during the production.

6.2.2 Test procedure

The Manufacturer of pipe elements shall develop and describe a test procedure that fulfils the requirements relevant for the specific surveillance system.

6.2.3 Replication of test

The compatibility test shall be replicated every time the production process is changed or the type of measuring element is changed.

6.3 Installation of measuring elements

6.3.1 Restrictions regarding type of measuring element

Only measuring wires shall be installed in pipe elements.

6.3.2 No electrical contact

The installation of measuring wires within pipe elements shall ensure that no electrical contact occurs between individual conductors of the measuring wires between conductors and any service pipe or between conductors and any electrical conductive diffusion barrier.

NOTE The definition of electrical contact is given in Annex E.

6.3.3 Connections

Connections of measuring wires shall not be located in pipe elements.

Connection of measuring wires inside T-fittings can be accepted. The position of the connection shall be properly registered in the documentation material given in 6.8.

6.3.4 Geometry of installation

Measuring wires shall be installed inside the pipe elements in accordance with the technical documentation made available by the Manufacturer of the measuring element, cf. 5.8.2.

NOTE The distance between measuring wire and the service pipe should be minimum 10 mm.

6.3.5 Spacers

In order to prevent the measuring wires being damaged during pipe element manufacturing according to EN 253, spacers used for positioning of the measuring wires inside the pipe elements shall be constructed and applied in such a way that the measuring wires are easily movable lengthwise before the manufacturing starts.

NOTE Pipe elements may be produced without spacers.

6.3.6 Mechanical tightening

If required before pipe element manufacturing, mechanical tightening of the measuring wire shall be performed within the limitations given in the technical documentation made available by the Manufacturer of measuring element, cf. 5.8.2.

6.4 After pipe element manufacturing

All pipe elements shall fulfil the tests according to 6.6.

6.5 Measuring wires at free ends

6.5.1 Wire length

Measuring wires led out at the free foam ends of pipe elements shall exceed the length of the service pipe with minimum 20 mm.

6.5.2 Protection of measuring wires

Measuring wires led out at the free foam ends of pipe elements shall be protected against damages during transport and handling.

NOTE The wires may be fixed to the foam.

6.6 Tests

6.6.1 General

The following tests in 6.6.2 and 6.6.3 are acceptance tests for manufacturing of pipe elements with measuring element. Alternative tests may be used during production of the pipe element.

6.6.2 Continuity of measuring wire

Test of continuity of measuring wires shall be performed by a loop test according to Annex D.

6.6.3 No electrical contact

Test for no electrical contact (cf. 6.3.2) shall be made by measuring of the electrical insulation resistance by a high voltage test. Method and criteria for passing of test are given in Annex E.

6.7 Quality control programme

Activities in accordance with Annex F, F.2 should be incorporated in the quality control programme of the Manufacturer.

6.8 Technical documentation

6.8.1 General

The following documents shall be available on request:

6.8.2 For assembly of measuring elements in the field

— Documents made available by the Manufacturer of measuring element, cf. 5.8.3.

— Documents given in Annex C, Table C.2 position No 8.

6.8.3 For operation of a surveillance system

— Documents made available by the Manufacturer of measuring element, cf. 5.8.4.

— Documents given in Annex C, Table C.3 positions No 3.

7 Assembly of measuring elements in field

7.1 Check upon receipt of pipe elements

A quality check should be made upon receipt of pipe elements. The following activities should be included:

— check for continuity of measuring wire by a loop resistance test according to Annex G;

— check for no electrical contact by measuring of the electrical insulation resistance according to Annex H;

— visual check of wiring ends for damages.

7.2 Extension of an existing measuring section

7.2.1 Actual state

Before extending or renovating an existing measuring section, the actual state shall be measured and documented by measurements similar to the tests described in Annex G and Annex H.

NOTE 1 The measurements are important for the delimitation between the existing and the extended system.

NOTE 2 Special attention should be made when pipe elements with diffusion barrier or twin pipes is mixed with pipe elements without diffusion barrier and twin pipes.

7.2.2 Change of system

In the case of a change in characteristics of the surveillance system a connection point shall be established in order to perform separate measurement.

7.3 Wiring design diagram

A wiring design diagram shall be available before the assembly work can take place.

7.4 Assembly work in joints

Connections and installation of measuring elements in joints shall be made in accordance with the instructions and specifications made available by the Manufacturer of measuring element, cf. 5.8.3.

Ordinary electrical wire or any other kind of unauthorised wire is not allowed to form part of the assembly. All wires to be installed must be designated by the manufacturer of the measuring elements.

7.5 Assembly check

Checks specific to the respective surveillance system shall be carried out continuously during the assembly work.

NOTE Description and specification for the different checks and the required equipment to be used are made available by the Manufacturer of measuring element, cf. 5.8.3.

7.6 Test after finishing a measuring section

7.6.1 General

After finishing each measuring section including foaming of joints it is important to check the finished assembly work. For proper operation of the surveillance system it is also important to check for moisture in the joints or other irregularities that occurred during the joint assembly. The following test shall be carried out:

7.6.2 Continuity of measuring elements

Test of continuity of measuring elements with connections in the whole measuring section shall be performed by a loop test according to Annex G.

7.6.3 No electrical contact and moisture

The electrical insulation resistance shall be measured for the whole measuring section according to Annex H. There shall be no electrical contact and no moisture shall be present.

7.6.4 Functional test

A functional test specific to the installed measuring system shall be carried out by fault simulation according to the technical documentation made available by the Manufacturer of measuring elements, cf. 5.8.3.

7.7 Test and measurement during system operation

After approximately 4 weeks of operation, the following test and measurements should be carried out:

— loop test, cf. 7.6.2;

— measuring of the electrical insulation resistance, cf. 7.6.3;

— functional test, cf. 7.6.4.

The measuring of the electrical insulation resistance shall be documented for later monitoring purposes.

Contractor and Operator shall agree upon the exact time of operation before the abovementioned measurements are carried out.

7.8 Quality control programme

Activities in accordance with Annex F, F.3 should be incorporated in the quality control programme of the Contractor.

7.9 Technical documentation

The following documents shall be available for operation of a surveillance system:

— documents made available by the Manufacturer of measuring element, cf. 5.8.4;

— documents made available by the Manufacturer of pipe element, cf. 6.8.3;

— documents given in Annex C, Table C.3 positions No 4-5.

Annex A
(informative)

Principal function

All requirements and recommendations described in this standard are based on the experience gained with existing surveillance systems and their principal function. The following assumptions therefore have formed the basis for the structure and the wording of the standard:

— the surveillance system is based on an electrical function;

— the moisture-related parameters used by the surveillance system for detection and location are based on electrical resistance or electrical impedance;

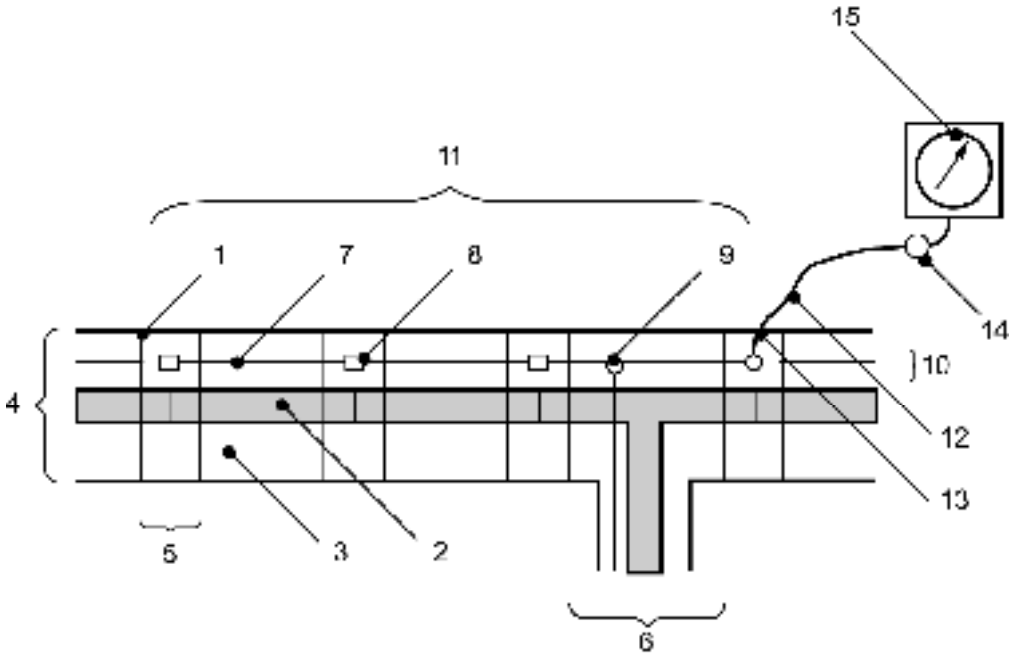
— the surveillance system is based on a solution with measuring wires and possibly combined with special measuring sensors at selected spots;

— measuring of the moisture-related parameters can take place between measuring wires and service pipe, or between two conductors in connection with a measuring sensor.

Other types of parameters or basic function can be relevant in the future but found outside the range of this standard as it is construed today. Revision of the standard shall then be considered in order to fulfil the objectives of the standard.

Annex B
(informative)

Principal parts of a measuring section



Key

1 HDPE casing
2 Service pipe
3 PUR insulation foam
4 Preinsulated bonded pipe
5 Field joint assembly
6 T-fitting
7 Measuring wire
8 Measuring sensor
9 Connection of measuring element
10 Measuring element
11 Measuring section
12 Connection cable
13 Cable outlet
14 Connection point
15 Measuring instrument

Figure B.1 — Principal parts of a measuring section

Annex C
(normative)

Technical documentation

NOTE The different positions in the Tables are normative according to the text in the clauses in the standard, but the specific list of text for each position given in the Annex depends on the surveillance system and is therefore only informative.

Table C.1 — Necessary for installation of measuring wires within pipe elements

No.	Item
1	Material a) Data for: 1) type of material and quality 2) tensile limit 3) system characteristics
2	Geometry — Data for dimension of conductors
3	Geometry of installation — Drawing showing the allowable positions of the measuring wires in pipe elements depending on pipe dimension
4	Temperature durability — Data for maximum allowable temperature during pipe element manufacturing
5	Handling — Specification of special requirements for handling of measuring wire before installation — Specification of treatment of free wire ends after pipe element manufacturing
6	Mechanical tightening — Data for allowable tightening force during pipe element manufacturing

Table C.2 — Necessary for assembly of measuring elements in the field

No.	Item
1	Measuring sections — Schematic drawing of a measuring section
2	Measuring elements a) Description of measuring sensors regarding: 1) geometry of installation 2) temperature durability 3) handling
3	Connections — Specification of assembly instruction — Description for required assembly tools
4	Connection cable — Specification for connection of a measuring section to a connection point including cable outlet
5	Assembly check — Specification of necessary assembly check — Description for equipment required for the check
6	Functional test of a measuring section — Description for equipment required for the test — Specification of a fault simulation test — Data for acceptable test values
7	Electrical insulation resistance test — Guidelines for the procedure — Wiring diagram

Table C.2 *(continued)*

No.	Item
8	Data for pipe elements — Data specific for pipe elements of different dimension and type — Drawings for different dimension and type — Wiring diagram for fittings — Dimensional drawing for fittings (length)

Table C.3 — Necessary for operation of a surveillance system

No.	Item
1	Function a) Description of surveillance principle for: - 1) detection of moisture, deviations, multiple deviations and disorders 2) location of moisture and disorders b) System specifications for:- 1) range of surveillance 2) maximum extent of a measuring section 3) sensitivity in detection of deviations 4) precision in location of moisture and disorders (e.g. in percent of the total length of a measuring section or in absolute figures) 5) acceptance values for electrical insulation resistance
2	User's manual a) Description of procedure for: - 1) normal operation in surveillance mode 2) handling of alarms etc. 3) detection of moisture, deviations, multiple deviations and disorders 4) location of moisture and disorders

Table C.3 *(continued)*

No.	Item
3	Data for pipe elements — Data specific for pipe elements of different dimension and type — Drawings for different dimension and type — Wiring diagram for fittings and valves — Dimensional drawing for fittings and valves (length of wire)
4	Wiring design diagrams for each measuring section — Drawing with legend — Loop plans including all measuring elements, all connected branches and their respective destination — Drawing showing the location of connection points, etc. — Data giving the comparison of mechanical length and measured electrical length for location of moisture and disorder
5	Test result — Log report of test after finishing a measuring section, cf. 7.6 — Log report of test and measurements during system operation, cf. 7.7.

Annex D
(normative)

Loop test by pipe Manufacturer

D.1 General

The loop test is performed as an electrical measurement.

All measuring elements shall be connected in series.

NOTE If the need should arise an auxiliary wire can achieved this.

The test equipment used shall meet the following parameters:

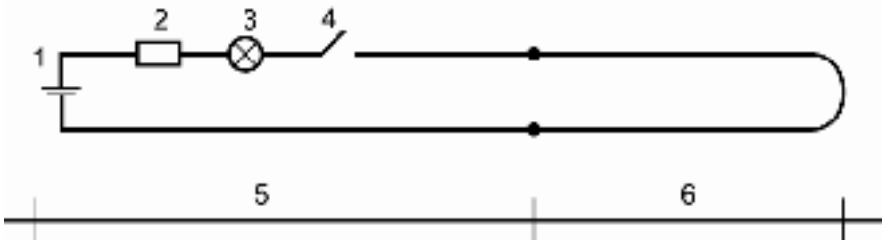
— test voltage ≤ 24 V D.C.;

— short-circuit current < 100 mA.

One of the following measuring methods can be used.

D.2 Conductor continuity test with an optical or acoustic signal.

Principal diagram of the test set up is given in Figure D.1.



Key

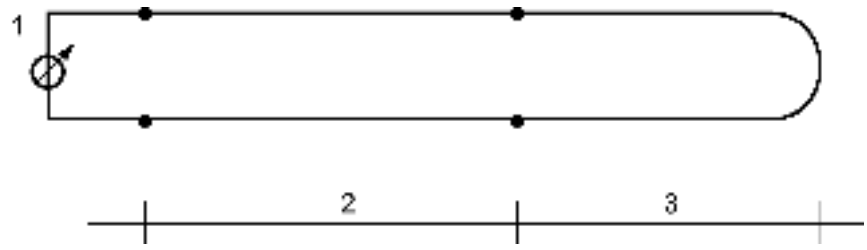
1 DC power supply
2 Resistor
3 Optical or acoustic indicator
4 Switch
5 Test equipment
6 Measuring elements

Figure D.1 — Test set up for conductor continuity test

The exact parameters of the test equipment shall be set according to the system characteristics made available by the Manufacturer of measuring element, cf. 5.8.2.

D.3 Measuring ohmic resistance

Principal diagram of the test set up is given in Figure D.2.



Key

1 Resistance measuring device

2 Connection cable

3 Measuring elements

Figure D.2 — Test set up for ohmic resistance measuring

The measured ohmic resistance shall fall within the system characteristics made available by the Manufacturer of measuring element, cf. 5.8.2.

Annex E
(normative)

High voltage test by pipe Manufacturer

The test is used for measuring of the electrical insulation resistance.

The loop test (cf. Annex D) must be passed before the execution of the following test takes place.

The measuring device used for the test shall comply with EN 61557-2.

Measuring of the electrical insulation resistance shall be performed with a voltage of 1 000 V D.C. for a period of 1 min. If the measured electrical insulation resistance is higher than 500 MΩ it is confirmed that no electrical contact has occurred.

Measurements shall be made conductor to conductor or conductor(s) to any service pipe as well as conductor(s) to any electrical conductive diffusion barrier.

It is permissible to use an alternative test, provided that it is shown that the alternative test gives results as least equivalent to the result achieved by the specified test.

NOTE The described test is only permissible for check of single pipe elements. The test of pipe sections or measuring sections is described in Annex H.

Annex F
(informative)

Quality control programme

F.1 General

In order to achieve the desired quality and to document that the requirements listed in the standard are fulfilled the quality control programme of the relevant party should as a minimum include the following items listed in the Tables below.

Use of EN ISO 9001, *Quality management systems – Requirements (ISO 9001:2008)*, will assure a proper inspection and documentation level.

F.2 Quality control programme for Manufacturer of pipe elements with measuring wires

Table F.1 — Compatibility test

Clause	Activity
6.2.1	Evaluation of result of compatibility test
6.2.2	Check of developed test procedure

Table F.2 — For the installation process of measuring wires within pipe elements

Clause	Activity
6.3.4	Check of geometry
6.3.5	Where relevant check of mobility of wire in spacers
6.3.6	Where relevant check of the mechanical tightening force
None	If the measuring wires are tightened mechanically, the equipment used should be checked regularly regarding to the system conformity

Table F.3 — During pipe element manufacturing

Clause	Activity
None	Where relevant, check the linear expansion of wire due to a rise in temperature
None	Where relevant, check mobility of wire

Table F.4 — After pipe element manufacturing

Clause	Activity
6.6.2	Evaluation of result of loop test
6.6.3	Evaluation of result of high voltage test

Table F.5 — By shipment of pipe elements

Clause	Activity
6.5.2	Check protection of measuring wires at free end
6.8	Check technical documentation according to procurement documents

F.3 Quality control programme for Contractor assembling the measuring elements in field

Table F.6 — Upon receipt of pipe elements

Clause	Activity
7.1	Check for continuity of measuring wires
7.1	Check for no electrical contact
7.1	Visual check of wiring ends

Table F.7 — During assembly of measuring elements in the field

Clause	Activity
7.5	Continuous check of assembly work

Table F.8 — After finishing a measuring section

Clause	Activity
7.6.2	Evaluation of result of loop test
7.6.3	Evaluation of result of measurement of the electrical insulation resistance
7.6.4	Evaluation of result of functional test

Table F.9 — During system operation

Clause	Activity
7.7	Evaluation of result of loop test
7.7	Evaluation of result of measurement of the electrical insulation resistance
7.7	Evaluation of result of functional test

Annex G
(normative)

Loop test in field

The loop test is performed as an electrical measurement.

The test is used for checking single pipe elements or a whole measuring section.

When checking a whole measuring section all measuring elements shall be connected according to the wiring plan.

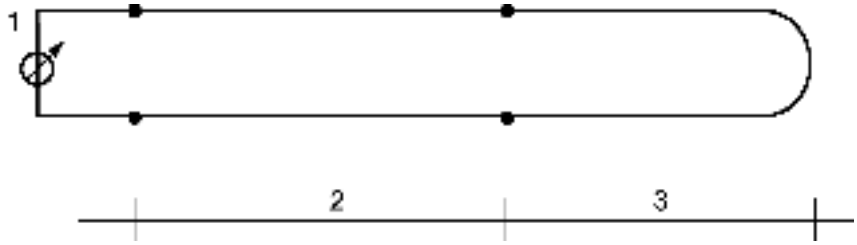
The test equipment used shall meet the following parameters:

— test voltage ≤ 24 V D.C.;

— short-circuit current < 100 mA.

The ohmic resistance shall be measured.

Principal diagram of the test set up is given in Figure G.1:



Key

1 Resistance measuring device

2 Connection cable

3 Measuring elements

Figure G.1 — Test set up for ohmic resistance measuring test in field

The measured ohmic resistance shall fall within the system characteristics made available by the Manufacturer of measuring element, cf. 5.8.2.

It is permissible to use an alternative test, provided that it is shown that the alternative test gives results at least equivalent to the result achieved by the specified test.

Annex H
(normative)

Measuring of the electrical insulation resistance in field

The loop test (cf. Annex G) shall be passed before the execution of the following measurements takes place.

The measurements are used to check for no electrical contact and for no moisture in a measuring section and to form basis for the later monitoring of a pipe system.

The measuring device used for the test is given by the individual system.

Measuring of the electrical insulation resistance shall be performed with a voltage equal to or less than 24 V D.C. The measured electrical insulation resistance shall fall within the acceptance values made available by the Manufacturer of measuring element, cf. 5.8.4.

Measurements shall be made conductor to conductor as well as conductor(s) to service pipe.

It is permissible to use an alternative test, provided that it is shown that the alternative test gives results at least equivalent to the result achieved by the specified test.

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