SLOVENSKI STANDARD

SIST EN 253:2000

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Preinsulated bonded pipe systems for underground hot water networks - Pipe assembly of steel service pipes, polyurethane thermal insulation and outer casing of polyethylene

Preinsulated bonded pipe systems for underground hot water networks - Pipe assembly of steel service pipes, polyurethane thermal insulation and outer casing of polyethylene

Werksmäßig gedämmte Verbundmantelrohrsysteme für erdverlegte Fernwärmenetze - Verbund-Rohrsystem bestehend aus Stahl-Mediumrohr, Polyurethan-Wärmedämmung und Außenmantel aus Polyethylen

Systemes bloqués de tuyaux préisolés pour les réseaux enterrés d'eau chaude - Tuyau préisolé - Tube de service en acier - Isolation thermique en polyuréthane et protection en polyéthylene

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

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Foreword

This European Standard supersedes EN 253:1988 and was drawn up by the Technical Committee CEN/TC 107 »Prefabricated district heating pipe systems« the secretariat of which is held by the Danish Standards Association.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 1995, and conflicting national standards shall be withdrawn at the latest by April 1995.

The main areas of the revision are:

1. The requirements for the PE quality have been updated.
2. Any reference to CFC has been deleted and alternative blowing agents have been taken into consideration.

This specification is part of the standards for bonded systems using polyurethane foam thermal insulation applied by injecting (pouring), to bond to a steel service pipe and a polyethylene casing pipe.

The other standards from TC 107 are:

EN 448:1994 - Fittings
EN 488:1994 - Valves
EN 489:1994 - Joints

In compiling this document TC 107 has made use of results of research carried out by system manufacturers, raw material suppliers, users, universities and research institutes.

In accordance with the CEN/CENELEC Common Rules, the following CEN members are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies requirements and test methods for straight lengths of prefabricated thermally insulated pipe-in-pipe assemblies for underground hot water networks, comprising a steel service pipe from DN 20 to DN 600, rigid polyurethane foam insulation and an outer casing of polyethylene. However, the quality requirements can be applied for larger dimensions.

This standard applies only to injected (poured) insulated pipe assemblies, for continuous operation with hot water at various temperatures up to 120°C and occasionally with a peak temperature up to 140°C.
The estimation of expected life with continuous operation at various temperatures is outlined in Annex B.

2 Normative references

This European Standard 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 European Standard only when incorporated in it by amendment or revision.
For the undated references, the latest edition of the publication referred to applies.

ISO 844:1978,	Cellular plastics – Compression test of rigid materials
ISO 845:1988,	Cellular plastics and rubbers – Determination of apparent (bulk) density
ISO 1133:1991,	Plastics – Determination of the melt flow rate of thermoplastics
ISO 1167:1973,	Plastics pipes for the transport of fluids – Determination of the resistance to internal pressure
ISO 1183:1987,	Plastics – Methods for determining the density and relative density of non-cellular plastics
ISO 2506:1981,	Polyethylene pipes (PE) – Longitudinal reversion – Test methods and specification
ISO 3126:1974,	Plastics pipes – Measurement of dimensions
ISO 3127:1980,	Unplasticized polyvinyl chloride (PVC) pipes for the transport of fluids. Determination and specification of resistance to external blows
ISO 4200:1985,	Plain end steel tubes, welded end seamless – General tables of dimensions and masses per unit length
ISO 4590:1981,	Cellular plastics – Determination of volume percentage of open and closed cells of rigid materials
ISO 6761:1981,	Steel tubes – Preparation of ends of tubes and fittings for welding
ISO 8501-1:1988,	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 9329-1:1989[1)],	Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1: Unalloyed steels with specified room temperature properties
ISO 9330-1:1990[1)],	Welded steel tubes for pressure purposes – Technical delivery conditions – Part 1: Unalloyed steel tubes with specified room temperature properties
ISO/TR 10 837:1991,	Determination of the thermal stability of polyethylene (PE) for use in gas pipes fittings
ISO/CD 1872-2,	Plastics – Polyethylene (PE) thermoplastics – Part 2: Preparation of test specimens and determination of properties – Revision of ISO 1872-2:1989
ISO/DIS 3607,	Polyethylene (PE) pipes – Tolerances on outside diameters and wall thickness – Revision of ISO 3607 - 1977
ISO/DIS 8497[2)]	Thermal insulation – Determination of steady-state thermal transmission properties – Pipe insulation apparatus

[1)] Equivalent national standards may be used.

[2)] ISO/DIS 8497 has been for voting (April 1988). Until ISO 8497 is published, any equivalent national standard can be used.

3 Definitions

For the purpose of this standard the following definitions apply:

3.1 **ageing:** carried out by keeping the service pipe at a certain, elevated temperature for a certain time while the casing pipe is exposed to room temperature.

3.2 **bonded system:** a system consisting of a service pipe, insulating material and a casing pipe which are bonded by the insulating material.

3.3 **casing pipe:** a pipe protecting the insulation and the service pipe from ground water, moisture and mechanical damage.

3.4 **continuous temperature:** the temperature at which the hot water network is designed to operate continuously.

3.5 **core density:** the apparent density of the foam in the central part of the insulating layer.

3.6 **density:** the mass of a body of a material divided by the volume of the body.

3.7 **density of PE-raw material:** is determined in accordance with ISO 1183 method A or D on the extruded material from the melt flow rate measurement.

3.8 **centre line deviation:** the deviation between the centre line of the service pipe and the centre line of the casing pipe.

3.9 **high density Polyethylene (PE-HD):** polyethylene with a density from the upper end of the range of densities available.

3.10 **injected (poured) pipe assemblies:** those pipe assemblies in which the PUR foam has been injected or poured into the space between the service pipe and the casing pipe.

3.11 **insulation material:** a material which reduces the heat loss.

3.12 **MDI-index, (Polymeric Methylendiphenyl Diisocyanate-Index):** the quotient of the actual amount of isocyanate used and the stoichiometrically required amount, multiplied by 100.

3.13 **melt flow rate – MFR 190/5:** is defined in ISO 1133 (condition 18).

3.14 **overall density:** the mass of all PUR foam in the space betwen service and casing pipe divided by the volume of this annular space.

3.15 **peak temperature:** the highest temperature at which a system is designed to operate occasionally – see Annex B.

3.16 **pipe assembly:** the assembled product, consisting of a service pipe, insulating material and a casing pipe.

3.17 **polyurethane rigid foam (PUR):** is produced by the chemical reaction of polyisocyanates with hydroxyl containing compounds in the presence of catalysts, the foaming being assisted by a blowing agent. These foams have a mainly closed cell structure.

3.18 **room temperature:** defined as 23 ± 2°C.

3.19 **service pipe:** the steel pipe that contains the water.

3.20 **shear strength:** the ability of the pipe assembly to withstand a shear force acting between the casing and the service pipe.

4 Requirements

Unless otherwise specified, the requirements shall be valid for each single measurement.

4.1 Steel service pipe

A length of pipe shall not include a circular joint.

4.1.1 Quality

The steel service pipe shall be either welded pipe with a quality as stated in ISO 9330-1 [1] or seamless pipe with a quality as stated in ISO 9329-1 [1]. Steel grade TW 320 shall not be used for nominal diameters above 100 mm. Grade numbers 360 and 500 should be preferred.

4.1.2 Diameter

The diameter shall be in accordance with Table 1 which is derived from ISO 4200.

4.1.3 Wall thickness

The nominal wall thickness shall be in accordance with ISO 4200 with a minimum as indicated in Table 1. Tolerances and weights shall be in accordance with ISO 4200.

Subject to design considerations other wall thicknesses may be used, but in no case shall these be less than the minima indicated in Table 1.

Tabel 1: Steel service pipe dimensions

Nominal diameter DN	Outside diameter, d mm	Minimum nominal wall thickness, t mm
20	26,9	2,0
25	33,7	2,3
32	42,4	2,6
40	48,3	2,6
50	60,3	2,9
65	76,1	2,9
80	88,9	3,2
100	114,3	3,6
125	139,7	3,6
150	168,3	4,0
200	219,1	4,5
250	273,0	5,0
300	323,9	5,6
350	355,6	5,6
400	406,4	6,3
450	457,0	6,3
500	508,0	6,3
600	610,0	7,1

4.1.4 Surface condition

Prior to insulation, the outer surface of the pipe shall be cleaned so that it is free from rust, mill scale, oil, grease, dust, paint, moisture and other contaminants.

Before cleaning the pipe, the outer surface of the pipe shall comply with rust grade A, B or C of ISO 8501-1, without pitting.

[1] Equivalent national standards may be used.

4.2 Casing pipe

4.2.1 Material properties

4.2.1.1 Density and composition

When tested in accordance with 5.2.1 the base material from which the casing pipe is produced shall be PE of a density not less than 935 kg/m³ to which shall be added only those anti-oxidants, UV stabilizers and carbon black, necessary for the manufacture and end use of pipes to this specification.

The carbon black added shall comply to the following specifications:

- density: 1500 - 2000 kg/m³
- toluene extract: ⩽ 0,1% by mass
- average particle size: 0,01µm to 0,025µm

The pipe material shall be black coloured PE with a carbon black content of 2,5 ± 0,5 % by mass and of a density not less than 944 kg/m³.

4.2.1.2 Melt flow rate

To facilitate welding, the manufacturer shall quote the MFR of the PE pipe, determined in accordance with ISO 1133, condition 18. The melt flow rate of pipes to be welded shall not differ more than 0,5 g/10 min.

4.2.1.3 Thermal stability

The induction time of the pipe material shall be at least 20 min. when tested at 200 °C according to ISO/TR 10837.

4.2.1.4 Long term mechanical properties, raw material

The raw material to be used for the production of casing pipes shall meet the requirements of table 2 when tested with internal pressure in accordance with 5.2.5.

A brittle failure is conclusive.

If a sample on the 165 h test fails in less than 165 h and the failure mode is ductile, then a retest shall be performed, using the 1000 h parameters.

Table 2: Long term mechanical properties

Circumferential stress MPa	Minimum time to bursting h	Test temperature °C
4,6	165	80
4,0	1000	80

4.2.1.5 Use of rework material

The use of rework material shall be limited to 15% by weight.

Only clean rework-material, generated from the manufacturer's own production of pipes, shall be used.

4.2.2 Casing Properties

4.2.2.1 Nominal outside diameter

Prior to foaming, the nominal outside diameter, d_e, of the casing pipe should be selected from Table 3.

4.2.2.2 Wall thickness

Prior to foaming, the minimum wall thickness, e_{min}, of the casing pipe shall be in accordance with Table 3.

Table 3: Casing pipe dimensions

Diameter group	Nominal outside diameter, D mm	Minimum wall thickness, $e_{min.}$ mm
1	75	2,2
	90	2,2
	110	2,5
	125	2,5
	140	3,0
	160	3,0
	180	3,0
	200	3,2
2	225	3,5
	250	3,9
	280	4,4
	315	4,9
	355	5,6
	400	6,3
3	450	7,0
	500	7,8
	560	8,8
	630	9,8
	710	11,1
	800	12,5

4.2.2.3 Tolerances on outside diameter and wall thickness

Prior to foaming the tolerances on outside diameter and wall thickness[3] of the extruded PE pipes shall be as follows: (Derived from ISO/DIS 3607).

The permissible variation between the mean outside diameter (D_m) and the nominal outside diameter (D) of a pipe (D_m - D) shall be positive, in the form $^{+\,x}_{0}$, where $0 < x \leqslant 0{,}009 \cdot D$ rounded off to the next higher 0,1 mm.

The permissible variation between the nominal thickness ($e_{nom.} \geqslant e_{min.}$) and a wall thickness at any point (e_i), (e_i - $e_{nom.}$) shall be positive, in the form $^{+\,y}_{0}$, where $y = 0{,}1 \cdot e_{nom.} + 0{,}2$ mm.

The result of this calculation shall be rounded off to the next higher 0,1 mm.

4.2.2.4 Appearance, surface finish, pipe ends

The internal and external surfaces[4] of the casing pipe shall be clean and free from such grooving or other defects that might impair its functional properties (see 5.2.3).

The pipe ends shall be cleanly cut and shall be square within 2,5° with the axis of the pipe.

4.2.2.5 Elongation at break

Before foaming, the elongation at break determinded in accordance with 5.2.7 shall not be less than 350 %.

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[3] The wall thickness at any point, e_i, is the measured wall thickness at that point, rounded off to the next higher 0,05 mm.

[4] Surface treatment to improve the shear strength between the PUR foam and casing pipe is permissible provided that the treated pipe still complies with the specification.