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Thermally insulated fibre-cement piping systems

Systèmes de tuyaux en fibres-ciment isolés thermiquement

Reference number
ISO 9489:1991(E)

Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9489 was prepared by Technical Committee ISO/TC 77, *Products in fibre reinforced cement*.

Annexes A and B form an integral part of this International Standard.

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Thermally insulated fibre-cement piping systems

1 Scope

This International Standard gives specifications for thermally insulated fibre-cement pipes and joints suitable for use in heat transfer systems designed to reduce heat exchange between the media transported and its environment.

The thermal insulation is situated between casing and service pipe and is made of organic or inorganic materials. Prefabrication of insulation or mounting on site is possible.

Media primarily used in such piping systems are water or steam. Other media are possible provided service pipes carrying the media are able to withstand the forces caused by temperature and hydraulic pressure, and are not chemically attacked by the media.

The temperature of the media is limited by the service pipe and the insulation material used.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 160:1980, *Asbestos-cement pressure pipes and joints.*

ISO 390:1977, *Asbestos-cement products — Sampling and inspection.*

ISO 391:1982, *Building and sanitary pipes in asbestos-cement.*

ISO 844:1978, *Cellular plastics — Compression test of rigid materials.*

ISO 845:1988, *Cellular plastics and rubbers — Determination of apparent (bulk) density.*

ISO 881:1980, *Asbestos-cement pipes, joints and fittings for sewerage and drainage.*

ISO 2785:1986, *Directives for selection of asbestos-cement pipes subject to external loads with or without internal pressure.*

ISO 4590:1981, *Cellular plastics — Determination of volume percentage of open and closed cells of rigid materials.*

ISO 8497:—[1], *Thermal insulation — Determination of steady-state thermal transmission properties of thermal insulation for circular pipes.*

ISO 8873:1987, *Cellular plastics, rigid — Spray-applied polyurethane foam for thermal insulation of buildings — Specification.*

ISO 9229:1991, *Thermal insulation — Materials, products and systems — Vocabulary.*

ISO 9251:1987, *Thermal insulation — Heat transfer conditions and properties of materials — Vocabulary.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 9251 and ISO 9229 and the following definitions apply.

3.1 average density of foam: Average over the total thickness of the insulation layer.

1) To be published.

3.2 bonded system: System composed of a service pipe, insulating material and a casing pipe between which a bond exists.

3.3 sliding system: System composed of an insulated jacket pipe in which the service pipe slides unbonded, supported on a bearing-ring or on roller-bearings and surrounded by an air-gap.

3.4 casing-pipe: Pipe that protects the insulation and the service pipe from ground water, moisture and mechanical damage.

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

3.6 core pipe: Pipe that protects the inner surface of the insulation from mechanical damage and moisture. By building an air-gap around the service pipe, the temperature to which the insulation material is exposed is lowered.

3.7 service pipe: Pipe that contains the media.

3.8 shear strength: Measure of the ability of the pipe compound to withstand an axial force acting between the casing and the service pipe.

4 General composition of piping systems and their components

Fibre-cement pipes shall be made from a close and homogeneous mixture consisting principally of a suitable inorganic hydraulic binder[2], fibre and water, excluding any materials which might cause deterioration in pipe quality. Fibre-cement pipes used as transfer pipes may be arranged in various positions and should be suitable for underground and overhead laying. Typical compositions of piping systems are shown in table 1. The choice of a suitable system depends on temperature, pressure, nature of the media and laying conditions. One or more service pipes can be placed in one casing pipe.

Examples for typical compositions of piping systems are shown in figures 1 to 4, where the letters and numbers refer to table 1.

Table 1

No.	Element	A	B	C	D
1	service pipe	FC	St	St	St
2	inner air gap	no	no	yes	yes/no
3	sliding elements	no	no	yes	yes
4	core pipe	no	no	FC	no
5	insulation	PU	PU	PU	MF
6	drainage system	no	no	yes	no
7	outer air gap	no	no	no	yes/no
8	casing pipe	FC	FC	FC	FC
Conditions					
	upper limit of media temperature, °C	80	130	170	300
	maximum service pressure	16 bar	*)	*)	*)
	laying	U, O	U, O	U, O	U, O

PU = polyurethane foam

MF = mineral fibre

FC = fibre-cement pipe

St = steel pipe

U = underground laying

O = overhead laying

*) according to steel-pipe used

2) National standards may specifiy the hydraulic binder to be used.

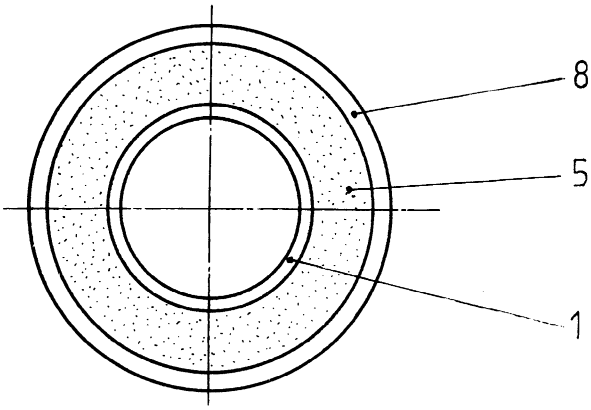

Figure 1 — System A

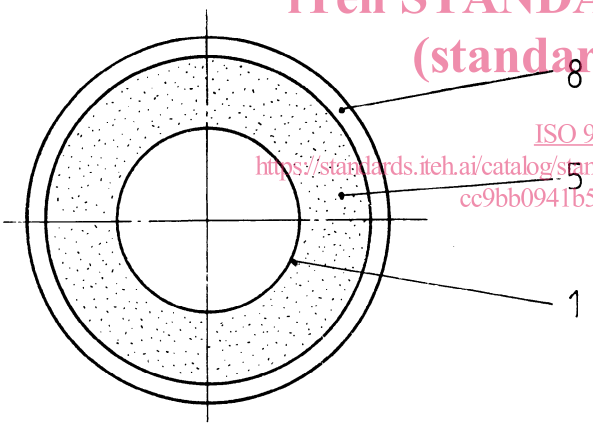

Figure 2 — System B

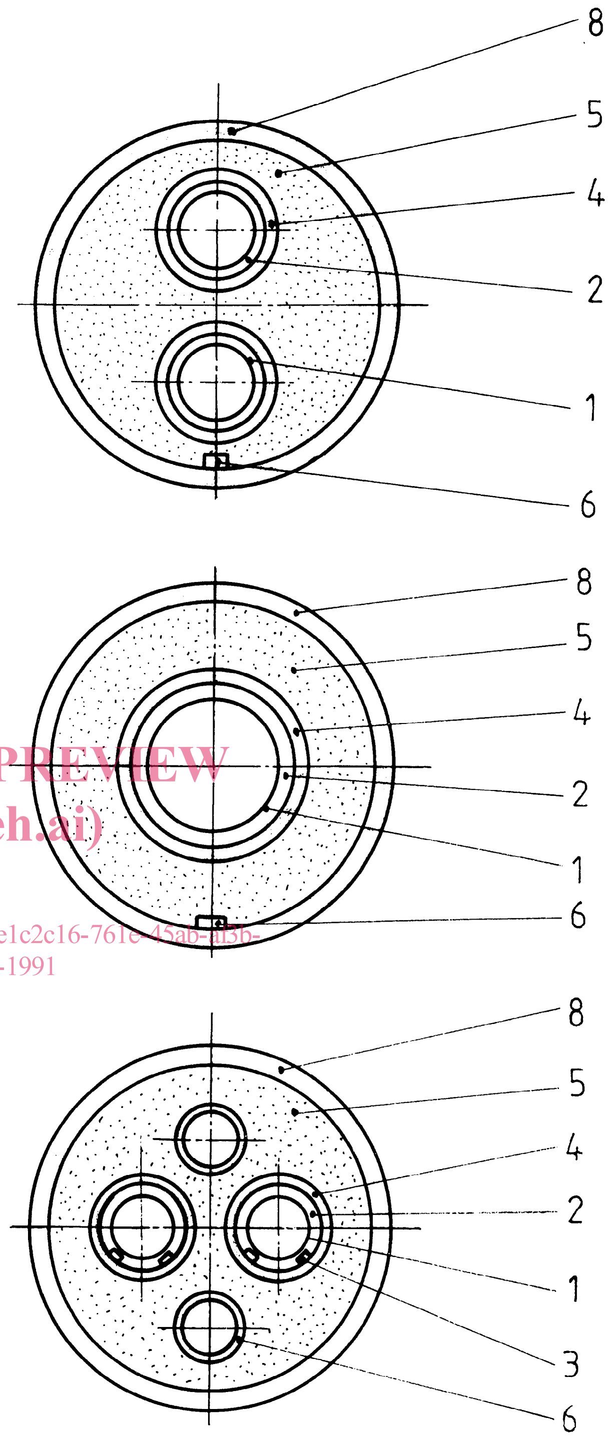

Figure 3 — System C

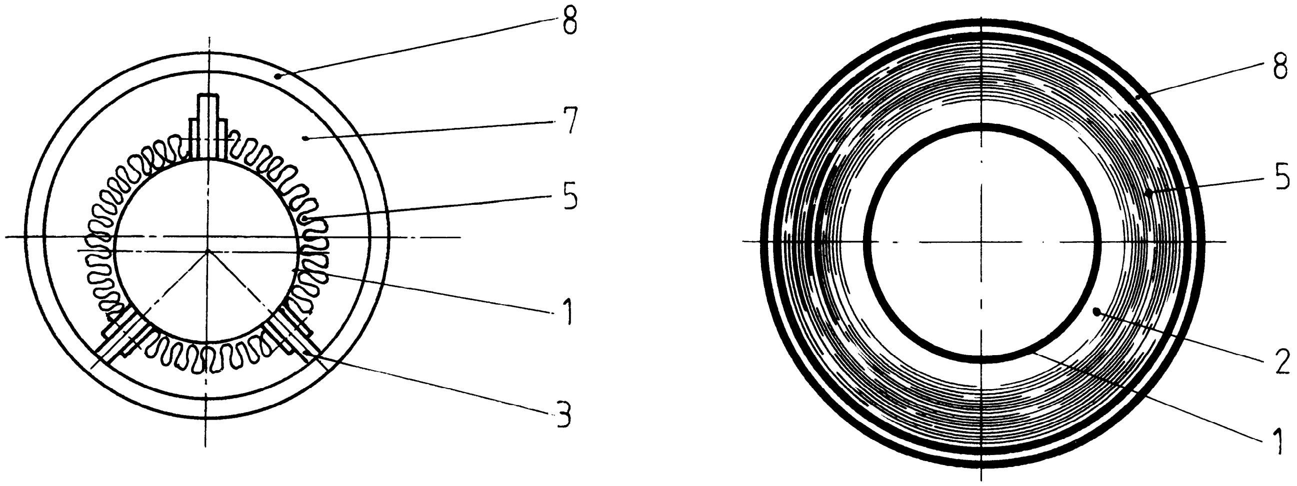

Figure 4 — System D

5 Characteristics and requirements

5.1 Fibre-cement pipes

5.1.1 Service pipes

Service pipes and couplings shall comply with ISO 160 with the following additional requirements:

a) The maximum allowable temperature in sustained service conditions shall be 80 °C. Under certain circumstances, higher temperatures may be permitted.

b) Above 50 °C, stresses due to the difference in temperature between the inside and outside shall be calculated and considered in selecting the dimensions of the pipe walls.

c) The design of the couplings shall by use, for example, ensure an appropriate distance between two successively laid pipes (rubber spacer) in order to account for dilatation movement due to changes in temperature and humidity.

d) The rubber rings shall withstand the design working temperature during the expected lifetime (usually 20 years to 30 years) of the piping system.

e) In closed networks including hot water distribution lines and cold water return lines, in order to avoid dissolution of $CaCO_3$, appropriate measures such as coatings resistant to temperature, or additives to the water, shall be taken.

Measures shall be taken to prevent ingress of water vapour into the insulation.

5.1.2 Casing and core pipes

Casing pipes and couplings shall comply with ISO 881 with the following additional requirements:

a) Calculated in accordance with ISO 2785 with respect to external loads, the safety factor shall be 1,5 if the temperature of the casing pipe is expected to be below 60 °C and 2 if above 60 °C.

b) Rubber rings for couplings shall withstand the expected temperature of the casing pipe during the lifetime of the piping system.

c) As for pressure pipes, precautions shall be taken to prevent alteration of the insulation.

Core pipes shall comply with ISO 881 or ISO 391.

5.2 Insulation

5.2.1 PUR foam

5.2.1.1 Visual criteria

The polyurethane rigid (PUR) foam structure shall consist of regular, fine cells of even colouring. The main diameter of cells in the radial direction shall be less than 0,4 mm on average. Faults in the foam (cavities) should be few and far between and they should not extend in the radial direction over more than two-thirds of the insulation thickness.

5.2.1.2 Core density

Average core density shall be $\geqslant 60\ kg/m^3$. For fittings and systems the construction of which is such that no loads are borne by the foam insulation, the average core density shall be $\geqslant 40\ kg/m^3$.

5.2.1.3 Average density

The average density shall be ⩾ 80 kg/m^3, but only ⩾ 55 kg/m^3 with systems the construction of which is such that no loads are borne by the foam insulation.

5.2.1.4 Compressive stress at 10 % compression

The relevant compression in the radial direction shall be 0,3 N/mm^2: this value applies only to systems in which the loads are borne by the insulation.

5.2.1.5 Shear strength

When tested in the axial direction, the shear strength of the pipe compound, F_{ax}, in newtons, shall be not less than

$$F_{ax} = \tau_{ax} \times l \times D_{St} \times \pi$$

where

τ_{ax} is the maximum shear stress, in megapascals (= 0,12 MPa);

l is the length of specimen in millimetres;

D_{St} is the outside diameter of the service pipe in millimetres.

5.2.1.6 Cell structure

The percentage of closed cells should be not less than 85 %.

5.2.1.7 Thermal conductivity

The thermal conductivity shall be 0,024 W/(m·K) to 0,030 W/(m·K) at an average temperature of 50 °C.

5.2.1.8 Water absorption

The water absorption shall be ⩽ 10 % (V/V).

5.2.2 Sprayed polyurethane foam

The requirements of ISO 8873 shall be met analogously.

6 Test methods

6.1 General

Where test requirements specified in this International Standard differ from those in other Standards referred to, the requirements of this Standard shall apply.

Single components of asbestos-cement pipes shall be tested in accordance with ISO 160 or ISO 881.

6.1.1 Test specimens shall only be taken from the PUR foam of a pipe assembly after it has been stored at room temperature of 20 °C ± 2 °C for not less than 72 h. Deviations from these periods are allowed, for example, for quality control purposes; however, in case of dispute, the required periods shall be observed. Any deviations should be recorded.

6.1.2 Test specimens to establish foam properties and to determine properties of the pipe assembly shall be taken from both ends of the pipe assembly, but in such a way as to exclude at least 500 mm from the end of the injected (poured) foam.

6.1.3 Test specimens may be taken closer to the pipe ends for example for quality control purposes; however, in case of dispute, the result from test specimens taken at least 500 mm but no more than 1 000 mm from the pipe ends shall be decisive.

6.1.4 Where requested, test specimens shall be taken at greater distances from the ends of the pipe in order to establish the uniformity of the foam.

6.1.5 When cutting test specimens from the foam to determine cell structure, core density, compressive strength and water absorption, the foam adjacent to the service pipe surface and casing pipe surface shall be excluded; clearances of at least 5 mm and 3 mm respectively shall be allowed.

6.1.6 At the locations where test specimens are taken to determine cell structure, core density, compressive strength and water absorption, at least three test specimens shall be taken, equally distributed around the circumference.

6.1.7 The outside dimensions of test specimens shall be measured by means of a gauge having a square or circular face area of 100 mm^2 and an applied force of 0,75 N to 1 N.

6.2 PUR foam

6.2.1 Composition

The MDI-index shall be calculated from the manufacturer's production data and be recorded.

6.2.2 Cell structure

6.2.2.1 The size of the cells shall be determined over a length of 10 mm measured in a radial direction with the centre of the 10 mm length coinciding with the nominal centre point of the applied insulation.

The size of the cells shall be the quotient of the test length and the number of cells counted along the radial line of test length selected.