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Thermal insulation — Bonded preformed man-made mineral fibre pipe sections — Specification

Isolation thermique — Isolations de tuyaux en fibres minérales manufacturées préformées encollées — Spécification

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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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8142 was prepared by Technical Committee ISO/TC 163, *Thermal insulation.*

Annexes A and B form an integral part of this International Standard. Annex C is for information only.

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Thermal insulation — Bonded preformed man-made mineral fibre pipe sections — Specification

1 Scope

This International Standard specifies the properties of bonded preformed man-made mineral fibre pipe insulation. It also gives test methods.

NOTES

1 For use at temperatures below ambient, attention is drawn to the need for an adequate water vapour retarder, either factory- or site-applied; this need is not covered by this International Standard.

2 No tests for compressive strength have been included since end results are achieved in service by the insulation system including the outer covering.

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 7345 : 1987, *Thermal insulation — Physical quantities and definitions.*

ISO 8302 : 1989, *Thermal insulation — Determination of steady state areal thermal resistance and related properties — Guarded hot-plate apparatus.*

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

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 7345 and the following definitions apply.

3.1 man-made mineral fibre: Fibre manufactured from glass, rock or other minerals, or from readily melted slags.

3.2 maximum service temperature: Temperature at which the thermal insulation installed at the maximum recommended thickness will continue to perform without degradation of necessary properties or creation of hazards.

3.3 pipe section: Complete cylinder of preformed pipe insulation comprising one or more pieces.

4 Composition and form

4.1 The preformed pipe sections shall be made from man-made mineral fibre manufactured by processing glass, rock or slag from a molten state into a fibrous form and bonded with a suitable binder.

4.2 The bonded fibre shall be formed by the manufacturer into annular sections to fit standard sizes of pipe.

4.3 Each section shall be supplied in a single piece or not more than four pieces.

NOTE — The preformed pipe insulation may be provided either with or without a factory-applied finish, but these finishes are not described in this International Standard.

5 Requirements

5.1 Dimensions

5.1.1 The manufacturer shall declare the nominal length and wall thickness of the product. He shall also declare the nominal external diameter of the pipe for which the section is designated.

NOTE — In some countries it is the practice to designate pipe size by quoting nominal internal diameter instead of external diameter. This is permissible as long as it is made explicit and means of relating internal to external diameter are available.

1) To be published.

5.1.2 These dimensions shall be measured by the method given in annex B and shall be subject to the following tolerances :

a) average length: ± 5 mm on declared nominal length;

b) squareness: The deviation of the ends from 90° shall not exceed 2 % of outside diameter or 4 mm, whichever is the greater;

c) average wall thickness: ± 3 mm or ± 6 % of declared nominal wall thickness, whichever is the greater;

uniformity of wall thickness: The local thickness at any point shall not differ from the mean thickness by more than 3 mm;

d) average inside diameter: $^{+4}_{-1}$ mm or $^{+2}_{-1}$ %, whichever is the greater on declared nominal internal diameter.

NOTE — Where it is intended to nest layers of pipe sections, different tolerances may be needed; the manufacturer's recommendations should be sought.

5.2 Density

The manufacturer shall declare the density of the product. The declared value shall be subject to a tolerance of ± 15 %.

NOTE — This factor is required for design purposes, so that for example, pipe hangers are adequate. It is also required for shipping purposes.

Density shall be determined as the quotient of mass and volume calculated from the nominal dimensions.

The sample shall consist of the number of pieces indicated in annex C.

5.3 Physical properties

Owing to the narrow range of test pipe sizes available in most countries and to the length of time required to perform the following tests, it will rarely be practicable or economic to adopt the requirements of clause 6 and annex C for purposes of conformity control. Therefore "representative product tests" may be performed on appropriate specimens corresponding in composition and density to the material supplied. These tests should be repeated once per year or whenever a significant process or product change occurs to ensure that conformity with the requirements of this specification is maintained.

However, this shall not preclude the use of the conformity control system of annex C for some or all of the following tests if the manufacturer and user agree to do so, for example if a delivered lot is to be tested (Type I testing). In this case the number of specimens for each test shall be as specified in annex C. The test result for each specimen shall be compared with the manufacturer's declared value for that property, and the acceptance criteria of annex C applied.

When representative product tests are used, three specimens shall be tested for each property; the acceptance criteria are specified in 5.3.1 to 5.3.4. These also specify the test procedures to be used for representative product tests and for tests in the conformity control system.

5.3.1 Thermal conductivity

The manufacturer shall declare values of thermal conductivity at a minimum of three mean temperatures covering the useful service temperature range of the product. These values shall be quoted in the form of a graph or table.

To demonstrate compliance in each representative product test, three specimens shall be tested in accordance with ISO 8497 with the specimens mounted tightly on the pipe. The measured average value of the thermal conductivity at each mean temperature shall not exceed the manufacturer's declared value for that mean temperature. Individual values shall not exceed the manufacturer's declared value by more than 15 %. The density of the samples tested shall be included in the test report.

NOTES

1 The guarded hot-plate method of ISO 8302 may be used when the sections supplied have an internal diameter exceeding 500 mm. Flat slabs shall be prepared having the same thickness and density as the sections. If the guarded hot-plate method is used, the fact should be stated clearly in the test report.

2 The thermal conductivity of pipe insulation may be affected by the diameter, thickness and density of the sections tested.

5.3.2 Maximum service temperature

The manufacturer shall declare the maximum service temperature of the product and the maximum thickness that may be used at this temperature.

To demonstrate compliance in each representative product test, when tested in accordance with annex A at the maximum service temperature recommended by the manufacturer and at the maximum thickness recommended for that temperature, each specimen shall satisfy the criteria of clause A.5.

5.3.3 Fire behaviour

It is recommended that fire properties be assessed according to the regulations and codes pertaining to the locality in which the product is to be used.

NOTE — The basic mineral fibres used in moulded preformed pipe sections are inherently non-combustible. Although the organic binder normally used is a combustible component, it is present only as a small percentage by weight.

5.3.4 Corrosive attack

The product shall not include significant quantities of substances which will promote corrosive attack on the surfaces with which it is to be in contact, particularly steel, copper and aluminium.

NOTE — Water-soluble chlorides and other halides are normally present in trace quantities in most commercial thermal insulating

materials. In the presence of moisture and oxygen and in certain service conditions, chloride ions are capable of initiating stress-corrosion cracking in susceptible metal alloys such as austenitic stainless steels.

It is not practicable to indicate a safe upper limit for chloride content since water can leach out soluble chlorides from substantial volumes of insulating materials or from the environment and allow them to be concentrated at the metal-insulation interface.

In conditions potentially conducive to stress-corrosion cracking, appropriate safeguards should be adopted such as coating the pipe with a protective or sacrificial membrane.

6 Sampling and conformity control

Sampling and conformity control procedures are recommended in annex C.

7 Marking

Packages containing pipe insulation complying with this International Standard shall be clearly marked with the following:

a) manufacturer's name, mark or symbol;

b) manufacturer's type designation and maximum service temperature;

c) nominal dimensions (length, thickness of the sections and diameter of the pipe for which it is intended);

d) number of pieces of insulation in the package;

e) reference to this International Standard.

Annex A
(normative)

Test method for determining the maximum service temperature of preformed man-made mineral fibre pipe sections

A.1 Purpose

This test method describes a procedure for determining the performance of preformed man-made mineral fibre pipe sections at the maximum service temperature recommended by the manufacturer and at the maximum thickness recommended at that temperature. The test insulation is installed on a horizontal heated metal pipe using generally accepted application techniques. The test insulation is installed without a factory-applied finish or jacket so that physical characteristics such as wall thickness can readily be checked during the test period.

A.2 Test specimen

The test specimen shall comprise preformed pipe sections of internal diameter to fit the test pipe (see A.3.1). It shall be of the same thickness as, and typical of, the consignment of material being evaluated which may, however, be of different internal diameter. The thickness may be provided in a single layer or by testing two or more layers. The overall length of the specimen, which may comprise more than one section, shall be sufficient to insulate the test pipe. The specimen shall be dry and free from extraneous matter.

If the insulation is supplied already covered by a factory-applied jacket, this shall be removed before installing on the test pipe. No further conditioning is necessary.

A.3 Apparatus

A.3.1 The apparatus is illustrated in figure A.1 and shall consist of a heated test pipe and instrumentation for controlling and measuring the pipe temperature. The pipe shall be uniformly heated by an internal electric heater such as an electrical resistance winding on a separate internal pipe. The length of the pipe shall be not less than 1 m and the outside diameter between 80 mm and 250 mm. The heating system shall be capable of raising the pipe surface to the claimed maximum service temperature and controlling it to within ± 10 °C over the central 60 % of the pipe length.

A.3.2 The recommended number of thermocouples and their associated temperature recording equipment shall be provided and located as shown in figure A.1.

A.4 Procedure

A.4.1 The test specimens shall be fixed on to the pipe by wire ties or bands. If a single layer is used, the longitudinal joint or joints shall lie in a horizontal plane through the axis of the pipe. A circumferential or butt joint shall be provided, if necessary by cutting the sample, and positioned approximately at the centre of the pipe length. If more than one layer is used, the longitudinal joints shall be staggered just above and below the horizontal plane through the axis and the butt joints shall be staggered on either side of the central point. The specimens shall fit tightly on the pipe and all joints shall be closed.

A.4.2 Thermocouples shall be installed on the pipe surface, one for every 0,5 m of overall length with a minimum of three thermocouples; they shall be equally spaced over the central 60 % of the pipe length. All shall be on the top of the pipe.

An equal number of thermocouples shall be located with their junctions midway through the thickness of the insulation (e.g. on the interface between two nested layers of equal thickness). These shall be positioned above the top of the pipe and equally spaced over the central 60 % of the length.

Thermocouple positions are indicated in figure A.1.

A.4.3 The thickness of the insulation installed on the pipe shall be measured at 10 points. Five of these shall be equally spaced along the top surface of the specimen and shall be equally spaced vertically below it. Thickness shall be measured by the pin-probe illustrated in figure A.2. The pin shall be inserted radially through the insulation to contact the pipe surface and the collar shall be held against the insulation surface with light pressure. The insulation thickness at that point is equal to the length of pin protruding beyond the collar and shall be measured to the nearest 1 mm.

A.4.4 The pipe shall be raised to the test temperature at a rate of not less than 100 °C per hour, until it reaches the preselected temperature, and thereafter maintained within 2 % of that temperature for a further period of 72 h.

NOTE — It is advisable to equip the apparatus with an automatic power cut-off to operate when any temperature exceeds a predetermined value.

A.4.5 The test shall be determined 72 h after attaining the test temperature and the system cooled. Then the thickness shall be remeasured and the presence of any gaps in the longitudinal or horizontal joints detected and their width estimated.

A.5 Observations and criteria

To demonstrate that the material conforms to the manufacturer's declared value of maximum service temperature, the following observations shall be made and the criteria applied to each specimen.

A.5.1 The specimen shall not flame during the test.

A.5.2 During the test the temperature of each thermocouple shall be recorded at least every 2 min. The specimen shall not exhibit internal self-heating indicated by the temperature of any mid-thickness thermocouple exceeding that of the pipe surface. See figure A.3 for typical test curves and the interpretation of these.

A.5.3 At the conclusion of the test the width of the longitudinal or circumferential gaps between adjacent pieces of section shall not exceed 5 mm.

A.5.4 The mean specimen thicknesses above and below the pipe, when measured after the test, shall not have changed by more than 5 % compared with the initial measurements. At no point shall the thickness have changed by more than 10 %.

A.5.5 After the final thickness checks have been made, the insulation shall be removed from the pipe and examined visually to establish if the fibrous structure has been impaired. If cavities have formed within the insulation or if the specimen has visibly collapsed then this shall be reported as evidence of fusion.

NOTE — Any organic binder present is likely to have been removed from all parts of the specimen that have exceeded about 250 °C. This in itself does not impair the thermal performance of the product and is not a cause of failure in the test.

A.6 Report

The following information shall be included in the test report:

a) identification of test laboratory;

b) designation and description of the product, including the density;

c) pipe size and thickness tested;

d) maximum service temperature recommended for the product;

e) rate of heating used during the warm-up period;

f) average, maximum and minimum values of pipe surface temperatures after stability has been reached;

g) maximum temperature reached by any mid-thickness thermocouple during the test;

h) average and range of thickness measured before testing:

1) above the pipe,

2) below the pipe;

i) average and range of thicknesses measured after the test:

1) above the pipe,

2) below the pipe;

j) average and maximum change in thickness:

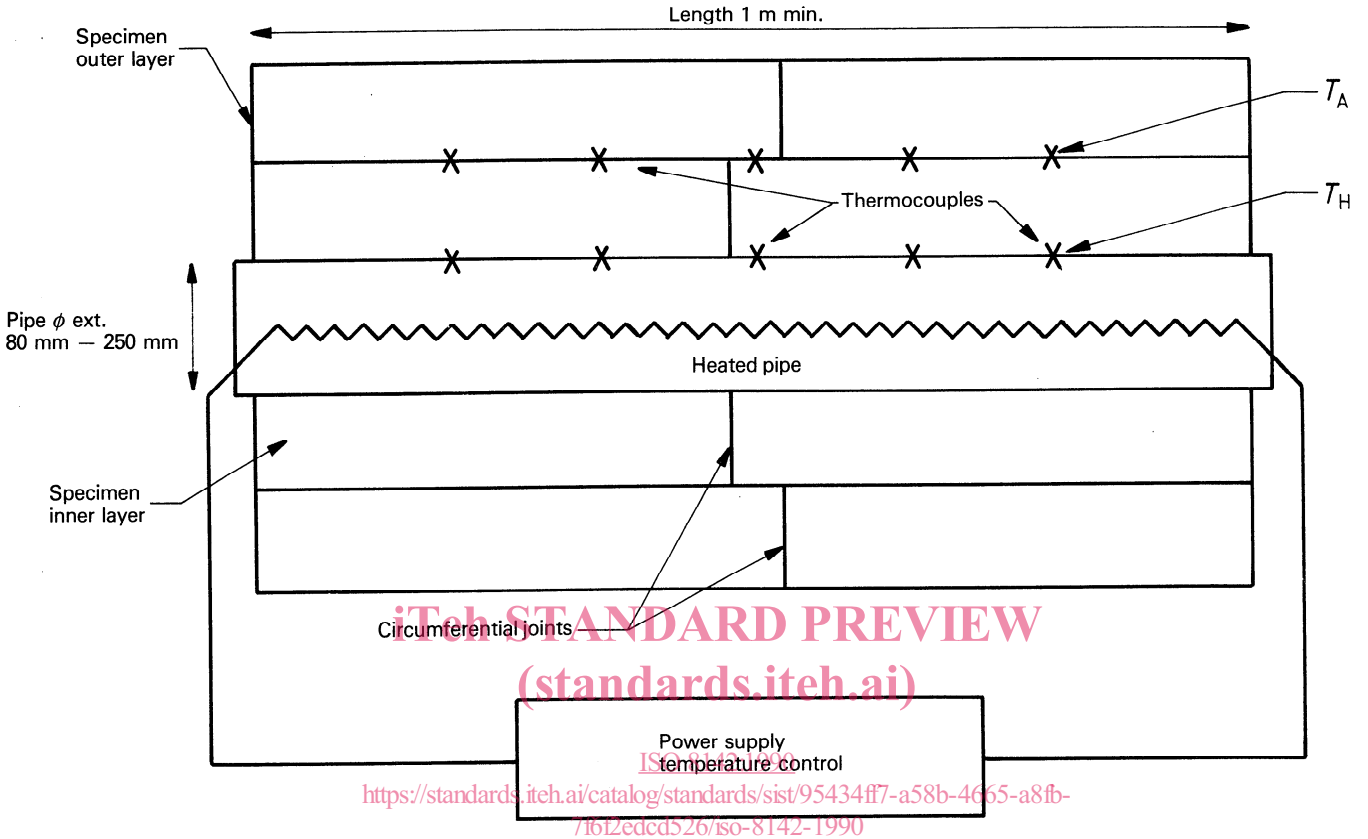
1) above the pipe,

2) below the pipe;

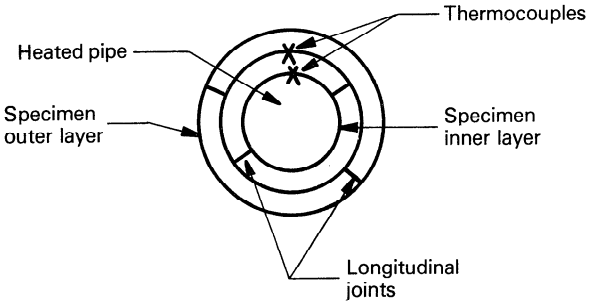
k) the presence after cooling of any gaps in the longitudinal or horizontal joints exceeding 5 mm width;

l) any flaming observed during the test;

m) any evidence of fusion or collapse in the test specimens after the test.



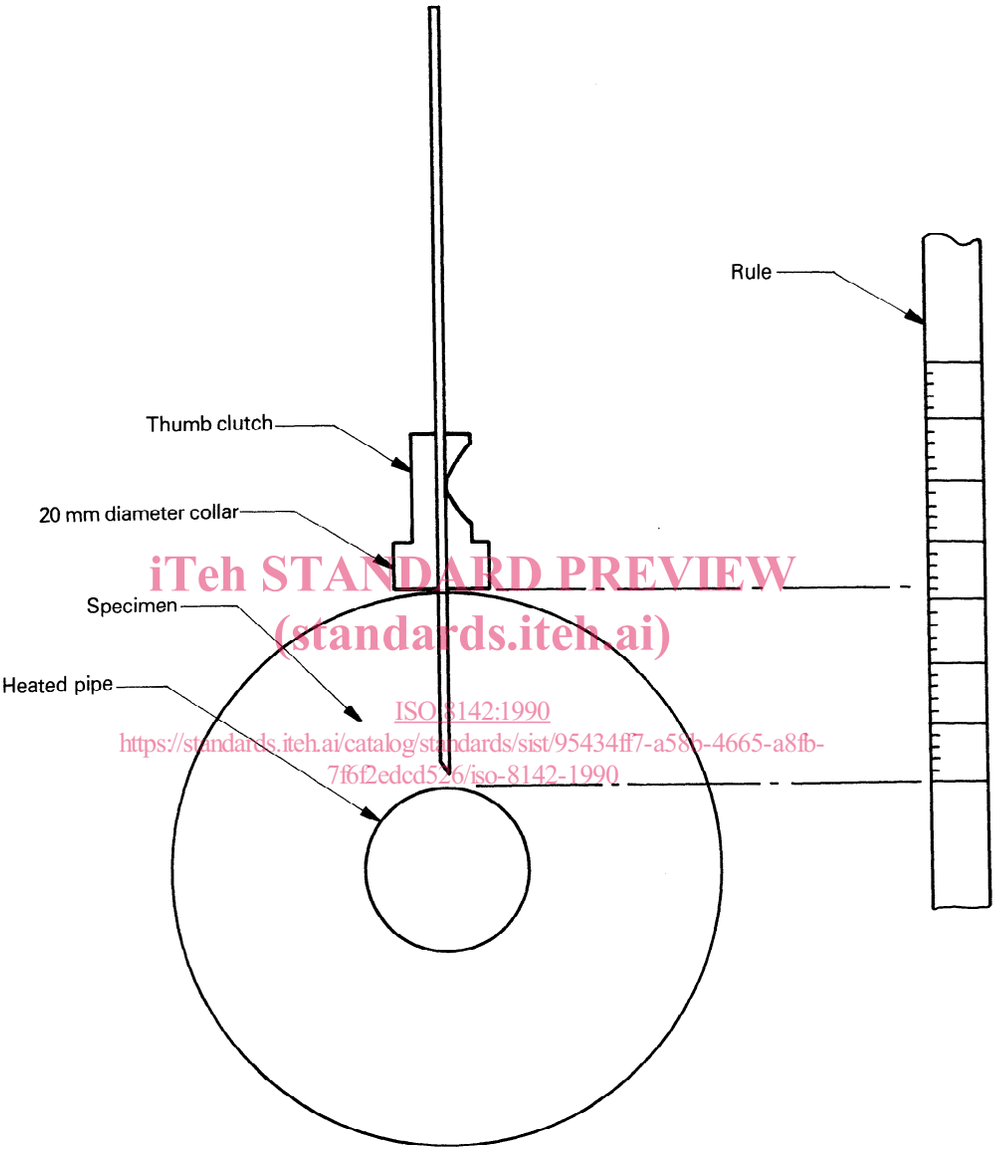
a) **General arrangement**



b) **Thermocouple location**

NOTE — If a single insulation layer is used, the interface in the diagram represents the mid-thickness.

Figure A.1— Apparatus for determining maximum service temperature



NOTE — The pin-probe is used for the maximum service temperature test.

Figure A.2 — Pin-probe for measuring specimen thickness *in situ*