TECHNICAL REPORT

ISO TR 1896

First edition
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Products in fibre-reinforced cement — Non-combustible fibre-reinforced boards of calcium silicate or cement for insulation and fire protection

Produits en ciment renforcé par des fibres — Plaques non combustibles, à base de ciment ou silico-calcaires, renforcées par des fibres, pour l'isolation et la protection contre le feu

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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.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 1896, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 77, *Products in fibre reinforced cement*.

It cancels and replaces ISO Recommendation R 1896:1971 of which it constitutes a technical revision.

Bearing in mind the nature of comments received and the fact that the products in question were still under technical development, the experts were unable to reach agreement on certain technical considerations.

Because there are no criteria for non-combustibility in ISO 1182, the term non-combustible, which is a key element in the Report, is defined only by regulations or national standards.

Even by establishing categories of thermal shrinkage, certain delegates considered that product interchangeability within each category was not possible, given that the concept of structure and performance of the board are closely connected to guarantee fire-resistance.

As a result of this lack of interchangeability, the Draft continually made reference to the need for the product to pass fire tests specified in other International Standards (e.g. ISO 834).

These facts are incompatible with the establishment of a complete International Standard. It was also noted that a large number of these products will be covered by a future International Standard.

As a consequence of these difficulties, it was decided to publish the Draft in the form of a Technical Report.

Annexes A, B and C form an integral part of this Technical Report. Annex D is for information only.

Introduction

ISO/R 1896, *Thermal insulating asbestos boards*, was published in May 1971. In 1974 ISO/TC 77 created a working group to revise this document. This Technical Report, which is the result of the deliberations of the working group, differs from the first edition in a number of important ways which reflect current trends in technology and market requirements. Some of the more important changes are as follows.

a) This Technical Report applies to any reinforcing fibres.

b) Greater emphasis has been given to the primary application of these boards in fibre protection and insulation. The boards are required to be non-combustible. Claims made for boards regarding their use in elements of construction required to provide fire resistance are based on the relevant national regulations, International Standard (e.g. ISO 834) or national standard.

   All claims should state the standard used.

   NOTE 1 In certain countries the term "non-combustible" is not permitted to apply to products. Refer to the appropriate national standards or regulations.

c) The minimum bending strength requirement has been related to both density and thickness. This is in accordance with practical experience regarding the requirements for board handling.

d) Many of the fire protection boards covered by this Technical Report retain their integrity in a fire by virtue of their low thermal shrinkage and consequently a test method for thermal shrinkage is included. Boards of higher thermal shrinkage and generally greater thickness can however provide fire protection by other mechanisms (e.g. the maintenance of a high thermal gradient through the thickness of the board so that, although the face exposed to the fire may shrink and micro-craze, the cool face maintains the integrity of the board).

The test methods given are, as far as possible, similar to those for fibre-cement flat sheets.

Products in fibre-reinforced cement — Non-combustible fibre-reinforced boards of calcium silicate or cement for insulation and fire protection

1 Scope

This Technical Report specifies the characteristics, test methods and checking of non-combustible fibre-reinforced boards of calcium silicate or cement intended primarily for insulation and for internal use in elements of construction required to provide fire resistance. Calcium silicate slabs for thermal insulation will be covered by a future International Standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Technical Report. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Technical Report 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 390:1977, *Asbestos-cement products — Sampling and inspection.*

ISO 834:1975, *Fire-resistance tests — Elements of building construction.*

ISO 1182:1990, *Fire tests — Building materials — Non-combustibility test.*

3 General composition

Non-combustible fibre-reinforced cement boards which are the subject of this Technical Report consist principally of an inorganic hydraulic binder[1] or a calcium silicate matrix formed by the chemical reaction of a siliceous material and a calcareous material reinforced with suitable fibres.

Process aids, fillers and pigments which are compatible with fibre-reinforced cement may be added.

4 Classification

The boards are classified in four categories according to their nominal density (see table 1). The general physical property requirements are given in table 1 and detailed in 5.4 and 5.5.

5 Requirements

5.1 General appearance and finish

The boards shall normally have at least one surface which appears smooth on visual inspection. If it is required, however, one or both surfaces may be specially finished for decorative or other purposes.

5.2 Geometrical characteristics

5.2.1 Nominal length and width

Fibre-cement boards are normally available in nominal lengths up to approximately 3 000 mm and nominal widths up to approximately 1 250 mm.

Preferred nominal dimensions for length and width may be specified in national standards taking into account that the dimensions of the sheet are determined largely by the purpose for which it is intended.

1) National standards may specify the binder to be used.

Table 1 — General physical characteristics

Board category	Nominal density, ϱ g/cm³	Minimum bending strength N/mm²			Maximum thermal conductivity W/(m·K)
		4,5 mm $< e \leqslant$ 7 mm	7 mm $< e \leqslant$ 12 mm	12 mm $< e \leqslant$ 70 mm	
A	$1{,}00 < \varrho \leqslant 1{,}25$	8	6	4	0,29
B	$0{,}75 < \varrho \leqslant 1{,}00$	6	5	4	0,25
C	$0{,}50 < \varrho \leqslant 0{,}75$	5	4	3	0,20
D	$\varrho \leqslant 0{,}50$	—	—	1,5	0,15

5.2.2 Thickness, e

The thickness selected depends on the application. The thickness range for the boards is from 4,5 mm to 70 mm.

5.2.3 Tolerances on dimensions

Tolerances on dimensions are as follows:

a) For each nominal width and length dimension

- above 2 m: ± 5 mm
- up to and including 2 m: ± 3 mm

The measurement method is given in 6.2.2.

b) For thickness: ± 10 % of nominal thickness up to a maximum of ± 2,5 mm. Within the same board, the difference between the maximum and minimum measurements shall not be greater than 10 % of nominal thickness up to a maximum of 2 mm.

The measurement method is given in 6.2.3.

5.2.4 Tolerances on shape

5.2.4.1 Straightness of edges

The tolerance on the straightness of edges is 0,2 % of the length of the edge, subject to a maximum tolerance of 3 mm. The measurement method is given in 6.2.4.

5.2.4.2 Squareness

The tolerance on squareness is 0,3 %. The measurement method is given in 6.2.5.

NOTES

2 Where boards are to be used in constructions employing the principles of modular co-ordination, the dimensions (work sizes) of the boards should follow the requirements for modular co-ordination. Information regarding these requirements is given in [1], [2], [3] and [4] (see annex D).

3 Other dimensions and tolerances may be supplied by special agreement between the manufacturer and purchaser.

4 The dimensions and tolerances given, except those for thickness, do not apply where oversized boards are supplied for applications where the board is required to be cut by the user.

5.3 Nominal density

When measured as described in 6.3, the density of a specimen shall not deviate from the nominal density declared by the manufacturer by more than 10 %.

5.4 Bending strength

5.4.1 Dry specimen

When tested as described in 6.4, the minimum bending strength shall be as given for the appropriate board category in table 1. The values given refer to the average of the bending strength in both directions.

5.4.2 Saturated specimen

In addition to the above requirement, the minimum saturated bending strength when tested as described in 6.4 shall be at least 50 % of the appropriate value shown in table 1.

5.5 Thermal conductivity

When measured as specified in 6.5, the maximum thermal conductivity of the dry specimen shall be as given in table 1.

NOTE 5 When calculating heat transfer through building structures, allowance for the effect of external factors, such as moisture, on the thermal conductivity may be necessary.

5.6 Non-combustibility

The board shall meet the criteria of non-combustibility as defined in national regulations.

5.7 Fire protection

Manufacturer's statements regarding the use of boards in elements of construction required to provide fire resistance shall be based on the relevant national regulations, International Standards (e.g. ISO 834) or national standards and be supported by certificates from an independent authority.

The manufacturer's literature shall state the standard used.

These requirements are compulsory for boards intended for fire protection.

5.8 Thermal shrinkage

Boards intended for fire protection, when tested in accordance with 6.7, shall have a linear thermal shrinkage according to their category as specified in table 2.

These requirements are obligatory for boards intended for fire protection.

Table 2 — Thermal shrinkage

Category	Thermal shrinkage, δ %
1	$\delta < 2$
2	$2 \leqslant \delta < 4$
3	$4 \leqslant \delta$

5.9 Moisture movement

When tested in accordance with 6.8, moisture movement shall not exceed 0,35 %.

5.10 Sag under humidity

Where there is a requirement for resistance to sag (e.g. ceiling panels), the test method described in 6.9 shall be used and the sag under humidity shall not exceed 3 mm.

5.11 Screw retention

Where there is a requirement for screw retention, the test method described in 6.10 shall be used.

6 Test methods

6.1 General

The acceptance tests shall be carried out on boards and specimens cut from boards which are representative of the material to be supplied using the inspection and acceptance procedures described in annex A.

6.2 Geometrical characteristics (obligatory acceptance test)

Geometrical characteristics shall be determined at normal ambient temperature and humidity.

6.2.1 Equipment

6.2.1.1 The smooth, flat inspection surface shall be large enough to take the sheet.

Two metal rules may be fixed at right angles along the edge of the inspection surface. The straightness of each metal rule shall be at least 0,3 mm/m and the right angle shall be accurate to at least 0,1 % (less than 1 mm deviation from normal per metre of length) or 0,001 rad.

Alternatively, a portable square may be used. The same requirements for straightness and angularity apply.

6.2.1.2 Suitable metal rulers, capable of being read to 0,5 mm, are used.

6.2.1.3 A micrometer accurate to 0,05 mm, with flat parallel metal jaws, between 10 mm and 15 mm in diameter is needed.

6.2.2 Length and width

For each dimension, carry out three measurements, taking care to avoid measuring over any local deformation large enough to constitute a visible defect.

Each reading shall be taken to the nearest 0,5 mm. Before taking a reading, ensure that the edges are clean. Each of the three measurements shall conform to the tolerance requirements of 5.2.3.

6.2.3 Thickness

Take three measurements at one end, with the micrometer, as indicated in figure 1.

Each of the three measurements and the difference between the extreme values of the measurement shall conform to the tolerance requirements of 5.2.3.

Dimensions in millimetres

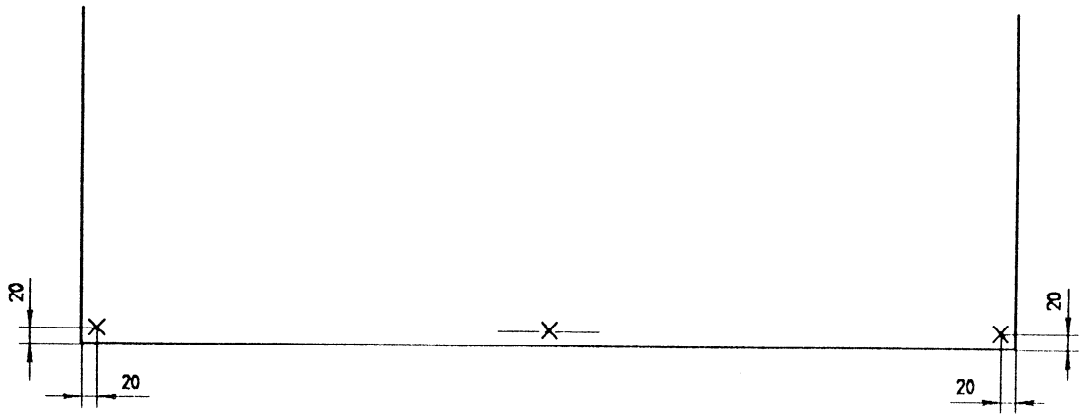


Figure 1 — Location of thickness measurements

6.2.4 Straightness of edges

Apply each edge of the board to the straight edge which shall be longer than the edge being tested. Measure to the nearest 0,05 mm the greatest distance between the edge of the board and the reference edge. The result expressed as a percentage of the length of the edge of the board shall conform to the tolerance requirements of 5.2.4.1.

6.2.5 Out-of-squareness

Place each of the four corners of the board in succession between the arms of the square, keeping the longer edge of the board firmly in contact with the longer arm of the square. Measure to the nearest 0,5 mm the greatest distance, d, between the board and the other arm of the square, as shown in figure 2. The out-of-squareness angle, given by d/L and expressed as a percentage shall conform to the tolerance requirements of 5.2.4.2.

L is given by the short arm of the square or the edge of the board as indicated in figure 2.

A similar procedure applies to the use of either the control surface or the portable square.

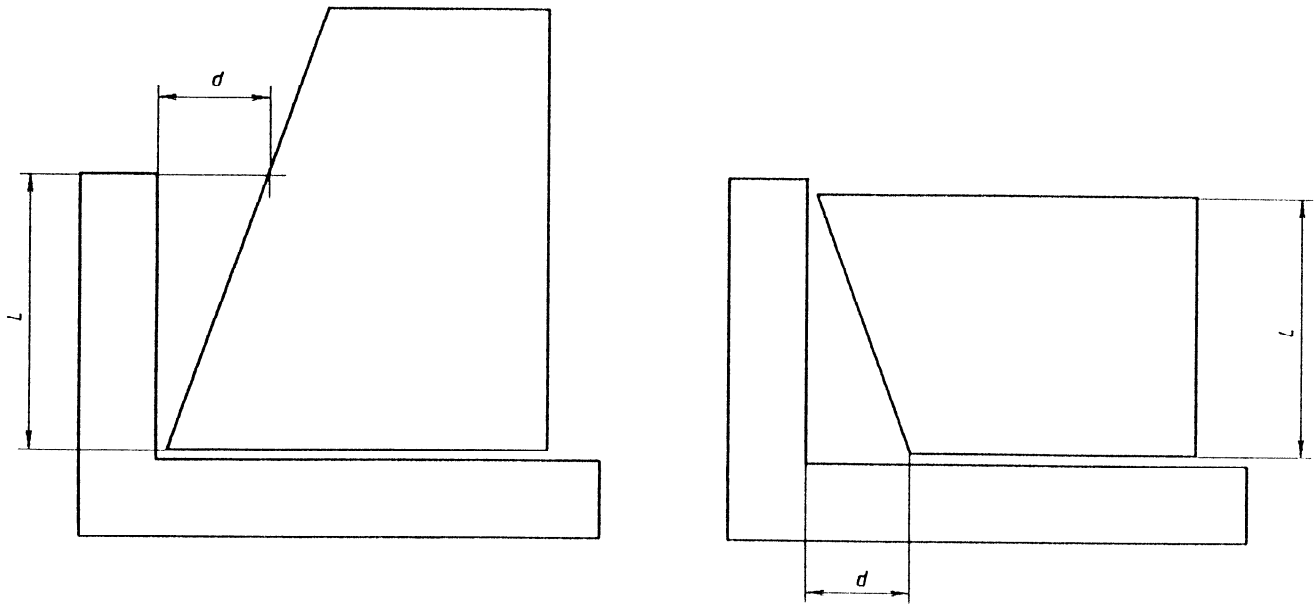


Figure 2 — Out-of-squareness measurements

6.3 Density (obligatory acceptance test)

6.3.1 Specimen preparation

Take a specimen of approximately 40 mm × 60 mm (see note in 6.3.2) from the material to be tested.

6.3.2 Procedure

Determine the dry mass of the test specimen by drying it out in an oven at 100 °C to 105 °C until the difference between two consecutive weighings made in an interval of not less than 2 h is less than 1 % by mass.

Determine the volume of the specimen by any method capable of giving a result accurate to within 2 %, e.g. immersion in potable water. If water is used, the specimen shall be saturated before determining the volume. The density, ϱ, is given by the formula:

$$\varrho = \frac{m}{V}$$

where

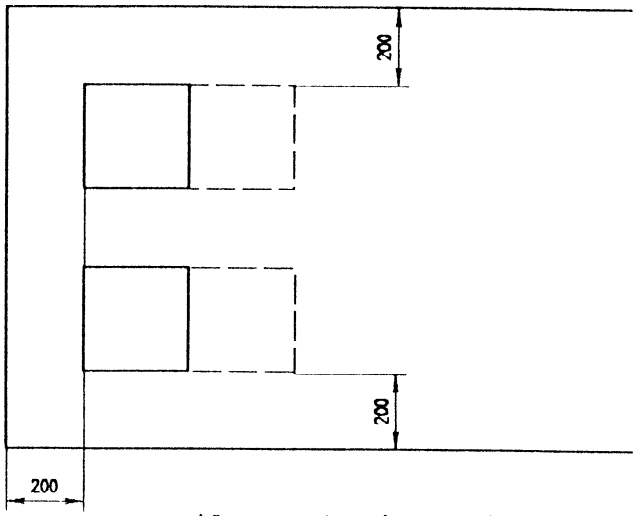
m is the dry mass of the specimen, in grams;

V is the volume of the specimen, in cubic centimetres.

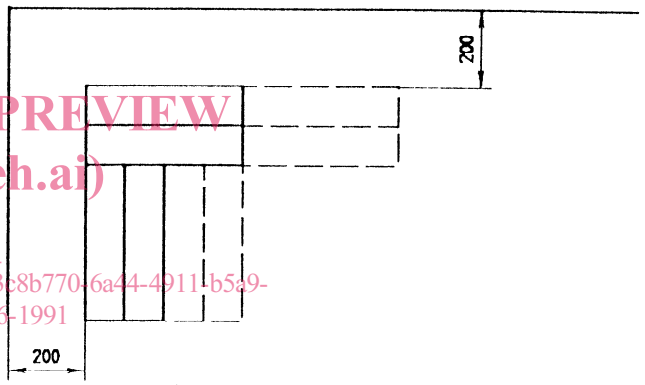
Check that the measurement conforms to the tolerance requirements of 5.3.

NOTE 6 It is convenient to use a fragment from a specimen which has been subjected to a bending test. In the case of the specimen having an added coating, the coating shall be removed before testing.

Dimensions in millimetres



a) Square specimens ($e \leq 20$ mm)



b) Rectangular specimens ($e > 20$ mm)

Figure 3 — Cutting of specimens

6.4 Bending strength (obligatory type test)

6.4.1 Specimen preparation

6.4.1.1 Dry strength

Cut two specimens per board from boards with a thickness, $e \leq 20$ mm, and four specimens per board from boards with a thickness, $e > 20$ mm, observing the conditions in table 3.

The specimens are cut from the board as shown by the solid lines in figure 3 (the dimension of 200 mm is indicative) and conditioned by drying them in an oven following the procedure given in 6.3.2.

Cool the specimens in a rack at ambient temperature and humidity and test within 1 h to 2 h of removal from the oven.

6.4.1.2 Saturated strength

Cut two specimens per board from boards with a thickness, $e \leq 20$ mm, and four specimens per board from boards with a thickness, $e > 20$ mm, observing the conditions in table 3.

The specimens are cut from the same board as specimens for determining the dry strength as shown by the dashed lines in figure 3 (the dimension of 200 mm is indicative).

Immerse the specimens in water at a minimum temperature of 5 °C for at least 24 h before testing.