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PAS 670:2021

# **PUBLICLY AVAILABLE SPECIFICATION**

## **Magnesium oxide-based boards for use in buildings – Specification**

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## **PAS 670:2021**

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## **Foreword**

### **Publishing information**

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Acknowledgement is given to XXXXXX, as the technical author, and the following organizations that were involved in the development of this PAS as members of the steering group:

- XXXXXX
- XXXXXX
- XXXXXX

Acknowledgement is also given to the members of a wider review panel who were consulted in the development of this PAS.

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### **Information about this document**

**Product certification/inspection/testing.** Users of this PAS are advised to consider the desirability of third-party certification of product conformity to this PAS.

Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

### **Presentational conventions**

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

### **Contractual and legal considerations**

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## **Introduction**

Magnesium oxide building boards are a generic group of building boards widely used in construction industries throughout the world. This PAS is applicable only to boards manufactured from magnesium oxychloride or magnesium oxysulfate. Combined, these two types of boards account for over 99% of magnesium oxide boards used in the UK. Other formulations of boards are **not** covered by this PAS.

Magnesium oxide boards have been used in construction for over twenty years. Typically, they are used as a component in a building. They are generally selected for their strength to weight ratio, structural strength, performance when exposed to fire and workability.

However, concerns have been reported, most notably in Denmark in 2015, and also in Australia, where a reaction between boards and water vapour in the air (humidity) led to rapid degradation of the boards which also damaged adjacent components of the building(s).

In Denmark the incidents were serious enough to elicit a high-level enquiry and some academic research into the cause of the failure. Despite these steps neither the precise origin of the boards or the exact reasons for failure were determined.

This served to highlight that no common standard existed for the selection, testing and verification of the consistency of boards.

This PAS provides consensual best practice on how to select, test and verify magnesium oxide boards for use in construction.

This is achieved using appropriate pre-existing standards for strength and durability testing, reaction to fire, testing requirements specific to the performance of these boards in a humid environment and governance of the manufacturing, supply chains and traceability of boards.

This PAS specifies the verification of the consistency of the manufacturing process and the testing of magnesium oxide-based boards for use in construction with reference to the following two standards:

- BS EN 12467:2012+A2, *Fibre cement flat sheets- product specification and test methods*, originally intended for fibre-cement flat sheets which have much in common with magnesium oxide boards, so much of the standard is highly relevant to these boards; and
- BS EN 13501-1, *Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests*, – resistance to fire is a key attribute of magnesium oxide boards, so the fire classification requirements of this standard are referenced.

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## **1 Scope**

This PAS specifies requirements for flat sheet building boards manufactured using magnesium oxychloride or magnesium oxysulfate for the purpose of partitioning, lining and encasement of buildings, including the following characteristics:

- a) dimensions and tolerances;
- b) strength and stiffness;
- c) reaction to fire;
- d) structural performance;
- e) durability;
- f) performance in a humid environment;
- g) verification of the consistency of the manufacturing process; and
- h) identification and traceability of the finished product.

The PAS is not applicable to the use of boards as flooring, sarking and roofing.

This PAS is intended for use by manufacturers, distributors and third-party verifiers, and sets out the requirements for how boards should be tested and verified as fit for purpose.

The PAS is not an installation guide.

Specific applications, e.g. use of boards for racking resistance and as direct render substrates, require specific testing to verify that boards are fit for purpose.

## **2 Normative references**

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 12467:2012+A2:2018, *Fibre-cement flat sheets – Product specification and test methods*

BS EN 13501-1, *Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests*

## **3 Terms, definitions and abbreviations**

### **3.1 Terms and definitions**

For the purpose of this PAS the following terms and definitions apply.

#### **3.1.1 factory production control (FPC)**

procedures in place to allow a manufacturer to maintain consistency in quality and to keep records of non-conforming products, processes, or materials, in order to make improvements

#### **3.1.2 quality management system (QMS)**

system which implements the manufacturer/distributor's policies and objectives into the processes that help maintain and improve a standard of quality

### **3.2 Abbreviations**

For the purposes of this PAS, the following abbreviations apply.

MoE Modulus of elasticity measured in megapascals

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MoR Modulus of rupture measured in megapascals

#### **4 Identification**

Boards shall have identification markings which allow them to be readily traced to the manufacturer.

#### **5 Initial type testing**

Testing methods for initial type testing of boards shall be in accordance with Clauses 7 to Clause 13 and BS EN 12467:2012+A2, Clause 7.

#### **6 Classification**

Boards shall be classified in accordance with BS EN 12467:2012+A2, 5.2, as:

- a) category A, B or C for weather resistance:
  - 1) Category A: boards intended for applications that might be subject to heat, high moisture and severe frost;
  - 2) Category B: boards intended for applications that might be subject to heat, moisture and occasional frost, e.g. where boards are either protected from or not subject to severe weathering conditions;
  - 3) Category C: boards intended for internal applications, where they might be subject to heat and moisture but not frost;

*NOTE Category D set out in BS EN 12467:2012+A2 is not applicable to magnesium oxide boards covered by this PAS.*

- b) class 1, 2, 3, 4 or 5 for bending strength;
- c) large or small sheet sizes for method of installation; and
- d) level I or II for dimensional tolerance.

#### **7 Dimensions and tolerances**

When tested in accordance with BS EN 12467:2012+A2, 7.2, the dimensions and tolerances of boards shall satisfy the permissible deviations from the nominal sizes, including tolerances on length and width, thickness, straightness and squareness of edges, specified by BS EN 12467:2012+A2, 5.3.

*NOTE 1 The specific tolerances are dependent on the nominal manufactured sizes of boards as supplied.*

*NOTE 2 BS EN 12467:2012+A2, 7.2, specifies the procedure for sample preparation, apparatus and measuring methods to be used for testing.*

#### **8 Physical requirements and characteristics**

When tested in accordance with BS EN 12467:2012+A2, 7.3, the physical requirements and characteristics of boards shall conform to BS EN 12467:2012+A2, 5.4, which specifies the mechanical and material properties of boards as delivered for installation, including:

- a) apparent density;
- b) moisture movement;
- c) mechanical characteristics – bending strength (modulus of rupture [MoR]);
- d) mechanical characteristics – modulus of elasticity (MoE); and
- e) water impermeability.

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*NOTE Warm water testing in accordance with BS EN 12467:2012+A2, 7.3.5, is not applicable to magnesium oxide boards.*

## **9 Durability**

The durability requirements of boards shall be in accordance with BS EN 12467:2012+A2, 5.5, with the specific durability test requirements dependent on the category of boards (see 5.3). This includes aspects of resistance to freeze-thaw, heat-rain and soak-dry.

*NOTE The requirements for warm water testing specified in BS EN 12467:2012+A2, 5.5.4, are not applicable to magnesium oxide boards.*

## **10 Release of dangerous substances**

This verification and declaration on release of dangerous substances shall be in accordance with BS EN 12467:2012+A2, 5.6.2.

## **11 Moisture movement**

The test methods specified in BS EN 12467:2012+A2, Annex C, shall be used for the determination of moisture movement characteristic of magnesium oxide boards.

## **12 Reaction to fire**

The reaction to fire classification of boards shall be confirmed using test data in accordance with BS EN 13501-1.

*NOTE 1 Users are advised to consider the desirability of third-party testing.*

*NOTE 2 BS EN 13501-1 requires testing in a configuration representative of end-use.*

## **13 Performance in a humid environment**

### **13.1 Requirement**

When tested in accordance with 13.2, no liquid droplets shall appear on the surface of boards and the strength retained shall be not less than 75%.

*NOTE This test specifically addresses historical performance issues identified in service where boards have been adversely affected by a humid environment.*

### **13.2 Method**

Select at least four test specimens and the same number of control specimens, of dimensions (250 × 250) mm, with two of the specimens being cut from a board at a distance of 100 mm from the edge.

Record the mass of the test samples.

Condition test specimens in the laboratory at a temperature of 20 °C and 65% relative humidity or 23 °C and 50% relative humidity until constant mass is reached.

After conditioning, record the mass of the test samples.

Carry out MoR testing on the control specimens in accordance with Clause 8c).

Lay the test specimens on horizontal steel racks and place them into a climate chamber at a temperature of 30 °C and relative humidity of 90%, for 90 days.

Test the conditioned specimens for MoR [see Clause 8c)].

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#### **14 Verification of quality management system (QMS), factory production control (FPC) and consignment inspection**

The manufacturer and distributor shall have in place a QMS that governs the supply chain and traceability of boards back to the point of origin.

Auditing of the production location shall be in accordance with BS EN 12467:2012+A2, 6.3, which specifies the documentation, control and regular governance checks required to maintain a controlled production process, including:

- 1) identifying and controlling non-conforming products;
- 2) implementing corrective action;
- 3) inspection, maintenance and calibration of manufacturing equipment;
- 4) specification and inspection regime for all raw materials;
- 5) traceability and marking of the finished product;
- 6) how the production conditions are controlled; and
- 7) testing and evaluation of the finished product.

*NOTE Inspection of a consignment of finished goods is required.*

Auditing of the production location shall include verification of the control of the formulation of boards.

Consignment inspection sampling methods shall be carried out in accordance with the manufacturers and distributors agreed programme.

#### **15 Product traceability**

Each board shall be marked with the following information:

- a) manufacturer's identification of batch number, enabling traceability to date of manufacture and FPC records for the batch;
- b) number of this PAS (PAS 670);
- c) category in accordance with Clause 6a);
- d) class in accordance with Clause 6b); and
- e) distributor's trade name.

#### **16 Installation instructions**

The manufacturer/distributor shall provide instructions for the installation of boards.