BRITISH STANDARD

BS 1982-0: 1990

Fungal resistance of panel products made of or containing materials of organic origin —

Part 0: Guide to methods for determination

Confirmed November 2008

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Wood Preservation Standards Policy Committee (WPC/-) to Technical Committee WPC/10, upon which the following bodies were represented:

Association of Consulting Scientists
British Pest Control Association
British Wood Preserving and Damp-proofing Association
Chemical Industries Association
Department of the Environment (Building Research Establishment)
Timber Research and Development Association

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Contents

Foreword

This Part of BS 1982 has been prepared under the direction of the Wood Preservation Standards Policy Committee. BS 1982 was published in 1968 as a single standard including three test methods. This revision provides a fuller consideration of the possible hazards to organic based panel products and has been divided into Parts to allow each method to be kept up-to-date separately. The following Parts supersede BS 1982:1968, which is withdrawn.

— *Part 0: Guide to methods for determination;*

— *Part 1: Method for determination of resistance to wood-rotting Basidiomycetes;*

— *Part 2: Method for determination of resistance to cellulose-decomposing microfungi;*

— *Part 3: Methods for determination of resistance to mould or mildew.*

Technical Committee 38 Durability of wood and wood-based products of the European Committee for Standardization (CEN) has just commenced work, under a mandate from the Commission of the European Economic Community (EEC), on the classification of biological hazards and durability of timber, performance of treated timber, and the performance testing of preservatives. With the publication of European Standards arising from this work, this Part of BS 1982 will be amended, revised or withdrawn so as to remove any conflicting aspects.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 1982 sets out general considerations to be taken into account in the selection of test methods for the assessment of fungal resistance of panel products, made of or containing materials of organic origin, in a variety of hazard situations.

The term "panel product" is used to include materials variously known or described as board or sheet materials, building boards, composite boards, rigid sheet materials, etc. It includes not only wood-based panel products such as plywood, particleboards and fibre building boards, but also products made of or containing other ligno-cellulosic fibres such as bagasse, flax and straw. BS 6100-4.3 and BS 4261 give guidance on terminology.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Nature of the problem

Many of the panel products used in building construction are made from or contain raw materials of organic origin. Nearly all such products are susceptible in some degree to fungal attack if their moisture content rises sufficiently to sustain fungal growth. Most materials of organic origin are also in some degree hygroscopic and, if they are exposed for any length of time to an atmosphere of high relative humidity, their moisture content rises until it reaches equilibrium with the surrounding atmosphere. The minimum moisture content at which fungi will develop depends on the temperature and the species of fungus concerned as well as the nature of the panel products.

Panel products, notably plywood, may be used constructionally in high hazard situations, for example decking of bridges and induced draught cooling towers, planking of boats, pontoons and lock or dock gates.

In industrial buildings in which processes are carried out that involve humidification of the atmosphere, either deliberately or accidentally, the relative humidity of the atmosphere may become sufficiently high for fungal growth to develop on susceptible materials. Panel products used for insulation of external walls and roofs may, in cold weather, become saturated by condensation. Condensation and fungal growth are likely to be troublesome, for example in weaving sheds, dye-houses, breweries, ice-cream factories and swimming baths. In farm buildings housing livestock similar conditions of high humidity may arise.

Formerly, in temperate countries, in properly-designed, well-maintained houses heated by solid-fuel fires with open flues, the relative humidity of the internal atmosphere seldom rose and remained above the minimum for growth long enough for fungi to become established. However, in dwellings built since the 1940s, the increasing use of central heating coupled with reduction of ventilation by the absence of open flues has introduced novel condensation hazards and concomitant risks of growth of fungi. The new industrial techniques of building construction with improved insulation to conserve energy, besides leading to greater use of panel products, also tend to reduce incidental ventilation and so introduce further condensation risks. These condensation problems are in addition to the ordinary risks of accidental wetting of components during construction and exposure to moisture in service through conditions of occupancy, accident or inadequate building maintenance. Resistance to the growth of fungi is therefore a desirable characteristic for panel products used in building construction.

3 Health and safety considerations

3.1 Conduct of tests

Because the procedures involve handling and working with micro-organisms, either in pure or mixed culture or from natural populations, it is important that personnel trained in microbiology should perform those parts of the test involving handling of organisms and infected test specimens. It is essential that personnel should be familiar with the general recommendations on personnel safety given in BS 2011-2.2J, in particular National appendix Z, and have appropriate equipment and facilities available.

3.2 In service considerations

Prevention of fungal growth on panel products can be important in respect of occupational and environmental health and safety. The presence of mould growth can lead to a build-up of populations of fungus-eating insects and disturbance of heavy mould growths can yield air-borne spores which, if inhaled in quantity, can induce allergic reaction in sensitive individuals. If panel products with a structural function are attacked by decay fungi, the safety of occupants and operators may be at risk.

4 Limitations of test methods

If it is suspected that panel products contain bonding agents which are not moisture resistant, so that significant loss of strength may occur as a result of wetting alone, the product should be tested using the methods described in BS 5669 prior to those for rot resistance described in Parts 1 and 2 of this standard.

Testing for the resistance to cellulose-attacking fungi of non-rigid sheet building materials, such as damp-proof membranes and breather papers, should be carried out by the soil burial test procedure in BS 6085.

If disfigurement in the form of blue or grey stains caused by fungi growing beneath surface finishes is of concern, it should be regarded as "blue stain in service" and assessed by the procedure described in BS 7066-1 and BS 7066-2.

5 Analysis of hazard in service

5.1 Usage and use situation

For panel products used decoratively, the major hazard as a result of wetting or exposure to high atmospheric humidity is mould growth.

Insulation materials lose their function if moisture penetrates and may suffer loss of integrity through attack by decay fungi.

In constructional usage, loss of strength through fungal attack needs to be considered as well as the possible strength loss directly consequent on wetting.

According to location in or on the building, an assessment can be made of the risks of wetting and hence the degree of hazard likely to be caused by decay fungi. Four categories based on those agreed by the European Homologation Committee[1)2)] are given in Table 1.

The nature of the hazard in a particular situation can be modified by the type of design used.

5.2 Nature of the panel products' components

The type of bonding agent used needs to be taken into consideration. If non-durable adhesives, i.e. adhesives which fail under the influence of moisture, are used in panel products' construction, the products should not be considered for use in high hazard situations. In contrast, the bonding agent in cement based boards is unaffected by moisture alone and, by virtue of its alkalinity, gives protection against fungal attack to non-decay resistant base materials.

Another feature of panel products which may need to be taken into consideration is their response to conditions in their environment. Normal softwood hardboard at 100 % r.h. equilibrates to a moisture content which is too low to support growth of wood-rotting *Basidiomycetes*. In contrast, solid softwood equilibrates to a moisture content which is about the limiting value for such attack. In contact with liquid water, softwood hardboard wets up much more slowly than pine sapwood but dries out at about the same rate as solid wood. Thus under fluctuating marginal conditions, hardboard is inherently much less at risk than comparable solid wood.

The fungal resistance of the wood components of panel products assumes importance only when the bonding agent is durable. Wood based panel products are then at least as resistant to decay as the timber from which they are made. Hardwoods are inherently more susceptible than softwoods to attack by microfungi and this is also true of panel products made from these two types of timber.

Table 1 — Degree of hazard of decay caused by fungi

Decay	Conditions	Examples
No decay	Interior use in permanently dry conditions	Upper floor materials Internal linings
Possible decay hazard	Neither in ground contact nor directly exposed to weathering; possibility of temporary wetting	Sheathing Ground floor materials
Decay hazard	Exposed to the weather or to condensation, but not in ground contact	Kitchen and bathroom floors Flat roof decking and insulation External cladding
High decay hazard	Permanent ground contact or exposed to continuous severe wetting	Farm building partitioning Cooling tower walling

[1)] See "The EHC — Reference Document 1984" edited on behalf of EHC by KOMO, Sir Winston Churchill-Iaan 273, Postbus 240, 2280 AE, Rijswijk (ZH), Netherlands.
[2)] A European Standard classifying biological hazards is in preparation and this Part of BS 1982 will be amended to align with it when it is published.

6 Types of fungal attack in service

6.1 General

For practical purposes fungal growth on panel products containing organic materials can be considered as belonging to one of the two types described in **6.2** and **6.3**.

6.2 Fungi which cause decay and breakdown of wood and other ligno-cellulosic materials

These fungi are referred to as "wood-rotting fungi" and include the following.

a) Wood-rotting *Basidiomycetes*, a group that includes those fungi which commonly cause decay in buildings including the dry rot fungus *Serpula lacrymans* and wet rot fungi, e.g. *Coniophora puteana.*

b) The cellulose-attacking microfungi including those which cause the decay of wood commonly known as soft rot. *Chaetomium globosum* is a well known example of this large group of fungi.

6.3 Other microfungi

These fungi, commonly referred to as moulds or mildew, grow on a variety of organic materials causing unsightly surface discolorations. The damage caused by these organisms may be disfiguring rather than structural. Many materials that are themselves resistant to mould growth may become infected if their surface is contaminated with traces of food stuffs or other organic matter.

NOTE Some preservative treatments which confer resistance to wood-rotting *Basidiomycetes* do not render the material proof against moulds and cellulose-attacking microfungi. It should also be noted that treatments which render materials immune to fungal attack do not necessarily render them resistant to insect attack.

7 Range of tests

7.1 Resistance to wood-rotting *Basidiomycetes* (Part 1)

The method in Part 1 is a soil/block test. This is preferred to an agar/block test which, while convenient, is not suitable for some types of panel product, e.g. phenol formaldehyde (PF) bonded plywood and chipboard.

7.2 Resistance to cellulose-decomposing microfungi (Part 2)

The method in Part 2 involves small stakes partially buried, vertically, in unsterile soil. The moisture gradient which occurs in these stakes allows the test fungi to attack in the area of most suitable moisture content.

7.3 Resistance to mould or mildew (Part 3)

The methods in Part 3 provide for separate tests for high and low moisture hazard; tests are also possible with or without additional nutrients.

7.4 Resistance to leaching in water or to evaporative loss

If the panel product is to be used externally in an exposed situation where weathering can occur, additional information about its resistance to leaching may be obtained by subjecting it to the leaching procedure described in BS 5761-2 before exposing it to the fungus using the methods described in other Parts of this standard.

Resistance to evaporative loss, e.g. of incorporated preservatives, can similarly be determined if the panel product is subjected to the test described in BS 5761-1 before exposing it to the fungus using the methods described in other Parts of this standard.

8 Control substrates

8.1 Virulence control

The virulence of the fungi used in the test needs to be checked by including a suitably susceptible "control substrate" in the test. Solid wood blocks of Scots pine sapwood or of beech will be appropriate for most tests with wood-rotting fungi. For tests with moulds, filter paper is more appropriate.

8.2 Artificially aged material

It is well known that unreacted constituents of some adhesives provide temporary protection against wood-destroying *Basidiomycete* fungi. This protection is eventually lost in service. It is therefore essential, when panel products of unknown composition are to be tested against *Basidiomycetes*, that an additional series of test blocks that have been subjected to an ageing procedure and included in the test.

8.3 Reference materials

The laboratory tests described in other Parts of this standard allow comparisons of the inherent resistance, natural or otherwise, of materials to wood-rotting fungi and moulds under conditions conducive to active growth of the fungi; conditions similar to the most severe conditions of service. However it has to be appreciated that, very often, service conditions are only marginally and/or intermittently favourable for fungal growth.

Nevertheless, some relationship of results to possible performance in practice can be achieved if an additional reference material of established performance in practice is also tested. To facilitate comparisons, the test blocks of this material should be of the same dimensions as those of the panel product under investigation. Comparison of the two materials under the test conditions can then be used to give some indication of relative performance in practice.

9 Choice of test procedure

9.1 General

Decisions as to the type of test that should be applied should be governed by factors such as the nature of the usage of the panel product (e.g. structural or decorative), the hazard in potential or intended use situations and the known properties of its components.

9.2 Nature of usage

Tests which give a measurement of the attack by *Basidiomycetes* or microfungi are appropriate for panel products used structurally such as plywood, chipboard, hardboard and insulating boards made largely from wood or other plant materials. Mould resistance tests may also be deemed appropriate for such panel products to ascertain their ability to maintain a "clean" appearance under building site conditions that engender short-term wetting and risks of mould growth.

Mould tests are appropriate for all materials that are required to present a decorative finish, e.g. plasterboards and sheet materials made of plastics or compositions containing small amounts of organic matter, which are often required to maintain a clean appearance in humid atmospheres.

9.3 Degree of hazard

9.3.1 *High hazard situations*

The *Basidiomycete* test is appropriate for durably bonded panel products used in high hazard situations. In the special case of hardwood based products which have received preservative treatment, tests against microfungi in the presence of additional nutrients are essential to provide an adequate challenge to the preservative. If the panel product is capable of providing a decorative function, then mould tests may also be appropriate.

9.3.2 *Low hazard situations*

Mould tests are appropriate for panel products used in the protected situation of low overall hazard which, paradoxically often presents a high risk of intermittent condensation and hence of mould growth.

Although *Basidiomycete* tests are not usually relevant to assessment of panel products in low hazard situations, special cases may arise. For example, accidental penetration of moisture might occur into otherwise protected structural components causing a decay hazard with potentially serious consequences. It could be argued that sheathing is one such protected structural component in timber frame houses and therefore tests against wood-rotting fungi should always be considered.

9.4 Nature of materials used in panel product construction

If non-durable bonding agents, i.e. those which will themselves fail under the influence of moisture and temperature alone, are used in panel product construction, then strength losses from this cause are of more immediate significance than those caused by fungal attack. In such cases rot resistance tests using loss in mass as a criterion of attack are inappropriate.

Emphasis should be given to the use of brown rot fungi in tests on softwood based panel products and the use of white rots and microfungi in tests on hardwood based panel products because of the particular associations of these types of attack in practice.

9.5 Treated panel products

Special consideration needs to be given to the testing of the rot resistance of panel products that have received preservative or other treatment. This applies most particularly to those panel products which are not of uniform consistency throughout their thickness and those which receive treatment after fabrication.

To accommodate the variations which may arise in the retention of the preservative or other treatment, samples for exposure to fungus should not be taken from positions closer than 300 mm to any edge of the test product and duplicate series of samples should be prepared; one series for exposure after being edge-sealed with a suitable sealant to prevent fungal colonization via the newly cut edges, and the other for exposure without edge-sealing.

To ensure effective challenge of preservatives, tests against cellulose-decomposing microfungi require to be carried out with samples in contact with supplies of additional mineral nutrients.

Panel products which withstand fungal attack only after edge-sealing should be classed as surface resistant and will be unsuitable for use in hazardous situations unless the original edges of the product and any cut edges are protected from fungal attack by a treatment of proven effectiveness under the conditions of service. No such provision is required for panel products which withstand fungal attack in the absence of edge-sealing on the samples exposed to attack.

Publication(s) referred to

BS 2011, *Environmental testing.*

BS 2011-2.2J, *Test J, Mould growth.*

BS 4261, *Glossary of terms relating to timber preservation.*

BS 5669, *Specification for wood chipboard and methods of test for particle board.*

BS 5761, *Wood preservatives. Accelerated ageing of treated wood prior to biological testing.*

BS 5761-1, *Evaporative ageing procedure.*

BS 5761-2, *Leaching procedure.*

BS 6085, *Methods of test for determination of the resistance of textiles to microbiological deterioration.*

BS 6100, *Glossary of building and civil engineering terms.*

BS 6100-4.3, *Wood based board panel products.*

BS 7066, *Laboratory method for determining the protective effectiveness of a preservative treatment against blue stain in service.*

BS 7066-1, *Brushing procedure.*

BS 7066-2, *Application by methods other than brushing.*

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