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growing the use of wood

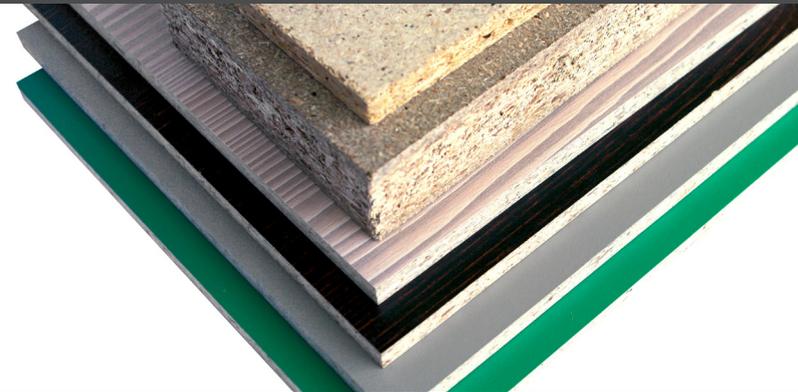


The leading authority on wood

WOOD  
PANEL  
INDUSTRIES  
FEDERATION

# Panel Guide

Version 4



# 1 Introduction

## 1.1 General overview

Wood-based panel products are panel materials in which wood is predominant in the form of strips, veneers, chips, strands or fibres. The categories usually recognised within this group of panel materials are:

- plywood, including blockboard and laminboard
- particleboard, including wood particleboard (chipboard), flaxboard and cement-bonded particleboard (CBPB)
- oriented strand board (OSB)
- fibreboards, including medium density fibreboard (MDF).

Wood-based panels are versatile products with a wide variety of end uses. Their use continues to expand because of:

- their good strength/weight ratio
- their good strength/cost ratio
- their ease of working/finishing/fixing
- the range of sizes and thicknesses available
- the range of types and special products available
- their good environmental credentials (made from a renewable raw material, recyclable, low life-cycle costs)
- their long, proven history of successful use.

The consumption of wood-based panels in the UK is now almost 5 million cubic metres per annum, with UK production comprising a substantial proportion of this figure concentrated in OSB, particleboard and MDF. The UK does not currently produce other types of wood-based panel.

## 1.2 Development of panel products

Particleboards and fibreboards were originally developed to provide utility panel materials with uniform properties. They utilise chipped or defibrated forest round wood and thinnings, sawmill products and recycled wood. There have been many developments in adhesive and manufacturing technology and, from the original utility products, the industry has developed a whole family of panel products with specific properties targeted at a wide variety of end uses. They can be found in numerous high-profile, prestige projects.

OSB was developed in the mid 1970s to utilise smaller logs that are not suitable for plywood production. Made of strands normally about 75mm long, OSB is often in three layers, with the strands in the surface layer oriented roughly in line with the length of the panel. This gives the panel higher mechanical properties in that direction. OSB was developed from the earlier waferboard or flakeboard, which had random particle orientation.

Plywood was originally developed to provide panels with dimensional stability and good strength properties both along and across the panel. Straight, well-grown timber is required for plywood manufacture.

Plywood, particleboards and fibreboards all include both general purpose or utility boards and special purpose products. Several types of panel can be engineered to meet specific property requirements.

## 1.3 Standards and legislation

There is a fairly complex matrix of interrelated standards and legislation. PanelGuide helps users to understand the legislation and the relationship between the various standards. Refer to PanelGuide *Section 2.1* for more detail.

### 1.3.1 Standards

Wood-based panel products are now manufactured to a series of European Standards (ENs), which are published and implemented as national standards by individual EU Member States. In the UK these 'British adopted European Standards' are published as British Standards (BS ENs). The BS ENs replaced the previous BS wood-based panel product specification standards in the UK in 1997. Under the BS EN system, each category of panel material has its own standard(s) that generally follow a similar pattern:

- General information – defining the panel types and the general requirements for all panel types in relation to: tolerances on sizes, thicknesses, moisture content, density etc as appropriate.
- Requirements (which in some cases are published in a series of separate parts) that define the requirements for the panel type in relation to its use in different environmental and load conditions. The environmental conditions are 'dry', 'humid' or 'exterior' defined in relation to a series of 'service classes'. The requirements are also further refined, depending on the panel type, for non-load-bearing, load-bearing and heavy-duty load-bearing boards. (Note that throughout PanelGuide, the use of the term 'structural' is used to mean 'load-bearing', and conversely the term 'non-structural' means 'non-load-bearing'.)

The main product standard usually refers to other standards for test methods and methods of demonstrating compliance.

The specification standards are not related to any given application and reference should also be made to codes of practice or other application-specific guidance where appropriate. The specification standards as listed and referred to in PanelGuide have in general been developed to cover wood-based panels for use in the construction sector; they may also be utilised for the specification and testing of panels for non-construction uses.

Always ensure you are using the most recent version of a British Standard by referring to the BSI website: <http://shop.bsigroup.com/>

### 1.3.2 Construction Products Regulation (CPR)

In order to satisfy legal requirements, as of 1 July 2013 wood-based panel products used in construction have to comply with the Construction Products Regulation (CPR)<sup>1</sup>. The CPR makes it a requirement for construction products that fall under the scope of a harmonised European standard (hEN) to be CE marked and provide a Declaration of Performance (DoP). The harmonised European standard for wood-based panels is published in the UK as *BS EN 13986 Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking*<sup>2</sup>.

## 1.4 Product types

Information on each product type is given in the Annexes and selection and specification information in relation to end use is covered in the main text. The following sections outline the range of products available.

## 1.5 Veneer and core plywood

Plywood is a versatile product that can maintain a high performance under a wide variety of environmental conditions. Its construction enables comparatively high strength to weight ratios which are predominantly influenced by the species used. It is available in a range of wood species (both hardwood and softwood), some of which can have an attractive surface appearance, and a range of glue types for interior and exterior conditions. The term 'plywood' includes the true 'veneer plywood' and also 'blockboard' and 'laminboard'.

Veneer plywood is generally made from veneers that are peeled from a log. These are bonded together with an adhesive that is appropriate to the end use, with the grain of adjacent veneers generally at right angles to each other. The adhesive is cured by pressing the panel using heated platens.

Blockboard and laminboard are produced in a similar fashion to plywood except that the core of the material is made up from strips of solid wood or veneer laid on edge



Figure 1.1: Different types of plywood

and this core is then faced with two or more veneers on each side.

The current British Standard for specifying both veneer and core plywood is: *BS EN 636 Plywood. Specifications*<sup>3</sup>.

*BS EN 636* refers in turn to other standards dealing with factors such as bond quality and surface appearance. The durability of plywood is a function of the bond quality, the durability of the timber species used in the veneer and the veneer quality. Suitable coatings or preservative treatments can also enhance the durability. Plywood is one of the few panel types that has an EN product standard covering its use in exterior conditions.

Plywood is an engineered wood product that can be manufactured to have specific properties, making it suitable for a wide range of applications. It is the only wood-based panel for which information on the use in structural applications under external conditions is given in *BS EN 1995-1 Eurocode 5: Design of timber structures. General. Common rules and rules for buildings*<sup>4</sup> or *BS 5268-2 Structural use of timber. Code of practice for permissible stress design, materials and workmanship*<sup>5</sup> (although now withdrawn, this latter standard will still be in use for a period).

The mechanical (structural) properties are a function of the species of timber used, the veneer quality and the lay-up. Because of the wide range of products available, mechanical properties for plywood have not been standardised. Refer to the manufacturer's DoP for details of the strength properties of their products.

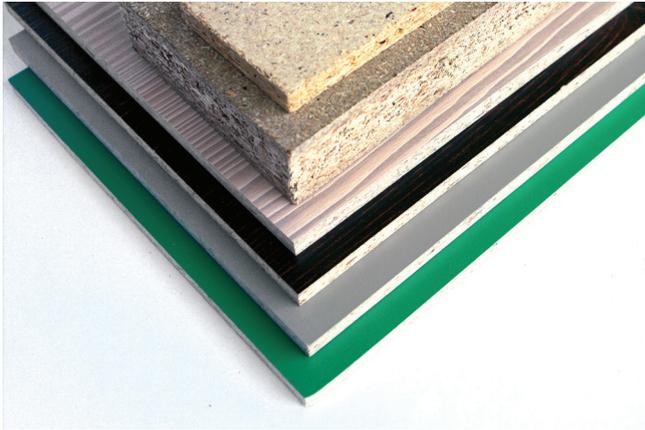
Some of the typical 'types' of plywood include:

- structural plywood
- marine plywood
- utility plywood
- decorative/overlaid plywood
- blockboard/laminboard.

The two panel directions are termed the major and minor axes, with the higher mechanical properties being in the direction of the major axis. In structural applications it is important that the panels are laid in the direction specified by the manufacturer. Further information on plywood, its properties and uses can be found in PanelGuide Annex 2D.

## 1.6 Particleboard

Particleboard as defined in the British Standard *BS EN 309 Particleboards. Definition and classification*<sup>6</sup> is a 'panel material manufactured under pressure and heat from particles of wood (wood flakes, chips, shavings, sawdust and similar) and/or other lignocellulosic material in particle form (flax shives, hemp shives, bagasse fragments, straw and similar), with the addition of a polymeric adhesive'. In the UK, particleboard is made from wood and is traditionally known as wood chipboard.



**Figure 1.2: Raw and coated particleboard**

Wood chips comprise the bulk of particleboard and are prepared in a mechanical chipper generally from coniferous softwoods, principally spruce (although pine and fir and hardwoods, such as birch, are sometimes used). Particleboards may also incorporate a large proportion from recycled sources. These chips are generally bound together with synthetic resin systems such as urea-formaldehyde (UF) or melamine urea-formaldehyde (MUF), though phenol-formaldehyde (PF) and polymeric methylene di-isocyanate (PMDI) are used by a few manufacturers. The chips are formed into a mat and are then pressed between heated platens to compress and cure the panel. The finished panels are then sanded and cut to size.

The current British Standard for specifying particleboard is *BS EN 312 Particleboards. Specifications*<sup>7</sup>.

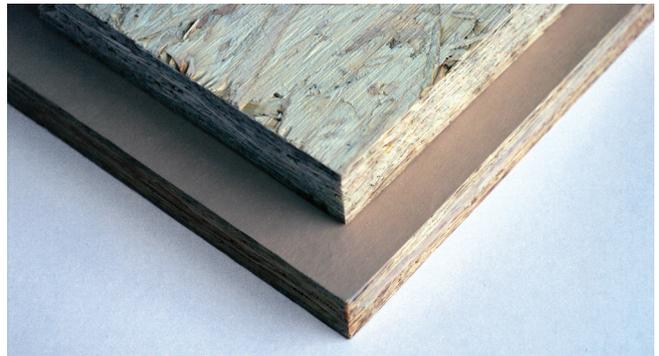
*BS EN 312* specifies the requirements for particleboards to be used in dry and humid conditions; they are not normally suitable for exterior applications. The term 'moisture resistant' is sometimes used in relation to panels classified for use in humid conditions. While such panels may be resistant to periods of short-term wetting or high humidity, this term does not mean that the panel is waterproof and direct wetting should be avoided. While particleboard is not normally attacked by wood-boring insects, it can be subject to fungal decay under prolonged wetting.

The basic mechanical properties of particleboard are controlled by *BS EN 312* and design characteristic values for use of the load-bearing grades with *BS EN 1995-1-1 (Eurocode 5)* are given in *BS EN 12369-1 Wood-based panels. Characteristic values for structural design. OSB, particleboards and fibreboards*<sup>8</sup>. *BS 5268-2* gives conversion factors to allow these values to be used with that standard, which although withdrawn, is still in use by some designers.

The various types of panel defined in *BS EN 312* indicate the range of use conditions of particleboard, and common applications include domestic, office and mezzanine flooring, kitchen units and worktops, furniture and shop-fitting. Further information on particleboard, its properties and uses can be found in PanelGuide Annex 2A.

## 1.7 Oriented strand board (OSB)

OSB is an engineered wood-based panel material in which long strands of wood are bonded together with a synthetic resin adhesive. OSB is usually composed of three layers with the strands of the outer two layers orientated in a particular direction, more often than not in the long direction of the panel. While there is an orientation, it is often hard to see because there is quite a large degree of variability in this orientation among adjacent strands in the panels from any one production line, as well as between panels from different producers.



**Figure 1.3: Coated and sanded OSB**

The current British Standard for OSB is *BS EN 300 Oriented Strand Boards (OSB). Definitions, classification and specifications*<sup>9</sup>.

*BS EN 300* contains the requirements for the following four grades (technical classes):

- OSB/1 – General purpose boards, and boards for interior fitments (including furniture) for use in dry conditions
- OSB/2 – Load-bearing boards for use in dry conditions
- OSB/3 – Load-bearing boards for use in humid conditions
- OSB/4 – Heavy-duty load-bearing boards for use in humid conditions.

Selection of a grade of load-bearing panel is dependent upon the ambient climatic conditions together with the level of loading that is anticipated.

As with particleboards, there is no specification for an exterior quality OSB, and panels should generally be kept away from direct contact with water. Panels for use in humid conditions have a degree of resistance to short-term wetting and high humidity but are not intended for exposure to prolonged wetting.

Common applications for OSB include flooring, wall sheathing, roof sarking, packaging and furniture. Some specialist products, with a surface coating, are now available for non-structural applications, such as site hoarding, giving an extended service life.

Further information on OSB, its properties and uses can be found in PanelGuide Annex 2B.

## 1.8 Flaxboard

*BS EN 15197 Wood-based panels. Flaxboards. Specifications*<sup>10</sup> is the British Standard which specifies the requirements for flaxboard for general purposes, non-load-bearing applications and interior fitments in dry conditions, and for flaxboard for non-load-bearing applications for use in humid conditions. Flaxboard is not suitable for exterior applications.



Figure 1.4: Flaxboard

The basic mechanical properties of flaxboard are controlled by *BS EN 15197*. Panels in accordance with this standard may be referred to as FB1, FB2, FB3 or FB4 panels and indicate the range of use conditions of flaxboard. Common applications include filling purposes, further processing such as veneering, and furniture.

Further information on flaxboard, its properties and uses can be found in PanelGuide Annex 2G.

## 1.9 Cement-bonded particleboard

Cement-bonded particleboards (CBPB) are also available in which a cementitious binder, usually Ordinary Portland Cement (OPC), is used.

Cement-bonded particleboards are produced in accordance with *BS EN 634-1 Cement-bonded particleboards. Specification*<sup>11</sup> and *BS EN 634-2 Cement-bonded particleboards. Specifications. Requirements for OPC bonded particleboards for use in dry, humid and external conditions*<sup>12</sup>. They can be bonded with OPC or with magnesium-based cements. *BS EN 634-2* relates only to OPC CBPB. They have a very high durability and are suitable for use in dry, humid or exterior conditions. Their high



Figure 1.5: Cement-bonded particleboard

density gives good acoustic and fire performance. They are used for flooring, modular buildings and applications where high durability is required.

Further information on cement-bonded particleboard, its properties and uses can be found in PanelGuide Annex 2C.

## 1.10 Fibreboards

Fibreboard is produced by one of two basic process methods, according to type. These are:

- wet process
- dry process.

Wet process fibreboards are made by reducing steamed wood into fibres and adding water to form a slurry. This is then formed into a mat on a moving wire mesh. During processing, much of the water is removed by pressing and the final heated pressing promotes bonding of the fibres using the adhesive properties of the natural lignin adhesive present in the wood.

Depending upon the degree of pressing involved and hence the final density of the panel, the product is termed softboard, mediumboard or hardboard. Additives are sometimes included to improve properties.



Figure 1.6: Wet process fibreboards

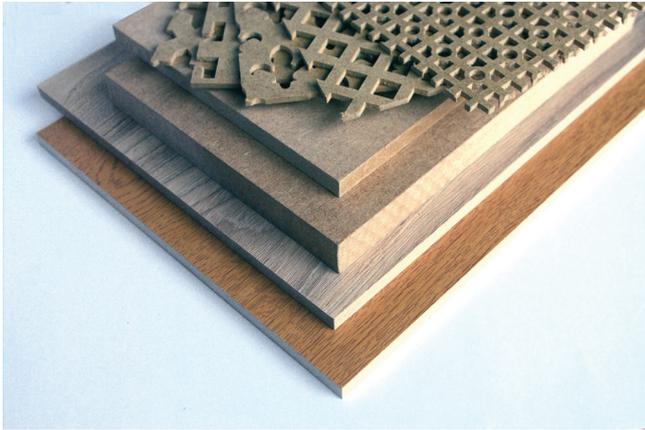


Figure 1.7: Dry process fibreboards

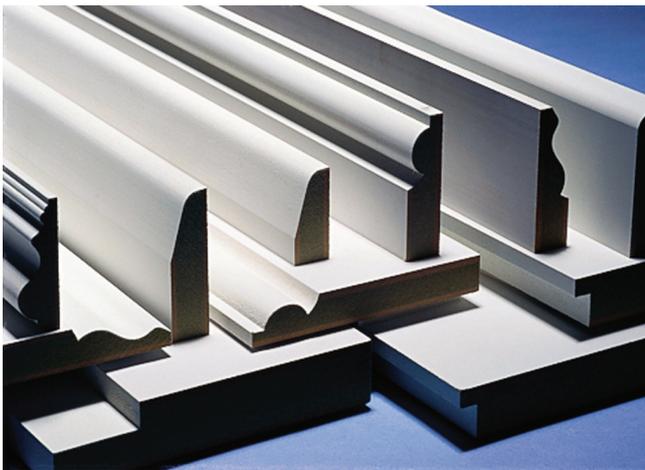


Figure 1.8: MDF rail and skirting

In the case of dry process fibreboards, the wet fibres are dried and an adhesive is added. This is then formed into a mat and pressed in a similar way to particleboard. The resulting product is generally termed medium density fibreboard (MDF) and should not be confused with the wet process mediumboard.

The current British Standard for fibreboards is *BS EN 622*. This is divided into five parts as follows:

- *BS EN 622-1 Fibreboards. Specifications. General requirements*<sup>13</sup>
- *BS EN 622-2 Fibreboards. Specifications. Requirements for hardboards*<sup>14</sup>
- *BS EN 622-3 Fibreboards. Specifications. Requirements for mediumboard*<sup>15</sup>
- *BS EN 622-4 Fibreboards. Specifications. Requirements for softboard*<sup>16</sup>
- *BS EN 622-5 Fibreboards. Specifications. Requirements for dry process boards (MDF)*<sup>17</sup>

Within parts 2 to 5 of *BS EN 622*, there is a series of grades of product defined according to:

- suitability for use in dry, humid and exterior conditions
- application – general purpose, load-bearing, heavy-duty load-bearing.

The wide range of panel types within the fibreboard family means they have a wide range of properties and end uses. While some fibreboards are available in load-bearing grades, most of the types are not intended for structural applications.

Typical end uses of fibreboards include flooring and roofing overlays, internal wall linings, roof sarking and wall sheathing. MDF is commonly used for architectural mouldings, staircases and window boards.

Further information on fibreboards, their properties and uses can be found in PanelGuide Annex 2E and Annex 2F.

## 1.11 References

- 1 Construction Products Regulation (CPR), Regulation 305/2011/EU
- 2 BS EN 13986. Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking, BSI
- 3 BS EN 636. Plywood. Specifications, BSI
- 4 BS EN 1995-1-1. Eurocode 5: Design of timber structures. General. Common rules and rules for buildings, BSI
- 5 BS 5268-2. Structural use of timber. Code of practice for permissible stress design, materials and workmanship [WITHDRAWN], BSI
- 6 BS EN 309. Particleboards. Definition and classification, BSI
- 7 BS EN 312. Particleboards. Specifications, BSI
- 8 BS EN 12369-1. Wood-based panels. Characteristic values for structural design. OSB, particleboards and fibreboards, BSI
- 9 BS EN 300. Oriented strand boards (OSB). Definitions, classification and specifications, BSI
- 10 BS EN 15197. Wood-based panels. Flaxboards. Specifications, BSI
- 11 BS EN 634-1. Cement-bonded particle boards. Specification. General requirements, BSI
- 12 BS EN 634-2. Cement-bonded particleboards. Specifications. Requirements for OPC bonded particleboards for use in dry, humid and external conditions, BSI
- 13 BS EN 622-1. Fibreboards. Specifications. General requirements, BSI
- 14 BS EN 622-2. Fibreboards. Specifications. Requirements for hardboards, BSI
- 15 BS EN 622-3. Fibreboards. Specifications. Requirements for mediumboard, BSI
- 16 BS EN 622-4. Fibreboards. Specifications. Requirements for softboard, BSI
- 17 BS EN 622-5. Fibreboards. Specifications. Requirements for dry process boards (MDF), BSI

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