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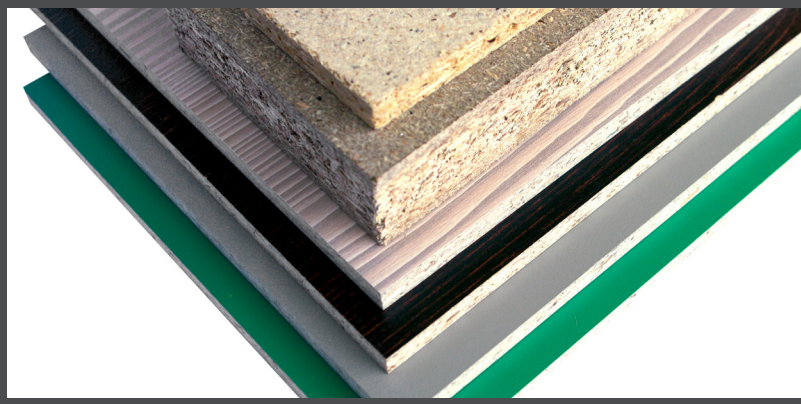
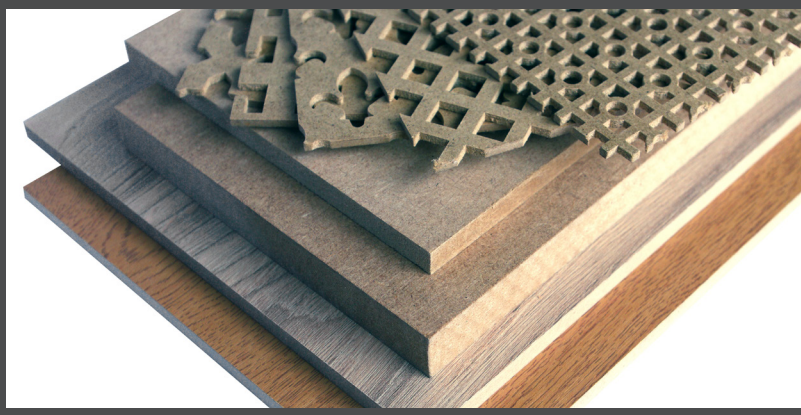
Panel Guide

Version 4







Annex 2A: Particleboard (wood chipboard)

Description

Particleboard as defined in the European Standard *BS EN 309 Particleboards. Definition and classification*[1] 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'. Particleboard should not be mistaken for flaxboards made to *BS EN 15197 Wood-based panels. Flaxboards. Specifications*[2] (see *Annex 2G*). In the UK, particleboard is made from wood and is traditionally known as wood chipboard.

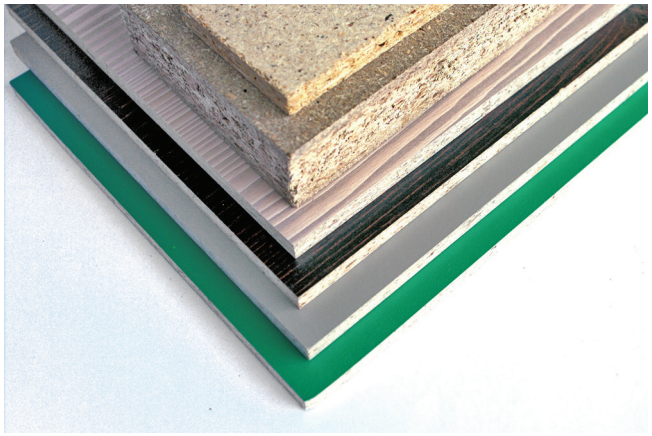


Figure A2.1: Particleboard

The particleboard industry in the UK dates from the 1940s and originated in a time of austerity with the purpose of utilising waste timber. The process of manufacture was quite crude compared to the present time and reproducibility of quality was relatively poor. Over the years the application of new technologies in both production and control, together with the production of tailor-made chips from solid softwood, as well as the use of more sophisticated resin systems, has led to the production of huge quantities of a range of panels having a known and reproducible performance.

Composition

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 binding system employed depends on the intended end use and the grade of the product. The most common resin employed is urea-formaldehyde, but this is only suitable for use in dry conditions: the other three resin systems confer a measure of moisture resistance to the composite.

Typical constituents of particleboard are of the order (by mass) of:

- wood chips 83% to 88%
- formaldehyde based resin 6% to 8% or PMDI 2% to 3%
- water 5% to 7%
- paraffin wax solids 1% to 2%.

Appearance

Particleboard has smooth, sanded surfaces. In order to achieve this smooth surface, the panel density is increased at the faces by the use of smaller wood particles with a larger percentage of resin binder compared to the core of the panel.

Generally, particleboard has a pale straw colour, but for identification purposes the whole panel, or individual layers of the panel, may be dyed according to industry practices (eg green for panels with enhanced moisture resistance, or red for panels integrally treated with flame-retardant chemicals). The presence of a coloured surface does not in itself infer that these enhanced properties are present and reference should always be made to panel markings or manufacturer's literature to confirm such enhanced performance. Integral colouring is distinct from the voluntary coloured stripe system that may be applied on the outside edge of panels in a pack, at opposite corners, to identify particular grades in accordance with BS EN Standards (for example Annex A of *BS EN 312 Particleboards. Specifications*[3]).

Density, mass and panel size

Panel density (and therefore panel mass) varies depending upon the product, being affected by the timber species and the process used in manufacture. Typical densities are 600 kg/m^3 to 680 kg/m^3. For example a 2400mm × 1200mm × 19mm panel will weigh approximately 36kg.

Panel sizes commonly available are:

- 1830mm × 1200mm
- 2440mm × 1220mm
- 2750mm × 1220mm
- 3050mm × 1220mm
- 3660mm × 1220mm

in thicknesses of: 2.5mm, 3.2mm, 6mm, 9mm, 12mm, 15mm, 18mm, 19mm, 22mm, 25mm, 30mm and 38mm.

Other sizes are available or can be produced to order. Panels are produced with either square or tongued and grooved (T&G) edges.

Applications

The special properties of particleboard have several advantages in a wide range of construction and furniture applications.

In construction applications its good mechanical performance, which is the same along and across the panel, and its availability in large sizes renders it appropriate for use as floor decking, either on timber joists or as a floating floor system. Different grades of the product are available for different environmental conditions and different levels of loading, ranging from domestic to industrial usage, including both platform and raised access floors. The higher grades also find widespread use in industrial storage systems. Guidance on the use of load-bearing grades of particleboard in floors, walls and roofs is given in *DD CEN/TS 12872 Wood-based panels. Guidance on the use of load-bearing boards in floors, walls and roofs*[4], see also PanelGuide *Section 2.2*.

Large quantities of particleboard are also used in the manufacture of kitchen units and worktops, as well as in dining-room and bedroom units; these generally have a veneered or laminated finish.

Specification

Particleboard manufactured in Europe and used in construction must be specified in accordance with *BS EN 312*. As explained in PanelGuide *Section 2*, particleboard that is used in construction must comply (by law) with the Construction Products Regulation (CPR)[5] by compliance with the harmonised European standard (hEN) for wood-based panels (*EN 13986*, implemented in the UK as *BS EN 13986 Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking*[6]); this standard calls up *BS EN 312*, which contains the requirements for the following seven grades (technical classes):

- P1: general purpose boards for use in dry conditions
- P2: boards for interior fitments (including furniture) for use in dry conditions
- P3: non load-bearing boards for use in humid conditions
- P4: load-bearing boards for use in dry conditions
- P5: load-bearing boards for use in humid conditions
- P6: heavy duty load-bearing boards for use in dry conditions
- P7: heavy duty load-bearing boards for use in humid conditions.

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

Guidance on the selection of the different grades of particleboard is given in tabular format in PanelGuide *Sections 2.4 to 2.14*.

Physical properties

Climate

Like other wood-based panel products, particleboard is hygroscopic and its dimensions change in response to a change in humidity. A 1% change in moisture content typically increases or decreases the length, width and thickness of the different grades of particleboard by the amount set out in *Table A2.1*.

Table A2.1: Dimensional change for a 1% change in particleboard moisture content (DD CEN/TS 12872)

Grade	Dimensional change at 1% change in panel moisture content		
	Length %	Width %	Thickness %
P4 and P6	0,05	0,05	0,7
P5 and P7	0,03	0,04	0,5

Table A2.2: Expected moisture content of particleboard

Relative humidity at 20ºC	Approximate equilibrium moisture content
30%	7%
65%	11%
85%	15%

Particleboard, therefore, should be conditioned to bring it into equilibrium with its environment before it is fixed. This is usually achieved by loose stacking the panels in the room where they will be used prior to fixing them. The time required for the panels to achieve equilibrium moisture content will vary depending upon the temperature and relative humidity in the building (*Table A2.3*).

Table A2.3: Likely equilibrium moisture content of particleboards in various conditions

In a building with continuous central heating	7% to 9%
In a building with intermittent central heating	9% to 12%
In an unheated building	up to 15%

When components are factory produced for installation on site, it is essential that the site conditions are suitable to receive the components, with wet trades completed and the building dried out.

Panels with enhanced moisture resistance are not waterproof; the term 'moisture resistant' applies to the adhesive binder which (within limits defined by *BS EN 312*) will not break down in the presence of moisture. Physical wetting of all grades of particleboard should be avoided.

Biological attack

Particleboard will not normally be attacked by wood-boring insects common in temperate climates, but it is susceptible to fungal attack under prolonged wet conditions.

General guidance on the use of preservative treatments for panel products can be found in the Wood Protection

Association Manual *Industrial wood preservation specification and practice. Commodity Specification C11*[7]. This guidance assists with making the correct choice of preservatives for the end use and the panel product to be treated, as not all panel products need to be treated for particular end uses or are indeed suitable for some treatments. It also stresses that the preservative and/or the panel manufacturer should be consulted before any treatment is carried out as treatment may alter the physical and/or visual properties of the panel product.

Water vapour 'permeability'

The value of the water vapour resistance factor (μ) for particleboard varies with density and with the method of determination (*BS EN 12572*) as set out in *Table A2.4*, which is an extract from *BS EN 12524* and *BS EN 13986*.

Table A2.4: Water vapour resistance factor (μ) for particleboard

Mean density	Vapour resistance factor	
Kg/m³	Wet cup μ	Dry cup μ
300	10	50
600	15	50
900	20	50

Thermal conductivity

The thermal conductivity (λ) of particleboard as determined according to *BS EN 12664* varies with density as set out in *Table A2.5*, which is taken from *BS EN 13986*.

Table A2.5: Thermal conductivity (λ) of particleboard

Mean density ρ Kg/m³	Thermal conductivity λ W/(mK)
300	0.07
600	0.12
900	0.18

Reaction to fire

Under the Euroclass system for characterising the reaction to fire performance of materials, as taken from *European Commission Decision 2007/348/EC*, an untreated particleboard may be assumed to achieve the reaction to fire performance shown in *Table A2.6*.

If the manufactured product does not satisfy any of these minimum requirements and a reaction to fire claim is to be made in a Declaration of Performance (DoP) for CE marking purposes, then it must be tested and classified according to *BS EN 13501-1 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests*[8]. However if no claim is made in the DoP for CE marking purposes it is still possible to use the British standard system to make a separate claim.

Further information on the reaction to fire testing in both the BS and EN systems is provided in PanelGuide *Section 2.2.3*.

Storage and handling

Careful storage and handling is important to maintain panels in their correct condition for use; it is therefore imperative that particleboard is protected from rain and accidental soaking. During transport, it is particularly important to keep edges well covered. Panels should be stored flat in an enclosed, dry building. When handling panels, the edges and corners should be protected against damage.

Detailed guidance on the storage and handling of wood-based panel materials is given in *DD CEN/TS 12872* and PanelGuide *Section 4*.

Table A2.6: Reaction to fire classification without further testing of untreated particleboard

Product	EN Product standard	End use condition(6)	Minimum density (kg/m³)	Minimum thickness (mm)	Class (7) (excluding floorings)	Class (8) (floorings)
Particleboard(1),(2),(5)	BS EN 312	Without an air gap behind the wood-based panel	600	9	D-s2,d0	D_{fl}-s1
Particleboard(3),(5)	BS EN 312	With a closed or an open air gap not more than 22mm behind the wood-based panel	600	9	D-s2,d2	-
Particleboard(4),(5)	BS EN 312	With a closed air gap behind the wood-based panel	600	15	D-s2,d0	D_{fl}-s1
Particleboard(4),(5)	BS EN 312	With an open air gap behind the wood-based panel	600	18	D-s2,d0	D_{fl}-s1
Particleboard(5)	BS EN 312	Any	600	3	E	E_{fl}

(1) Mounted without an air gap directly against class A1 or A2-s1, d0 products with minimum density 10 kg/m³ or at least class D-s2, d2 products with minimum density 400 kg/m³
(2) A substrate of cellulose insulation material of at least class E may be included if mounted directly against the wood-based panel, but not for floorings
(3) Mounted with an air gap behind. The reverse face of the cavity shall be at least class A2-s1, d0 products with minimum density 10 kg/m³
(4) Mounted with an air gap behind. The reverse face of the cavity shall be at least class D-s2, d2 products with minimum density 400 kg/m³
(5) Veneered phenol- and melamine-faced panels are included for class excl. floorings
(6) A vapour barrier with a thickness up to 0,4mm and a mass up to 200 g/m² can be mounted in between the wood-based panel and a substrate if there are no air gaps in between
(7) Class as provided for in Table 1 of the Annex to Decision 2000/147/EC
(8) Class as provided for in Table 2 of the Annex to Decision 2000/147/EC
NOTE: The classes given in this table are for unjointed panels, T&G jointed panels installed according to *DD CEN/TS 12872* and fully supported joints installed according to *DD CEN/TS 12872*

Working with particleboard

Particleboard can be cut by a hand saw or power saw and machined (routed, spindled, planed and bored) with normal woodworking machinery. Tungsten carbide cutting edges are recommended for use with power tools.

Further information on working with particleboard is included in PanelGuide *Section 4.4*.

Mechanical joints and fixings

Wherever possible, fittings that depend upon face fixing should be selected; fittings that depend upon the expansion of a component inserted into the panel edge should be avoided.

Conventional woodworking fixings and techniques can be applied to particleboard which provides good holding power for screw fixings into the panel faces; generally, edge fixing is not recommended. Parallel core screws should be used because they have greater holding power than conventional wood screws. A high ratio of overall diameter to core diameter is desirable.

Pilot holes for all screw fixings are required. Typically, the holes should be 85% to 90% of the screw core diameter. Fixings into the panel face should not be within 8mm of edges and 25mm of the corners.

Nails and staples can be used for lightly loaded fixings or to hold glued joints while the adhesive sets.

Further information on fixing particleboard is included in PanelGuide *Section 4.5*.

Adhesive-bonded joints

A wide variety of jointing methods can be used, provided the following simple guidelines are observed:

- Ensure the joint parts are accurately machined.
- Use sharp cutters to avoid tearing or burnishing the surfaces to be bonded.
- Use a high solids content adhesive with low flowing properties such as polyvinyl acetate or urea-formaldehyde.
- Locate mating pieces accurately and hold them under pressure while the adhesive sets.
- Limit the width of grooves machined in particleboard to about one-third of the thickness of the panel. The depth of groove is typically about one-half of the panel thickness.
- Allow adhesive-bonded joints to condition for several days before sanding and finishing; this avoids the appearance of sunken joints and is essential with high-gloss finishes.
- For an efficient tongued and grooved joint ensure the fit of the joints is not too tight, as this can cause a split along the edge.
- For tongued and grooved flooring, apply glue liberally to both the tongue and the groove to ensure the entire joint is bonded.
- When attaching lipping, ensure the tongue is machined on the solid wood piece.

Finishing

The faces of particleboard are usually pre-sanded at manufacture to provide a smooth surface suitable for direct application of most veneers and plastic foils.

Additional information on finishing is provided in PanelGuide *Section 4.7*.

Health and safety

In panel or processed form, particleboard does not present any health or safety risk. Contact with wood products can cause irritation effects but the most significant risks come from mishandling the material.

Dust

Particleboard will generate dust when it is machined which, like any other wood dust, is defined as a potentially hazardous substance and must be controlled. There is no evidence that exposure produces health effects that are different in nature to those associated with exposure to similar levels of dust from other wood sources.

Dust from cutting operations can be controlled adequately by complying with the Control of Substances Hazardous to Health (COSHH) Regulations 2002. Under these Regulations particleboard dust has a Workplace Exposure Limit (WEL) of 5 mg/m^2 expressed as an 8-hour time-weighted average. Exposure must be reduced as far as possible below this limit, usually with properly designed and maintained dust extraction equipment fitted to woodworking machines.

Extraction equipment is often not practicable or even available when using portable or hand-held tools, so a suitable dust mask should be worn. If possible, work in a well-ventilated place.

Further information on dust and dust masks is given in PanelGuide *Section 6.3.3*.

Formaldehyde

Free formaldehyde in the workplace atmosphere has a WEL of 2 parts per million (ppm). However, studies indicate that anyone machining particleboard in mechanically ventilated situations is exposed to levels of free formaldehyde significantly below this.

Two classes of 'in service' formaldehyde potential are specified in *BS EN 13986*, Class E1 and Class E2, E2 being the higher of the two. The test methods available for determining the formaldehyde potential are:

- *BS EN 717-1 Wood-based panels. Determination of formaldehyde release. Formaldehyde emission by the chamber method*[9]
- *BS EN 120 Wood based panels. Determination of formaldehyde content. Extraction method called the perforator method*[10]
- for coated particleboard: *BS EN 717-2 Wood-based panels. Determination of formaldehyde release. Formaldehyde release by the gas analysis method*[11].

Table A2.7: Particleboard – common hazards and methods of control

Activity	Hazard	Control
Manual handling (in full panel form)	Large panel sizes present a risk of strain or crush injuries if not handled correctly	• Store carefully in uniform stacks on a flat level base • Use mechanical handling equipment • Adopt correct manual handling procedures
Carpentry work Activities likely to produce high dust levels include: • Sanding by machine and by hand • Sawing, routing and turning • Hand assembling machined or sanded components	• Wood dust in general (including dust from particleboard) has health risks – it may cause dermatitis and allergic respiratory effects • Wood dust is flammable	• Off site: preparation under exhaust ventilated plant • On site: enclosure and exhaust ventilation • Dust extraction on portable tools • Good ventilation • Respiratory protection equipment (RPE) Note: Any health hazards arising from the use of particleboard at work can and should be controlled by compliance with the requirements of the Control of Substances Hazardous to Health (COSHH) Regulations 2002

Manufacturers in the UK and Ireland do not offer standard grades of particleboard with Class E2 formaldehyde content. Further information on formaldehyde is given in PanelGuide *Section 6.4*.

Hazards and control

In panel or processed form, particleboard is non-classifiable under the COSHH Regulations. However, there may be handling hazards.

COSHH Regulation 6 requires an assessment of health risks associated with wood dust or formaldehyde (normally recorded), together with any action needed to prevent or control those hazards.

Table A2.7 presents the most common hazards and identifies control methods to minimise the risk of harm actually occurring, more detailed information is given in PanelGuide *Section 6.3* and by the Health and Safety Executive.

References

1 BS EN 309. Particleboards. Definition and classification, BSI

2 BS EN 15197. Wood-based panels. Flaxboards. Specifications, BSI

3 BS EN 312. Particleboards. Specifications, BSI

4 DD CEN/TS 12872. Wood-based panels. Guidance on the use of load-bearing boards in floors, walls and roofs, BSI

5 Construction Products Regulation (CPR), Regulation 305/2011/EU

6 BS EN 13986. Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking, BSI

7 WPA Manual: Industrial wood preservation specification and practice, 2nd edition, Wood Protection Association, April 2012

8 BS EN 13501-1. Fire classification of construction products and building elements. Classification using test data from reaction to fire tests, BSI

9 BS EN 717-1. Wood-based panels. Determination of formaldehyde release. Formaldehyde emission by the chamber method, BSI

10 BS EN 120. Wood based panels. Determination of formaldehyde content. Extraction method called the perforator method, BSI

11 BS EN 717-2 Wood-based panels. Determination of formaldehyde release. Formaldehyde release by the gas analysis method, BSI

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