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FACTS ABOUT PARTICLEBOARD AND MDF

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Standard Particleboard

Standard Particleboard is the standard, basic type of Particleboard product. It is not suitable for exterior use, or in interior areas where wetting or prolonged high humidity conditions are likely. Since Standard Particleboard is the standard or basic product, the practice has developed that the special products (MR and Flooring) are the ones specifically identified by name printed on the sheet or by colour code.

The binder system used for Standard Particleboard is urea formaldehyde. Paraffin wax is added to the surface layers to provide protection against accidental water spillage.

Standard Particleboard is manufactured by EWPAA Members in the following thicknesses:

Thin	9, 12 mm
Medium	15, 16, 16.5, 18, 20, 22mm
Thick	25, 28, 30, 33 mm
Thick Special	43 mm

(NOTE: Not all EWPAA Members manufacture all thicknesses).

Mechanical and Physical Properties

The Australian Standard (AS/NZS 1859) gives limit values for certain mechanical and physical properties. Table I gives typical values of these properties (rather than limit values) presented in 3 thickness classes:

Thin	up to 12 mm thick
Medium	13 – 22 mm thick
Thick	more than 23 mm thick

Table 1 - Typical Property Values for Standard Particleboard

Property	Units	Thickness Class - mm		
		<=12	13 - 22	>23
Density	kg/m^3	660 - 700	660 - 680	600 - 660
Bending Strength (MOR)	MPa	18	15	14
Bending Stiffness (MOE)	MPa	2800	2600	2400
Internal Bond Strength	MPa	0.6	0.45	0.40
Surface Soundness	MPa	1.25	1.30	1.30
Screw Holding - Face	N	-	600	700
Screw Holding - Edge	N	-	700	750
Thickness Swell (24 Hr)	%	15	12	8
Formaldehyde E1 (Desiccator Method)*	mg/l	1.0 – 1.5	1.0 – 1.5	1.0 – 1.5

*E0 Standard Particleboard is also available from some manufacturers. Refer to the EWPAA "Register of Certified Products" at http://www.ewp.asn.au/register.

Dimensional Tolerances

Dimensional Tolerances agreed to by EWPAA Members are given in the table below. In some cases, these are tighter tolerances than required by AS/NZS 1859 and may not apply to Particleboard from non-member producers.

Dimensional Tolerances

Property	Units	Thickness Class - mm		
		<12	13-22	>23
Length & Width – nominal	mm	+50	+50	+50
Length & Width	mm	±1.5	±1.5	±1.5
Thickness – Variation	mm	±0.2	±0.3	±0.3
Thickness – Profile	mm	±0.2	±0.3	±0.3
Flatness	m/mm	<1.5	<1.5	<1.5
Squareness	mm/m	<1.5	<1.5	<1.5
Edge Straightness	mm/m	<1.5	<1.5	<1.5

Moisture Properties

Particleboard, like other wood based products and many other building materials, will respond to changes in relative humidity of the surrounding air. Board dimensions are closely related to moisture content. Conditions likely to change the moisture content above or below the 8-12% range normally applying at dispatch from the factory, may give rise to problems. Particleboard should be conditioned to reach the humidity level in which it is to be used. Moisture content will normally be in the range 10-12% when used in buildings intended for human occupancy.

Measurement of moisture content may be achieved by weighing and drying or by using an electric moisture meter.

Absorption and Swelling

The most significant effect of moisture absorption by Particleboard is that of swelling in the thickness. Where this takes place there will be an amount of residual swelling after drying out. Standard Particleboard should not be used in applications where there is a risk of contact with water. MR Particleboard should be used in these cases, or the risk removed by effective protection of board surfaces and edges.

Dimensional Changes

When Standard Particleboard is exposed to changing relative humidity conditions —

- Linear dimensions will change about 0.03-0.06% for each 1% change in moisture content.
- Thickness change will be about 0.3-0.5% for each I % change in moisture content.

Thermal Properties

The Thermal Conductivity of Particleboard varies slightly according to thickness with the usual range being 0.10 to 0.14 W/mK.

Like natural timber, Particleboard has a low thermal capacity.

Within the normal range of temperature variation, Particleboard is dimensionally stable and its strength properties are unaffected.

Acoustic Properties

Sound Transmission Loss is another property that depends greatly on the building element and its method of installation. However as a general figure, Particleboard (16 mm and thicker) should achieve a sound transmission loss of 25 db.

Fire Behaviour

Fire Resistance

Fire Resistance relates to the period for which an element of construction will resist the passage of flame, remain free from collapse and insulate against an excessive temperature rise of the unexposed face. The property relates to a building element and its details of construction, rather than a particular material. Particleboard reacts generally to fire like natural timber. The rate of burning is similar and it does not shatter or delaminate.

Heat and Smoke Release Tests to AS/NZS 3837.1998 – Standard Particleboard

This test is relevant when the panel is to be used for wall and ceiling applications. In this test, EWPAA members' raw particleboard achieved the following results:

Av Heat Release	120 kW/m²
Av Specific Extinction Area	33 m²/kg
BCA Group Classification	3

Combustibility

Particleboard is combustible. The degree of combustibility varies according to the density and type of board. As with timber, burning will be limited by the formation of charcoal on the surface but shrinkage will tend to cause failure at the joint unless proper consideration has been given to its design.

Fire Hazard

Fire Hazard refers to the surface burning characteristics of a material and indicates whether a material will allow a fire to spread quickly. Smoke developed is also part of hazard assessment.

Fire Hazard is measured by procedures laid down in AS1530 Part 3 and is expressed as Indices. Typical results for Standard Particleboard are:

	Index	Range
Ignitability	13-14	0 - 20
Spread of Flame	6-7	0 - 10
Heat Evolved	6	0 - 10
Smoke Developed	3	0 - 10

Specific Building Regulations indicate where materials with specific Early Fire Hazard Indices can be used.

Bio-deterioration

As with most other wood products, Particleboard is susceptible to attack from wood destroying fungi and termites. However moisture contents of over 18% must be maintained before either form of bio-deterioration can occur. Under such conditions, Standard Particleboard should not be used.

Post treatment with brush-on preservatives will protect against the growth of surface mould which can disfigure the surface appearance.

Attack by wood-destroying beetles is possible but unlikely in Australia.

Particleboard Flooring

The Australian / New Zealand Particleboard Flooring Standard (AS/NZS 1860.1) defines two classes of flooring (Class 1 and Class 2) although Class 2 flooring is not approved for use in Australia. It also covers three products manufactured with special resistance, Fungus Resistant Flooring (designated F), Termite Resistant Flooring (H2) and Fire Retardant Flooring (FR).

Particleboard flooring is intended to be used in platform construction where it can be exposed to full weather conditions for up to three months.

Flooring manufactured by EWPAA Members has the following markings:

1. Manufacturer's Brand Name
2. EWPAA logo, Flooring Type (Class 1 or 2. Fungus, Termite or Fire resistant).
3. Reference to Australian Standard AS/NZS 1860.1.
4. Identification of top or bottom side for laying.
5. Floor joist span for which the board is designed.

Manufacture

Wood particles are coated with a resin, formed into a mat and pressed to cure the resin and produce the required board thickness. Again it is the resin used that differentiates Flooring from other types of Particleboard. Most of the Particleboard Flooring manufactured in Australia is made with large flakes, compared with the fine flakes used for Standard and MR Particleboard. However Flooring can be made from fine flakes, its principal difference lies in the resin system.

Particleboard Flooring currently manufactured by EWPAA Members is based on an MUPF resin system ie the resin used to bond flakes is a melamine - urea - phenol formaldehyde co-condensed resin. Some tannin formaldehyde resins are also used. These resins provide extra protection from moisture and weathering, in recognition of the use of Particleboard Flooring in platform construction.

Particleboard Flooring is available with a fungicide incorporated into the resin system to protect the board from fungus attack during service life. Particleboard Flooring is also manufactured with termiticide addition and with fire retardant treatment.

Particleboard Flooring is available in square edged sheet form, but most of the material is used with tongued and grooved edges. All EWPAA Members use a plastic inserted tongue, which allows easier, more accurate installation and is resistant to handling and transport damage.

Particleboard Flooring from EWPAA Members is also factory edge sealed to reduce uptake of moisture and resultant edge swelling during the period of weather exposure.

Product Range

Particleboard Flooring is manufactured by EWPAA Members in 3 thicknesses: 19, 22 and 25 mm. It is available as Class 1 flooring, and with fungus, termite and fire resistance.
(NOTE: Not all EWPAA Members manufacture all products).

In domestic house construction, 19 mm Flooring is used with joists at 450 mm spacing and 22 mm Flooring with joists at 600 mm spacing. Both 19 mm and 22 mm can also be used for non-domestic applications. 25 mm Flooring is specifically made for these purposes.

Consult individual manufactures for specific load/span/thickness information.

Mechanical & Physical Properties

The Australian Standard (AS/NZS 1860.1) gives limit values for certain mechanical and physical properties. Table 2 gives typical values of these properties (rather than limit values) presented for each product thickness).

Table 2 - Typical Property Values for Class 1 Particleboard Flooring

Property	Units	Thickness - mm		
		19	22	25
Density	kg/m^3	680	700	700
Bending Strength (MOR)	MPa	24	21	24
Bending Stiffness (MOE)	MPa	3500	3250	3750
Internal Bond Strength	MPa	0.70	0.75	0.80
Surface Water Absorption	g/m^2	50	50	50
Thickness Swell (24 hr)	%	3	3	2
Glue Bond Durability	MPa	5.5	5.5	6
Glue Bond Quality	MPa	12	12	12
Thickness Stability	%	11	11	11
Formaldehyde Potential (Desiccator Method) *	mg/L	1.3	1.3	1.3

*E0 Particleboard Flooring is also available from some manufacturers. Refer to the EWPAA "Register of Certified Products" at http://www.ewp.asn.au/register.

Dimensional Tolerances

Dimensional tolerances (for all thicknesses) for flooring sheets are given below. In some cases, these are tighter tolerances than required by AS/NZS1860.1 and may not apply to flooring from non-member producers.

Property	Units	Tolerance
Length & Width	mm	+ 1.5
Thickness	mm	+ 0.4
Squareness	mm/m	< 0.5
Edge Straightness	mm/m	< 0.5

Structural Performance

The main applications for Particleboard Flooring are domestic flooring. However it can be used in buildings where design loads are in excess of domestic loadings; buildings such as sporting and community halls, educational institutions, light industrial and commercial areas. Design loads for these applications are given in the SAA Loading Code Part I - Dead and Live Loads (AS/NZS1170 Part 1).

Domestic usage is based on design loads of 2.0kPa Uniformly Distributed Load and 1.8kN Concentrated Load. Particleboard flooring can be used in applications where Uniformly Distributed Loads are up to 4.0kPa and Concentrated Loads up to 2.7kN.

Manufacturers' instructions should be consulted for applications with these non-domestic loadings.

Moisture Properties

Particleboard, like other wood based products and many other building materials, will respond to changes in relative humidity of the surrounding air. Board dimensions are closely related to moisture content. Ex-factory moisture content is about 10% with a usual range of ± 2%.

Dimensional Changes

The highest potential for moisture movement exists when Particleboard Flooring is exposed to the weather as platform construction. Sheets that have been left exposed on a building site should be dried out before installation so as to avoid shrinkage gaps later.

Consult Flooring Installation Sheets (AI 1 and AI 2) for practical information relating to moisture effects for Platform Construction and Fitted Floor Construction.

Fire Behaviour

Fire Resistance

Fire resistance relates to the period for which an element of construction will resist the passage of flame, remain free from collapse and insulate against an excessive temperature rise on the unexposed face. The property relates to a building element and its details of construction, rather than a particular material. Particleboard reacts generally to fire like natural timber, the rate of burning is similar and it does not shatter or delaminate.

Fire Hazard

Fire Hazard refers to the surface burning characteristics of a material and indicates whether a material will allow a fire to spread quickly. Smoke developed is also part of hazard assessment.

Fire Hazard is measured by procedures laid down in AS1530 Part 3 and is expressed as indices. Typical results for Particleboard Flooring are:

	Index	Range
Ignitability	12-13	0 - 20
Spread of Flame	6-7	0 - 10
Heat Evolved	7-8	0 - 10
Smoke Developed	2-3	0 - 10

Specific Building Regulations indicate where flooring with these Early Fire Hazard Indices can be used.

Thermal Properties

The Thermal Conductivity of Particleboard Flooring varies slightly according to thickness with a typical figure being 0.13 W/mK.

Like natural timber, Particleboard has a low thermal capacity. Used as flooring, it is warm to the touch, which contributes to comfort.

Within the normal range of temperature variation, Particleboard is dimensionally stable and its strength properties are unaffected.

Acoustic Properties

Sound transmission loss is another property that depends greatly on the building element and its method of installation. However, as a general figure, Particleboard flooring should achieve a sound transmission loss of at least 25 db.

The transmission of impact sound is the most likely form of sound transmission with timber floor systems; ie the noise of footsteps reaching a room below. The simplest solution to this problem though is the use of soft floor coverings - carpets or rugs. The prevention of impact sound transmission via structural design involves the use of damping materials between sheet flooring and joists and some mass in the sub-floor space (such as dry sand) to attenuate direct sound transmission.

Bio-deterioration

As with most other wood products, Particleboard is susceptible to attack from wood destroying fungi and termites. However moisture contents of over 18% must be maintained before either form of biodeterioration can occur.

Moist conditions are more likely to occur with flooring than with most other applications for Particleboard. Information on prevention of moisture build-up is provided in Applications & Installation Sheet 1 - Domestic Flooring.

Fungus resistant Particleboard Flooring should be used where there are any doubts about preventing moisture build-up or liquid water contact. Such cases may arise with difficult soil drainage conditions under the floor or where experience indicates a risk of leaks from shower recesses, plumbing or overflowing appliances. However it should be realised that Particleboard Flooring, like other wood products, will not perform satisfactorily if its full service life is under saturated conditions.

Particleboard Flooring is also available with termite and fire resistance.

Moisture Resistant Particleboard

Moisture Resistant (MR) Particleboard displays a high degree of resistance to moisture.

Individual sheets of MR Particleboard can usually be identified by a green colouration of the core of the board, visible on board edges. Pack identification is facilitated by a vertical green stripe, approximately 50 mm wide, down the right hand edge of each pack, on the same face as the label.

MR Particleboard is manufactured by EWPAA Members in the following thicknesses:

Thin	9, 12 mm
Medium	15, 16, 17, 18mm
Thick	25, 30, 33 mm

(NOTE: Not all EWPAA Members manufacture all thicknesses).

Manufacture

The manufacturing process of MR Particleboard is as outlined in EWPAA Data Sheet 1 - Manufacture. Wood particles are coated with a resin, formed into a mat and pressed to cure the resin and produce the required thickness. It is, however, the resin used that differentiates MR Particleboard from Standard Particleboard. Current MR Particleboard manufactured by EWPAA members, uses a melamine-urea formaldehyde (MUF) resin (plus other additives), with a substantial melamine content. Because MUF resin cures to a clear film, similar to UF resin, a green dye is added to the resin mixture for the core flakes, to enable MR Particleboard to be distinguished from Standard Particleboard. MR Particleboard manufactured from other moisture resistant resins (such as phenol formaldehyde, tannin formaldehyde or co-condensates of these with urea formaldehyde) will be dark brown in colour and so readily distinguished from the UF bonded product. The green colouration is only necessary if MUF resin is used.

Wax emulsion is also included in the resin system for MR Particleboard. Wax imparts resistance to the penetration of liquid water by providing water repellent properties to board surfaces.

Mechanical and Physical Properties

Compared with Standard Particleboard, MR Particleboard has higher Bending Strength and Stiffness and higher Internal Bond Strength. Of particular importance are controls on thickness swelling after 24 hours water immersion, and limits on loss of bending and internal bond strength after various simulated durability tests. Typical property values are given in Table 3.

Table 3 - Typical Property Values for MR Particleboard

Property	Units	Thickness Class - mm		
		<=12	13-22	>23
Density	kg/m^3	670	640 - 670	600 - 650
Bending Strength (MOR)	MPa	19	18	16
Bending Stiffness (MOE)	MPa	3000	2800	2700
Internal Bond Strength	MPa	1.00	0.85	0.75
Surface Soundness	MPa	1.70	1.70	1.60
Screw Holding - Face	N	-	800	800
Screw Holding - Edge	N	-	1100	900
Thickness Swell (24hr)	%	6 - 7	3 - 4	3 - 4.5
Cyclic Test - Internal Bond	MPa	0.50	0.41	0.26
Cyclic Test - Thickness Swell	%	10 - 12	9	8 - 12
Formaldehyde (Desiccator Method) *	mg/L	1.0-1.5	1.0-1.5	1.0-1.5

*E0 MR Particleboard is also available from some manufacturers. Refer to the EWPAA "Register of Certified Products" at http://www.ewp.asn.au/register.

Dimensional Tolerances

Dimensional Tolerances agreed to by EWPAA Members are given in the table below. In some cases, these are tighter tolerances than required by the Australian Standard and may not apply to Particleboard from non-member producers.

Dimensional Tolerances

Property	Units	Thickness Class - mm		
		<12	13-22	>23
Length & Width – nominal	mm	+ 50 + 1.5	+ 50 + 1.5	+ 50 + 1.5
Length & Width – cut to size	mm	+ 0.3 + 0.3	+ 0.3 + 0.3	+ 0.3 + 0.3
Thickness – Variation	mm	<1.5	<1.5	<1.5
Thickness – Profile	mm	<1.5	<1.5	<1.5
Flatness	mm/m	<1.5	<1.5	<1.5
Squareness	mm/m	+ 50 + 1.5	+ 50 + 1.5	+ 50 + 1.5
Edge Straightness	mm/m	+ 0.3 + 0.3	+ 0.3 + 0.3	+ 0.3 + 0.3

Moisture Properties

Board dimensions are closely related to moisture content and the effect of long exposure to high humidity conditions may give rise to problems where close tolerances are required. Particleboard should be conditioned to reach equilibrium with the humidity level in which it is to be used. Moisture content will normally be in the range of 10-12% when used in air-conditioned buildings.

For other buildings, boards may require conditioning to higher or lower moisture contents with the range possibly covering 6-14%. This conditioning is important where close tolerances are required.

Measurement of moisture content may be achieved by weighing and drying or by using an electric moisture meter.

MR Particleboard is intended for use in areas where there is continued high humidity conditions or the occasional risk of wetting. Despite careful attention to performance after exposure to water, MR Particleboard should not be used in circumstances where continued wetting is likely. If the board is continually wet, degradation may occur through glue bond breakdown and through fungal attack.

Absorption and Swelling

MR Particleboard exhibits much slower response to wetting than does Standard Particleboard. While thickness swelling and residual swelling after drying out are also much lower, the slow response rate is a major practical advantage in minimising moisture effects. Residual thickness swell should be unnoticeable unless the board receives a prolonged soaking.

Permeability to Moisture Vapour

Moisture vapour will slowly permeate Particleboard; a typical figure for 13 mm MR Particleboard is 4.6 x 10 2 g/m^2 mmHg.

Dimensional Changes

When MR Particleboard is exposed to changing relative humidity conditions -

- Linear dimensions will change about 0.03 - 0.06% for each 1% change in moisture content.
- Thickness change will be about 0.03 - 0.5% for each 1% change in moisture content.

Handling and Storage

Although these boards are defined as moisture resistant, there is a likelihood of some swelling in thickness and change in dimensions if they are exposed to the elements for protracted periods. Care should therefore be taken to ensure that boards are not neglected in storage or on site. Planners should make the same considerations and take the same precautions with MR Particleboard as they would for Standard Particleboard.

Fire, Thermal, Acoustic Properties

Behaviour of MR Particleboard is similar to that of Standard Particleboard – click here.

Bio-deterioration

As with most other wood products, Particleboard is susceptible to attack from wood destroying fungi and termites. However moisture contents of over 18% must be maintained before either form of bio-deterioration can occur. Since MR Particleboard is intended for use in applications where there is likely to be moisture, bio-deterioration is a higher risk than for Standard Particleboard which must not be used in potentially damp applications.

However the cautionary note discussed under "Moisture Content" must be recalled here. MR Particleboard is intended for use in areas of high humidity or occasional water spillage. The material cannot be expected to perform satisfactorily if continually wet.

Board may be manufactured with fungus resistance. Post treatment with a brush-on preservative will provide surface protection. This will also retard the growth of moulds, which are not wood destroying, but can disfigure the surface appearance under damp conditions.

Standard MDF

This section applies to standard, general purpose, Medium Density Fibreboard (MDF) with a density range of about 650 to 850 kg/m3. The Australian Standard (AS/NZS 1859.2) includes three other general purpose dry-processed fibreboards – Ultra Low Density, Low Density and High Density. These are special products and their availability and application should be confirmed from manufacturers.

Standard MDF is designed for general purpose interior use only and is not suitable for exterior use or interior areas where wetting or high humidity conditions are likely.

Medium Density Fibreboard is manufactured from fibres or fibre bundles produced from wood by a mechanical refining process carried out at elevated temperature. A synthetic resin binder, typically urea formaldehyde, is added to impart strength properties and paraffin wax to provide protection against accidental water spillage.

Standard MDF is manufactured by EWPAA Members in the following thicknesses:

Thin	2.5, 2.7, 3, 3.2, 3.6, 4, 4.5, 4.75, 5.5, 6, 7.5, 9 mm
Medium	12, 15, 16, 17, 18, 20, 21 mm
Thick	24, 25, 30, 32, 32.8 mm

(NOTE: Not all EWPAA Members manufacture all thicknesses).

Mechanical and Physical Properties

Table 4 lists various mechanical and physical properties of Standard MDF.

Table 4 - Typical Property Values for Standard MDF

Property	Units	Thickness Class - mm			
		<=5	6 - 12	13 - 22	>23
Density	kg/m^3	800-850	775	725	650 -700
Bending Strength (MOR)	MPa	44	42	38	30 - 40
Bending Stiffness (MOE)	MPa	3800	3500	3300	3200
Internal Bond Strength	MPa	1.15	1.0	0.75	0.6
Surface Soundness	MPa	0.7	1.0	1.3	1.4
Screw Holding - Face	N	-	-	800	850
Screw Holding - Edge	N	-	-	1150	1000
Thickness Swell (24 Hr)	%	20-30	10-20	8-12	5-8
Formaldehyde E1 (Desiccator Method)*	mg/L	0.7 - 1.0	0.7 - 1.0	0.7 - 1.0	0.7 - 1.0

*E0 Standard MDF is also available from some manufacturers. Refer to the EWPAA "Register of Certified Products" at http://www.ewp.asn.au/register.

Dimensional Tolerances

The following dimensional tolerances are typical for MDF produced by EWPAA members:

Dimensional Tolerances

Property	Units	Tolerance
Length & Width	mm	+ 5 - 1.5
Length & Width (Cut to Size)	mm	+ 2
Thickness – Unsanded	mm	+ 0.4
Squareness	mm/m	1.5
Edge Straightness	mm/m	1.5

Moisture Properties

MDF, like other wood based products and many other building materials, will respond to changes in relative humidity of the surrounding air. Board dimensions are closely related to moisture content. Conditions likely to change the moisture content above or below the 7 - 12% range normally applying at dispatch from the factory should be conditioned to reach the moisture content in which it is to be used. Moisture contents will normally be in the range 10 - 12% when used in buildings intended for human occupancy.
Measurement of moisture content may be achieved by weighing and drying or by using an electric moisture meter.

Absorption & Swelling

The most significant effect of moisture absorption by MDF is that of swelling in the thickness. Where this takes place, there will be a small amount of residual swelling after the product has dried out. Standard MDF should not be used in applications where there is a risk of contact with water. MR MDF should be used in these cases, or the risk removed by adequate sealing of faces and edges.

Dimensional Changes

When Standard MDF is exposed to changes in relative humidity, it changes in length about 0.03 - 0.06% for every 1% change in moisture content. In thickness, the panel will change by 0.3 - 0.5% for each change in moisture content. These values relate to a linear hygro expansion of 0.3% from 30% to 90% relative humidity and a thickness expansion of 6% from 30% to 90% relative humidity.

Thermal Properties

The thermal conductivity of MDF varies slightly with thickness with the usual range being 0.05-0.08 kcal/mh°C (0.12 - 0.15 W/m°K).

Like natural timber, MDF has a low thermal capacity. Within the normal range of temperature variation, MDF is dimensionally stable and its strength unaffected.

Acoustic Properties

Sound transmission loss is a property that depends greatly on the building element and its method of installation. However, as a general figure, MDF of a thickness of 16mm and thicker should achieve a sound transmission class of STC - 29.

Fire Behaviour

Fire Resistance

Fire resistance relates to the period for which an element of construction will resist the passage whether a material will allow a fire to spread of flame, remain free from collapse and insulate against an excessive temperature rise on the unexposed face. The property relates to a building element and its details of construction, rather than a particular material. MDF reacts generally to fire like natural timber. The rate of burning is similar and it does not shatter or delaminate.

Combustibility

MDF is combustible. The degree of combustibility depends on type and density of the board. As with timber, burning will be limited by the formation of charcoal on the surface but shrinkage will tend to cause failure at joints, unless proper consideration has been given to design.

Fire Hazard

Fire hazard refers to the surface burning characteristics of a material and indicates whether a material will allow a fire to spread quickly. Smoke developed is also part of the hazard assessment. Fire hazard is measured by procedures laid down in AS1530 Part 3 and is expressed as indices. Typical results for Standard MDF are:

	Index	Range
Ignitability	15	0 - 20
Spread of Flame	7-8	0 - 10
Heat Evolved	6-9	0 - 10
Smoke Developed	3-5	0 - 10

Specific building regulations indicate where materials with specific early fire hazard indices can be used.

Heat and Smoke Release Tests to AS/NZS 3837.1998 – Standard Particleboard

This test is relevant when the panel is to be used for wall and ceiling applications. In this test, EWPAA members' raw MDF achieved the following results:

Av Heat Release	84 kW/m²
Av Specific Extinction Area	72 m²/kg
BCA Group Classification	3

Bio-deterioration

As with most other wood products, MDF is susceptible to attack from wood destroying fungi and termites. However, moisture contents of over 18% must be maintained before fungal attack can occur. Under such conditions, Standard MDF should not be used. Post treatment with brush on preservatives will protect against the growth of surface mould which can disfigure the surface appearance. Attack by wood destroying beetles is possible, but unlikely in Australia.

Moisture Resistant MDF

This section applies to Moisture Resistant (MR) Medium Density Fibreboard (MDF) with a density range of about 650 to 850 kg/m³. The Australian Standard (AS/NZS 1859.2) includes two other moisture resistant dry-processed fibreboards - High Density and High Performance MDF. These are special products and their availability and application should be confirmed from manufacturers.

MR MDF is suitable for areas of high relative humidity and occasional wetting.

As yet there is no uniform marking system that has been adopted by manufacturers. Some mark the pack edges with a vertical green stripe, some put a faint green dye in the core of each panel, and some colour the whole board with green dye.

MR Medium Density Fibreboard is manufactured from fibres or fibre bundles produced from wood by a mechanical refining process carried out at elevated temperature. A synthetic resin binder, typically melamine urea formaldehyde, is added to impart strength and moisture resistant properties and paraffin wax to provide protection against accidental water spillage.

MR MDF is manufactured by EWPAA Members in the following thicknesses:

Thin	2.7, 3.2, 7.5, 9, 10 mm
Medium	12, 15, 16, 18 mm
Thick	25, 32 mm

(NOTE: Not all EWPAA Members manufacture all thicknesses).

Mechanical and Physical Properties

Table 5 lists various mechanical and physical properties of Standard MDF.

Table 5 - Typical Property Values for Standard MDF

Property	Units	Thickness Class - mm		
		<=5	6 - 12	13 - 25
Density	kg/m^3	820 -850	750 - 810	700 - 750
Bending Strength (MOR)	MPa	55	45 - 60	40
Bending Stiffness (MOE)	MPa	4250	4250	3750
Internal Bond Strength	MPa	1.6	1.2	1
Surface Soundness	MPa	1.1	1.3	1.5
Screw Holding - Face	N	-	-	800
Screw Holding - Edge	N	-	-	1400
Thickness Swell (24 Hr)	%	18	6 - 10	4 - 5
Cyclic Test – Internal Bond	MPa	0.8	0.6	0.3 - 0.4
Cyclic Test – Thickness Swell	%	12	10	5 - 10
Formaldehyde E1 (Desiccator Method)*	mg/L	0.7-1.0	0.7-1.0	0.7-1.0

*E0 MR MDF is also available from some manufacturers. Refer to the EWPAA "Register of Certified Products" at http://www.ewp.asn.au/register.

Dimensional Tolerances

Producers in Australia work to the following dimensional tolerances:

Dimensional Tolerances

Property	Units	Tolerance
Length & Width	mm	+ 5 - 1.5
Length & Width (Cut to Size)	mm	+ 2
Thickness – Unsanded	mm	+ 0.4
Squareness	mm/m	1.5
Edge Straightness	mm/m	1.5

Moisture Properties

MDF, like other wood based products and many other building materials, will respond to changes in relative humidity of the surrounding air. Board dimensions are closely related to moisture content. Conditions likely to change the moisture content above or below the 7 - 12% range normally applying at dispatch from the factory may give rise to the dimensional movement. MDF should be conditioned to reach the humidity level in which it is to be used. Moisture contents will normally be in the range 10 - 12% when used in buildings intended for human occupancy.

Measurement of moisture content may be achieved by weighing and drying or by using an electric moisture meter.

MR MDF is intended for use in areas, which experience high relative humidity or the occasional risk of wetting. Despite the careful attention to performance after exposure to water, MR MDF should not be used in circumstances where continued wetting is likely. If the board is continually wet, degradation may occur through glue bond breakdown and fungal attack.

Absorption and Swelling

The most significant effect of moisture absorption by MDF is that of swelling in the thickness. Where this takes place there will be a small amount of residual swelling after the product has dried out. MR MDF exhibits a much slower response to wetting than does Standard MDF. While thickness swelling and residual swelling after drying out are also much lower, the slow response rate is a major practical advantage in minimising moisture effects. Residual thickness swelling should be unnoticeable unless the panel receives a prolonged soaking.

Dimensional Changes

When MR MDF is exposed to changes in relative humidity, it will change in length by 0.03 - 0.06% for every 1% change in moisture content.

In thickness, the panel will change by 0.3 - 0.5% for each 1% change in moisture content. These values relate to a linear hygro expansion of 0.3% from 30% to 90% relative humidity and a thickness expansion of 6% from 30% to 90% relative humidity.

Thermal Properties

The thermal conductivity of MDF varies slightly with thickness with the usual range being 0.05 - 0.08 kcal/mh°C (0.12 - 0.15 W/m°K).

Like natural timber, MDF has a low thermal capacity. With the normal range of temperature variation, MDF is dimensionally stable and its strength unaffected.

Acoustic Properties

Sound transmission loss is a property that depends greatly on the building element and its method of installation. However, as a general figure, MDF of a thickness of 16 mm and thicker should achieve a sound transmission class of STC - 29.

Fire Behaviour

Fire Resistance

Fire resistance relates to the period for which an element of construction will resist the passage of flame, remain free from collapse and insulate against an excessive temperature rise on the unexposed face. The property relates to a building element and its details of construction, rather than a particular material. MDF reacts generally to fire like natural timber. The rate of burning is similar and it does not shatter or delaminate.

Combustibility

MDF is combustible. The degree of combustibility depends on type and density of the board. As with timber, burning will be limited by the formation of charcoal on the surface but shrinkage will tend to cause failure at joints, unless proper consideration has been given to design.

Fire Hazard

Fire hazard refers to the surface burning characteristics of a material and indicates whether a material will allow a fire to spread quickly. Smoke developed is also part of the hazard assessment.

Fire hazard is measured by procedures laid down in AS 1530 Part 3 and is expressed as indices. Typical results for MDF are:

	Index	Range
Ignitability	14	0 - 20
Spread of Flame	8	0 - 10
Heat Evolved	7	0 - 10
Smoke Developed	4	0 - 10

Specific building regulations indicate where materials with specific early fire hazard indices can be used.

Bio-deterioration

As with most other wood products, MDF is susceptible to attack from wood destroying fungi and termites. However, moisture contents of over 18% must be maintained before fungal attack can occur. Since MR MDF is intended for use in applications where there is likely to be moisture, bio-deterioration is a higher risk than for Standard MDF which must not be used in potentially damp applications.

The material cannot be expected to perform satisfactory if continually wet. Boards may be manufactured with fungicide additives or have a brush on post treatment preservative to protect against surface moulds which although are not wood destroying, will cause a certain amount of surface disfigurement under damp conditions.

Attack by wood destroying beetles is possible, but unlikely in Australia.

Machining, Jointing and Fixing

This sheet describes basic principles of machining and fixing Particleboard and Medium Density Fibreboard (MDF). Any specific requirements related to a particular end use are dealt with in the relevant Installations and Applications sheets.

Particleboard and MDF are simply worked with normal woodworking tools. The uniform and consistent character of the material coupled with a non-directional grain, allows conventional techniques and machines to be readily and economically applied with constant results. Precision techniques are best suited to the machining of these wood panels and when extended to jointing and assembly the user will derive the greatest advantage from the use of the material.

Machining

Particleboard and MDF can be sawn, routed, spindled, planed or bored. The rate of feed should generally be slower than that used for natural timber and cutting edges should be kept thoroughly sharp. This is particularly important in the case of plastic laminate-faced boards as otherwise the edges may bell or spread slightly.

Sawing - Plain Particleboard and MDF

As the grain direction of the wood particles and fibres in Particleboard and MDF are of a random pattern, saw blades with cross-cutting tooth forms should be used.

Handling During Sawing

Control over the board during machining is important; boards should be properly supported and pressed down firmly against the cutting table and guides to avoid vibration. The most satisfactory results will be obtained with a constant rate of feed which should not exceed 23 m/mm. Generally mechanical feeding, though not essential, is recommended. Because of the difficulty in adequately controlling long boards, a travelling saw will often produce a more satisfactory result.

The projection of the saw above the board has a direct influence on the cleanliness of the cut. Breaking out or chipping of the top surface will occur if it is insufficient and on the bottom surface if it is too great. If either occurs, the projection should be adjusted accordingly until the defect disappears. If the fault persists, the saw speed should be increased or the rate of feed reduced.

Saws

For small quantities of intermittent use, any of the normal hand or power tools can be used with satisfactory results. An aluminium cutting saw blade, 175-250mm diameter, is recommended by one of the major power tool manufacturers. For quantity production, any of the conventional machines used for cutting natural timber are suitable. Tungsten-carbide cutting edges are recommended as they will have at least 20 times the cutting life between sharpenings of a high-speed steel blade and should be capable of about 30 sharpenings before the teeth are worn out.

Circular blades should be 355mm with 60 teeth and have a peripheral saw speed of 3000-3350 metres/min. Teeth angles are important and particularly the need for a positive front angle. The diagram below shows the recommended details:

The saw blade should rotate in the opposite direction to the feed and a riving knife should be fitted to open the cut.

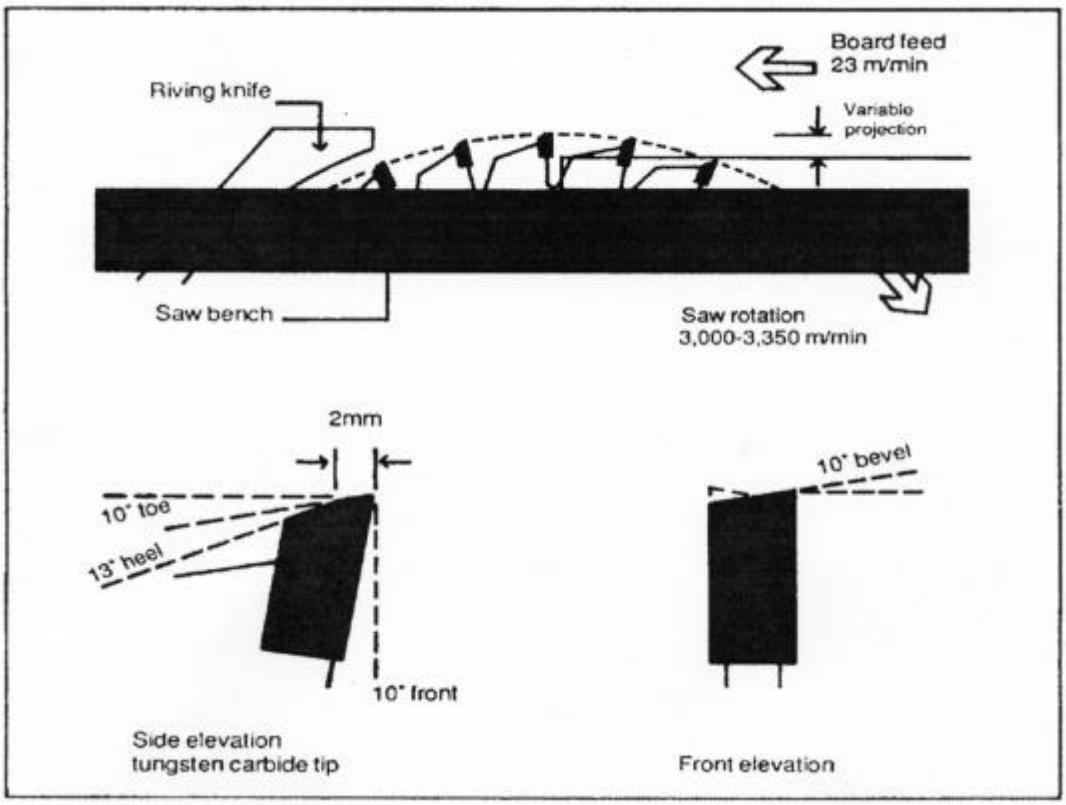
Sawing - Plastic Laminate / Veneered Particleboard & MDF

It is strongly recommended that surfaced boards are reduced to finished component size by sawing, and that spindling or muting cutters are only used on the edges when the shape of the panel precludes sawing.

The techniques of sawing wood panels are well established but cutting boards with a hard brittle skin, such as melamine surfaced and ready to paint boards, can cause unacceptable chipping or break-out of the surface. The need for high quality precision cutting at high output rates has led to the development of sophisticated equipment. Many modem panel cutting saws work on the principle of stationary work piece and a moving saw, cutting a number of boards at a time and with a small scribing saw to eliminate chipping. These machines may be necessary for specialist fabricators and others cutting large quantities of board, but satisfactory results can be obtained from an ordinary saw bench provided the equipment is in good order. With the variety of equipment likely to be encountered it is not possible to lay down precise details, but the notes below give general recommendations for a normal bench saw and should result in a clean cut with sharp edges on top and bottom surfaces.

Handling

Cut with face side uppermost. Direction of feed should be opposed to the rotation of the saw. Ensure the work piece is supported overall and not balanced precariously by the operative.



The work piece must be firmly bedded on the saw bench. Preferably cut exactly to size on the first pass. If it is necessary to rough cut oversize, note that careless cutting can cause hairline cracks in the surface which will lead to chipping on subsequent operations. This will equally apply if panels are spindled to final size.

Saws: Use tungsten-carbide tipped saws. Saw diameter 350mm or 450mm with 75 or 96 teeth. Tooth shape approximately as illustrated although this may vary according to the saw and the manufacturer's particular ideas. The positive front angle of 4°-5° has been found most satisfactory.

Feed speed should not exceed 15m/min. Mechanical feed is best but if hand feeding, a steady rate is more important than precise speed. Projection of the saw above the work piece should be between about 8mm and 20mm.

If chipping is observed on the top face raise the saw, if on the underside lower the saw.

Spindle and Router

As Particleboard and MDF have a non-directional grain, grooves, recesses and housings can be easily cleanly cut. These processes are normally carried out on a router and tungsten-carbide tipped cutters should be used. The cutter spindle speed should be 18,000 - 24,000 rev/min and the material feed rate 4.5 - 9.0 m/min. It may be necessary to bring a surfaced panel to size on a spindle or router with the aid of a jig. When minimal quantities are involved, high-speed steel cutters can be used but they rapidly lose their edge and for quantity production tungsten tipped cutters are necessary. However for large volume producers where consistent and accurate profiling is important, diamond tooling is now being used. Tooling might cost ten times the equivalent in tungsten carbide, but it will run 50-100 times longer without needing attention. Panels will have been cut oversize and the necessity for careful sawing is again stressed. Any excessive chipping at this stage inevitably gives rise to hair-line cracks which "chase through" with the impact of spindle or router cutters. Ideally make a clean saw cut and remove the minimum possible by cutter.

Keep cutters sharp. Dull Cutters will cause the edge to "bell" or spread, which will give trouble when subsequently dressing, edging or lipping flush with the surface. The edges of wood panels can be easily planed and profiled on a spindle machine. Rebates tongues and grooves are the types of moulding best suited to the material and profiles should be kept simple. Because the material can be cut easily and cleanly the use of simple joints in assembly is practical and economical. It is not possible to lay down precise details but in general feed speeds should be slower than for solid timber and the maximum number of cutting edges possible provided. The following is suggested:

Spindle Machine	
Speed	4000-10000 rev/min
Cutter Block	minimum 4 cutters
Cutters	Toe 42 ° Heel 45 °
Material Feed	4 to 5m/min

Router	
Speed	18000-24000 rev/min
Cutters	double edge bit minimum 25mm cutting edge ground 53° angle
Material Feed	4 to 5m/min

Drilling

As other processes, cutting edges must be sharp if a clean hole is to be cut. Drill speed and the angle of the drill point should be the same as that used for normal woodworking. When drilling through plastic laminates the point angle should be between 80° and 90° .

Planing

Particleboard and MDF are generally supplied sanded to a uniform thickness so planing should not be necessary. Should it be necessary to reduce the thickness this is best carried out on a belt or drum sander, but it is advisable to avoid reducing the thickness of layered boards on one side only as this may well unbalance the board.

Planing of the edges should similarly be unnecessary as a clean face can be obtained from a saw cut. However, where it is required, there is no difficulty (see notes under 'Spindle Machine' for cutter speeds).

Sanding

As most wood panels are supplied with a sanded finish, sanding is normally necessary only as a finishing process after the machining or fabrication of a component. Sanding is preferable to planing where the edge of Particleboard and MDF is required as a finished face and the saw cut edge considered unsatisfactory. Techniques used are similar to those for natural timber but as these wood panels have no grain direction, boards can be sanded in either direction.

For larger areas or quantity of work, fibre backed papers are recommended. For finishing work, a 120-200 grit grade should be used depending upon the degree of smoothness required. Excessive sanding should be unnecessary and because it could unbalance the board it should be avoided.

Jointing

Two of the outstanding characteristics of wood panels are that they have a non-directional grain and excellent gluing qualities in all planes. Pieces can be cut from a board in the most convenient and economic way irrespective of their orientation in the board. Because the wood fibres and flakes lie in a random pattern there is no end grain and a consistently good gluing surface can be obtained from a clean saw cut irrespective of the direction or angle of the cut.

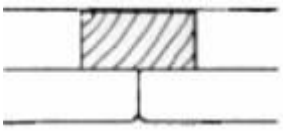
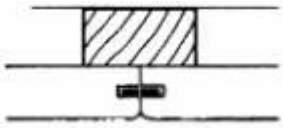
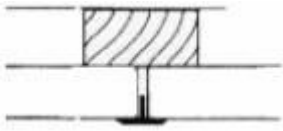
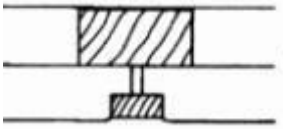
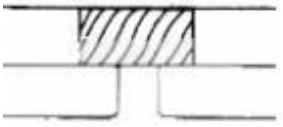
For the majority of situations, simple glued joints are the most appropriate and economic. They take full advantage of the characteristics of the material and make more complicated mechanical methods both unnecessary and relatively expensive.

Joints between boards

There are many ways of detailing board to board joints. The selection of a particular method will largely depend upon the finished appearance required and the equipment and facilities available. Where boards are to be painted, laminated or veneered, a plain butt joint is normally suitable. If the edges have been cleanly cut, planing will not be necessary. Both edges should be liberally coated with adhesive and pressure applied and maintained until the adhesive is set. A loose thin Particleboard, MDF or hardboard tongue, 4-5mm thick and about 18mm wide can be incorporated in the joint to facilitate surface location but will add little to its strength. Where joints between boards will be exposed, there are various methods that can be used. Some of these are described below.

Joint treatment

The treatment of the joints where two panels meet is very much a matter of taste but it is generally accepted that it is more effective to make a feature of the joint than to try hiding it or losing it.

V Joint		Suitable for all types of board but particularly plain or painted panels which can be nailed directly to battens.
V Joints with Tongue		V joints with ply tongue: Particularly suitable with decorative boards secret fix by skew pinning through the edge of the first board and pushing the next board into place. The centre of the board may be fixed to intermediate battens with adhesive.
Aluminium or PVC cover strip		Extruded cover fillets: Aluminium or PVC strip glued in place. A T shaped extrusion is generally used but a fiat section applied to the face is also suitable. Nails or other fixings can be covered by the extrusion.
Wood Insert		Rebated joint: Board rebated and fixed through the rebate. Polished hardwood or painted soft-wood strip set into the rebate, either sunk below the surface or protruding above it and fixed by pinning or gluing **.**
Open Joint		Boards fixed to battens with (say) 12mm gap between them. The face of the batten may be painted or it may be faced with plastic strip or extrusion.

Board Edging

Edging of Particleboard and MDF is carried out to match or harmonise with surface treatment. With its tight, fibrous edge, MDF can be edge profiled and painted to match the colour scheme. Particleboard should have an edging applied.

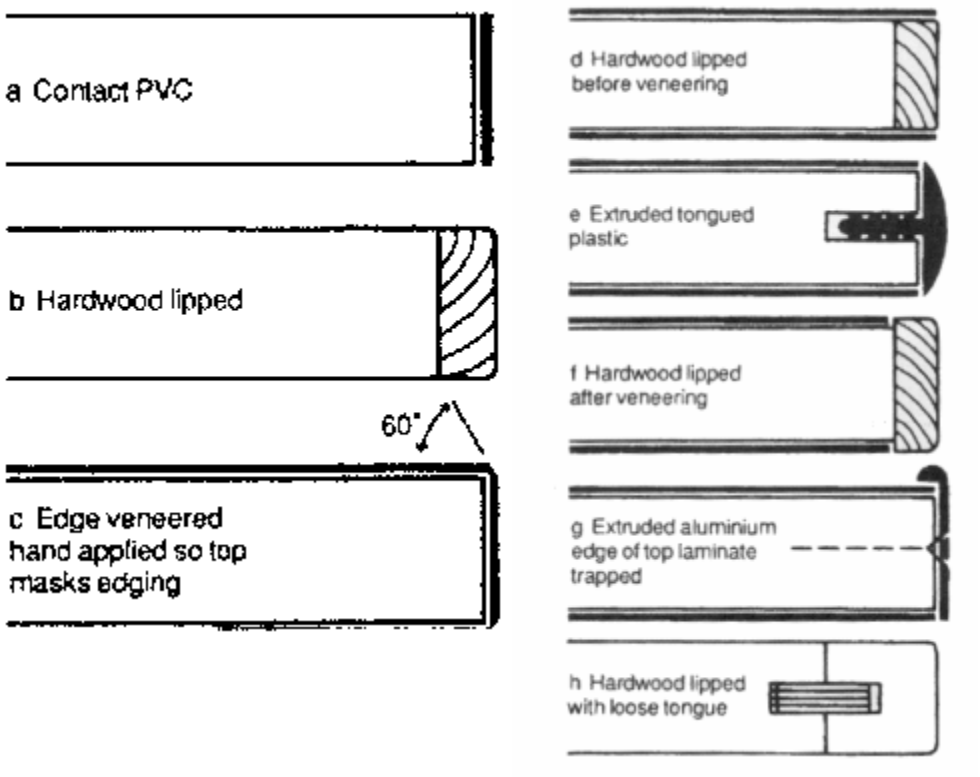
Boards can be edged or lipped in a variety of ways. Edges can be veneered easily to provide a matching finish to the surface. Provided that a clean saw cut has been made, further treatment of the edge surface is unnecessary. Veneers can be applied by hand or machine and the use of a urea-formaldehyde adhesive is suitable for most cases. An alternative edge details is to use a plastic strip with a toothed tongue on the back face which is pressed into a thin groove cut in the edge of the board.

Solid wood lippings of any suitable width can be satisfactorily glued with a plain butt joint direct to a cleanly cut edge of Particleboard. Edged boards are offered by most manufacturers.

A tongue and groove detail can be used but serves only to facilitate accurate location. Where this detail is used, the groove should be in the wood panel edge.

Although lippings are normally applied after veneering of the surface, they can be satisfactorily applied before if required. In this case, the adhesive should be allowed to dry out thoroughly before veneering to ensure minimal risk of the joint line 'showing through'. Where edges are to be lipped after veneering, it is usual practice to use a slightly oversize lipping and sand down either by hand or drum sander to provide a flush joint .

For most situations, a 6mm thick lipping is adequate but where provided to take hinge fixings, a thickness of at least 12mm should be used.



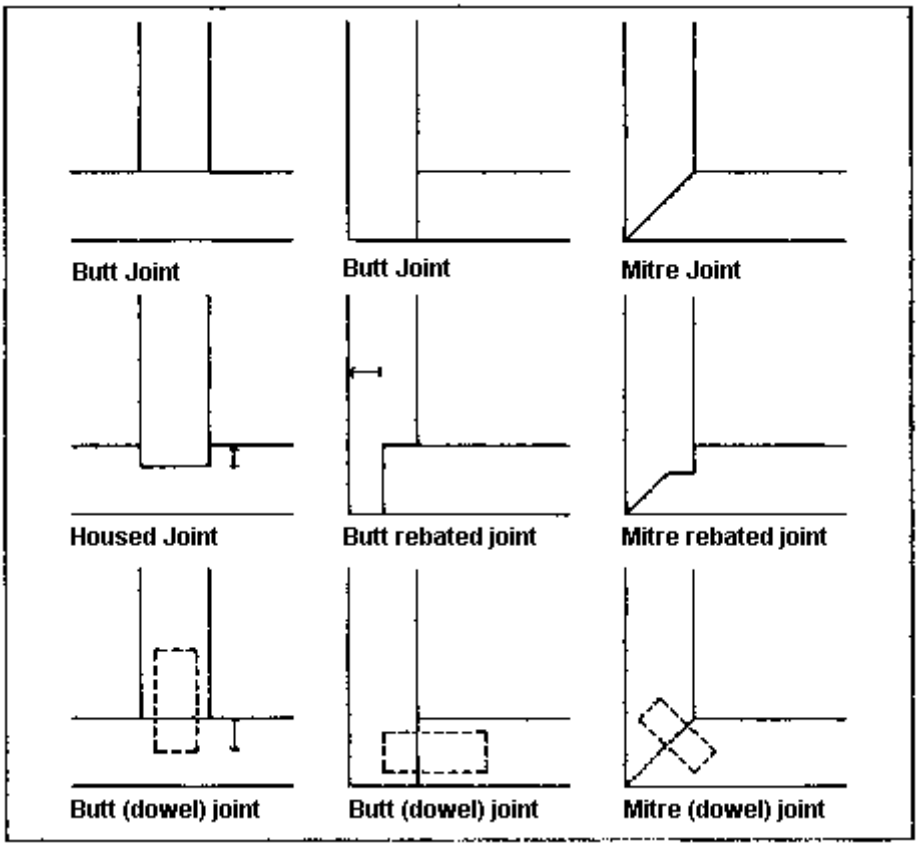
Carcase Joints

With care in the design and selection of joints, Particleboard and MDF are well suited to carcase construction. Simple glued joints are characteristic of the use of the material for this purpose and one of the main reasons for its widespread application in the mass production of furniture.

The gluing qualities of wood panels are excellent in all planes and full advantage should be taken of this in the design of joints. Deep and/or wide grooves cut in the edge, or thin and/or wide tongues moulded on the edge of boards will weaken the joint and should be avoided.

Provided that edges have been cleanly cut a plain butt joint provides adequate strength for many situations and is economic. At vertical corner junctions a plain mitred joint can be used successfully.

Some means of ensuring accurate location of the components to be joined is often of practical advantage in assembly; for example, a loose tongue may be incorporated in a mitred joint. There are various other ways in which such provision can be made and some are described and shown below. Generally, they assist only in locating the components and add little, if anything, to the strength of the joint.



Adhesives for Jointing

Although most of the adhesives commonly used for jointing natural timber are equally suitable for jointing wood panels, those made from synthetic resins are normally preferred. Animal glues are not generally suitable as their relatively high water content may cause local swelling of the board.

There are many types and grades of synthetic resin adhesives available for a wide variety of specific applications. The requirements of the user together with the facilities available to him will have influence on the choice of adhesive most suitable for his purpose. The following notes therefore give general guidance on the type of adhesive suitable for particular applications.

Synthetic resin adhesives consist of a syrup and a catalyst. The catalyst, which may be in either powder or liquid form, is either mixed in certain proportions or applied separately to one face and the syrup to the other. Adhesives of the mixed application variety, have the catalyst already incorporated. It is essential that the adhesive manufacturer's instructions are closely followed in all cases.

For board to board joints, a urea-formaldehyde (UF) adhesive should be applied to both edges. A mixed application type is recommended. Alternatively, a polyvinyl acetate (PVA) adhesive can be used and should be of high viscosity to avoid starved glue joints.

For edge lipping or veneering with wood, UF adhesives are usually best although a high viscosity PVA is also suitable. Mixed application types are preferred. Where separate application types are used, the syrup should always be applied to the board and the catalyst or liquid hardener to the wood to avoid starved glue joints. Plastic laminates are best bonded with a UF adhesive and it is important that pressure is applied and maintained on the joint until the resin is cured. Alternatively, a rubber-based contact or impact adhesive may be used. In this case, a coat of adhesive should first be applied to board edge and allowed to dry thoroughly. A second coat is then applied prior to bonding. Extruded PVC strip edgings should be bonded with a rubber-based adhesive . The wood panel edge should first be coated with a thinned solution of the adhesive and when dry a second coat applied.

MR Particleboard and MDF have special waxes incorporated to provide water repellent properties. This feature of MR boards may interfere with the curing of adhesives otherwise suitable for standard board. Specially formulated adhesives may be necessary for bonding MR Particleboard and MDF.
For carcase joints, mixed application UF or PV adhesives are recommended.

Fixing

Methods of fixing Particleboard and MDF are basically similar to those normally used for fixing natural timber and other wood-based boards and panels. They can be broadly divided into three groups, nailing, screwing and knock-down methods. The following notes give recommendations on the techniques and types of fastening generally suited to various applications of wood panels.

Nailing

This is the quickest and cheapest method of fixing wood panels to a timber supporting structure. Bullet head nails with either a round or oval shank can be used, particularly for secret nailing through the tongue of t & g boards. They can be punched below the surface easily where a painted finish is required. Helically threaded nails give some increase in the resistance to popping and withdrawal and a significant improvement is obtained by the use of annular ring-shanked nails. These latter types, and particularly annular nails, are preferred for flooring where fixing is through the surface of the board.

For temporary fixings and where easy withdrawal is required, for example in concrete formwork, duplex or double-headed nails are suggested.

Spacing of nails largely depends upon the purpose for which the board is being used and will normally vary between 300 and 600mm. Reference should be made to the relevant Applications & Installations Sheet for recommendations on nails spacing. Nailing should always be through the board into the member supporting or being supported rather than the reverse. Where fixings are required to be made into the board, methods other than nailing are more suitable and should be used.

Some are described in the following notes. Increasing use is being made of portable nailing and stapling machines for site assembly work and they can be used successfully for fixing wood panels. There are many types made by a number of manufacturers and reference should be made to their information in respect of the type of machine and associated fastening best suited for the user's requirements.

Screwing

The screw holding power of Particleboard and MDF is directly related to the type and density of the board and the type of screw used and this data should be obtained directly from the wood panel manufacturer. Screw holding power is also improved significantly with use of double threaded screws such as the GKN Twinfast. These screws have a greater length of thread than conventional single threaded types and are often threaded up to the head. The plain part or the shank is smaller in diameter than the threads and this virtually eliminates the splitting effect normally associated with single thread screws. They have a self-centering point and driving is claimed to be easier and faster.

Whichever type of screw is used it is recommended that a pilot hole is drilled for the full screw depth to avoid show-through on the opposite face of the board or splitting when screwing into the edge of the board. Screws should not be screwed over tightly and never hammered.

Although screwing directly into Particleboard and MDF for permanent fixings is often suitable, where improved strength or demountability is required, the use of a solid wood insert or special fastening is recommended. Wood dowels should be glued into holes bored of sufficient diameter and length to give a good fit without the need to hammer the dowel home. An alternative to the wooden dowel is a special fastening device comprising a nylon plug or bush which is vertically threaded on the outer face. It is glued into

a hole bored to give a good fit and a self-tapping screw is then driven into it. This type of fastener serves the dual purpose of providing a secure but easily demountable knockdown fixing.

Other forms of special fastening devices that provide a high degree of resistance to withdrawal are those that are inserted into a hole pre-drilled through the board and either partly deform or obtain anchorage on the back of the board when tightened. Devices that obtain anchorage on the back of the board are the spring and gravity toggle type. With the gravity type, a portion of the device is held parallel to the screw during insertion and drops perpendicular to the screw when passed through the board. The screw is tightened to obtain a firm anchorage. The spring toggle type normally has two sprung metal wings which are held closed during insertion and then open when passed through the board. Again the screw is tightened to obtain a secure anchorage. The hole size necessary to enable insertion of a toggle device is larger than the screw or shank diameter and thus lateral location will tend to be less rigid than with devices that expand or deform.
Where edge fixings are required to support heavy loads, such as hinge fixings for large doors, the use of a wood lipping is recommended. The lipping should be about 18 mm thick for large doors, although 12 mm would be suitable.

Knock-down Fastening

Only permanent fixing should be made directly into Particleboard and MDF. Where demountability and re-assembly will be required, the use of special inserts or knockdown fastenings is advised.

Reference has been made in previous section to the use of inserts with conventional screw fixing and these notes give a general description of the range of devices specifically made for knockdown applications. Knockdown or assembly fastenings can be broadly divided into three groups; concealed, surface and flush fitting.

Concealed fastenings are often based on press-stud action. These consist of an insert fixed into a pre-boxed hole in one component and a dowel fixed into a pre-boxed hole in the other. The insert is either ridged or lipped on the inside face and locates into grooves in the dowel when the two parts are brought together. With some types, the dowel is separate and locates into similar inserts fixed into each component and provide a neat and precise joint.

Surface fittings are widely used where visible fastenings are acceptable and economy important. They vary in the type of locating devise used but all are fixed directly onto the surface of each component and do not necessitate any machining. They consist of two parts which locate and are held together either by locking, screwing or wedging.

Locking and wedging devices are usually metal and screw devices either plastic or metal. Some are quite large, but they all tend to be less expensive than other methods.

Precise location of components may be made easier with some of these fasteners if dry dowels are incorporated in the joint.

A number of flush fitting devices are available and they vary widely in their design and method of fastening. Generally, these types of fastener require more machining of the components to be joined and tend to be more expensive but they give a stronger joint.

The range of fasteners available for knockdown applications is wide and varied. The type of applications, visual appearance and cost will influence the user's choice, so it is not possible to make specific recommendations on suitable fasteners.

Finishing

This section describes the basic principles of finishing Particleboard and Medium Density Fibreboard (MDF), including semifinished and fully finished boards from EWPAA Members.

Particleboard and MDF provide an ideal base for a wide variety of surface treatments. Apart from clear finishes and paints these include wood veneers, high and low pressure laminates, papers, PVC film and fabrics. The following notes give guidance on the suitability and application of these treatments, but are not intended to provide complete application instructions. Consult finish manufacturer's instructions for complete details.

Clear Finishes

The surface colour and pattern of Particleboard and MDF is naturally decorative and the application of a clear finish accentuates this quality and provides a wear-resistant coating.

For floors, a two-part polyurethane finish will provide an excellent hard-wearing and decorative surface. The floor must first be fine sanded and then vacuumed to remove all dust. Nail holes should be filled with an appropriate coloured putty. Apply the polyurethane finish with a wide brush or lamb's wool applicator. When Particleboard flooring is used in platform construction, the use of a sealer prior to closing in the building is not recommended. Some moisture will still penetrate the surface and the effect of hot sun under these conditions will cause more deterioration than with an unprotected board. When the house is closed in, the Particleboard should be sanded (after drying out) and the clear finish then applied.

For other Particleboard and MDF surfaces (such as wall linings, partitions or ceiling surfaces) a one-part polyurethane coating will provide a good wearing clear finish. The surface may be filled before finish application which can be high gloss, satin or matt. An attractive surface can also be produced with clear Pine Finish or with pigmented or dye-type stains. Cellulose lacquer will also provide a satisfactory finish. However its wearing properties are inferior to polyurethane's and it would only be used if cost savings could be achieved.

Manufacturers' instructions should be followed for specific applications.

Paint

Although the surface of Particleboard and MDF appears to be smooth, it invariably contains small holes and interstices which become noticeable when paint is applied. There are three basic paint systems which can be used to give a range of surface finish quality.

In order to obtain the best quality, full gloss finish, the use of a filler is necessary. The surface should first be primed and then a fine surface filler applied. The filler will most likely be trowel-applied rather than brushed on. Rub down to give the required surface and then continue according to paint manufacturers' instructions. A first-class finish can readily be obtained with oil-based paints, polyester and melamine lacquers. Polyester and melamine lacquers are usually applied in industrial operations and require baking to cure and harden the coating.

The oil-based paint system consists of primer, undercoat and then enamel which will provide a good measure of surface filling from the paint films deposited. Oil-based paints also give better performance than water-based paints when steam or grease may be present (bathrooms and kitchens).

Emulsion and other water-based paints tend to swell surface particles of the wood panels which can result in a textured finish. The prominence of this texture will depend on the water content of the paint used and the reaction of the board surface to the moisture in the paint. With acrylic paint systems, an exterior-grade primer should be applied first, followed by undercoat and two coats of acrylic gloss or semi gloss. Sanding

before final coats, and the use of a semi gloss finish will minimise the texturing mentioned above and produce a quite satisfactory result for most applications.

Vinyl Film

These can be wood grain prints with matching embossing, or plain colours, with a smooth or textured surface. Higher quality wood grain pattern are usually surface printed with a clear protective PVA overlay or highly scratch resistant lacquer finish.

PVC film can be applied on a small scale using, for instance, cold setting ethyl vinyl acetate (EVA) emulsion adhesives in simple nip roll presses. However for high quality, high volume production, continuous laminating lines are required. EVA emulsions, two-part solvent-based polyurethane or epoxy systems are used. The adhesive is applied as a thin film to either the board surface or reverse side of the vinyl and where applicable, the excess solvent is flashed off and the vinyl nip-rolled onto the board. Vinyl coated board is available from wood panel manufacturers as well as independent processors laminating for the industry. The product is generally used for furniture manufacture, e.g. wall units, TV and Hi Fi cabinet speaker boxes and computer desks. The flexible nature of the PVC film has resulted in the development of the V grooving technique where the substrate is machined away leaving a 90 0 groove connected only by the PVC. This can then be folded to a right angle or to more complex profiles - many grooves of varying sizes are machined and multiple folding produces a shaped edge e.g. the front edge of a TV cabinet.

As with other laminated wood panel products, it is recommended that for large, freestanding panels, a balancing film is applied to the reverse side.

Matching edge banding can be obtained from vinyl manufacturers for edge finishing. High volume production is usually carried out on a proprietary edge banding machine using hot melt adhesive. Small operations can be carried out by hand using contact adhesive.

PVC film is not generally recommended for horizontal work surfaces.

Veneer

Natural wood veneer is generally regarded as the premium decorative finish for wood panels because of the individuality offered in choice of grain definition and species. Veneers are readily applied to Particleboard and MDF provided the substrate is of good quality, the board is uniform in thickness and the surface is dense and smooth with well bonded surface flakes. Urea formaldehyde and crosslinking P.V.A. resins are normally used. In order to obtain stability of the product a balancing veneer must always be applied to the reverse side.

Veneered Particleboard and MDF is available in good-one-side or good-two-sides configuration in both sliced and rotary cut veneers, and is usually supplied fine sanded by the manufacturer. Veneers can be finished with clear lacquer, oil, stain or paint depending on the wood species and the end product requirement. Exposed edges of veneered Particleboard panels are generally protected by matching solid timber edging, matching veneer applied by an edge bander using hot melt adhesive or by the use of pre-glued, "iron on" veneer.

Veneered MDF panels may have similar edge treatment but MDF edges can also be moulded and machined due to the better edge machining properties of MDF.

High Pressure Laminates

A hard wearing, scratch-resistant and easily cleanable surface is obtained by the application of a plastic laminate to Particleboard and MDF. Widespread use is made of this composite material in the furniture industry and particularly for kitchen units and bench tops.

Laminates can be applied by the furniture manufacturer using sprayable contact adhesive and a nip roll press. However they are often applied by carpenters during cabinetwork or shopfitting. In this case, adhesive is applied by brush or spreader, and bonding is achieved by hand roller or hand-applied pressure over the laminate surface.

Laminates are constructed from several layers of phenolic resin impregnated paper, together with 1 to 3 sheets of overlay papers, printed or clear, and impregnated with melamine resin. The finish can be gloss, matt or textured.

When any decorative overlay is applied to wood panels, it is generally recommended that a compensating overlay be applied to the opposite surface to balance the panel and ensure stability. High Pressure Laminates are often used successfully as a one side only overlay. The rigidity of the laminate itself aids stability, as does the stiffness of supporting framework such as for table or bench tops.

Low Pressure Melamine

Resin impregnated papers are applied to wood panel sheets in a short cycle hot press. Heat and pressure cause melamine resin to flow into the board surface and cures to a hard plastic finish that is an integral part of the surface, not just adhered to it.

This product is manufactured by most wood panel producers as well as several independent processors. Melamine-surfaced board is the most wear resistant of Particleboard and MDF finishes and is the largest and fastest growing segment of the range of finished wood panel products.

The full process consists of the following steps:

- Coloured or printed papers are impregnated with complex thermosetting resin formulations in a single or double dipping operation. Melamine is either the only resin used or it forms the outer layer of the impregnation to ensure a product of excellent properties results.

- The paper with its predetermined loading of resin is dried as a continuous sheet as it is transported through the hot air oven section of the "treater" plant.

- The paper, dried to the desired moisture content, contains partially polymerised resins. The sheet is docked to the desired lengths and stored in packs awaiting laminating to board substrate.

- Impregnating papers are always laid to form a balanced two-side construction on the panel core. At high heat and pressure in the laminating process, the melamine flows rapidly, integrally bonding with the board surface. An excellent surface pattern is formed, according to the texture of metal caul plates fitted to the press plattens.

A range of surface finishes and textures can be produced by selection of appropriate coating resins and press plates. The range includes gloss, satin, velvet, stipple and wood grain embossed.

Economy and quality control require that these operations are carried out on large scale, automated equipment.

Low Pressure Melamine products have wide application in cabinet making, cupboards, built-in wardrobes and vanity units and more recently into all areas of furniture manufacture. While the products are ideal for

shelving, they are not recommended for horizontal work surfaces unless a special wear-resistant grade of laminate is used.

Sheets can be pre-edged with matching melamine finish by the manufacturer or the user can apply edging.

Papers & Foils

Papers and foils of varying thicknesses or weights eg. from 30 gsm to 100gsm, can be applied to wood panels using techniques similar to those used in the application of PVC film. There is a considerable range in the types and patterns available, from plain paper, which can often be used as a base for further finishing, to decorative patterned or wood grain finishes. The latter are available chemically etched or embossed to highlight the grain. Papers are also available with a clear protective coating e.g. polyurethane.

Fabrics

For special effects, fabrics of various types may be bonded to Particleboard and MDF. PVA or cold setting UF formulations are satisfactory .

Storage and Handling

Particleboard and Medium Density Fibreboard (MDF) requires special care in storage and handling to maintain the product in good condition for future use. Correct methods are of the highest importance in order to minimise damage and wastage. No special skills are required to fully protect the product and this data sheet briefly sets out the main considerations for storage and handling.

Transport and Delivery

Particleboard and MDF should be adequately protected by a waterproof covering and fully supported on equal size bearers during all transportation. It is particularly important that the edges are fully protected from damage by transport lashings or other banding and careful loading is necessary to avoid distortion. A cartnote or delivery docket should accompany each delivery, which will specify details of board type and quantity.

Handling

The most vulnerable parts of board packs during handling operations are edges, corners and bottom sheets. Particular care by forklift trucks will minimise damage during handling operations, and regular cleaning of lift truck forks will avoid damage to the bottom sheets. This particularly applies to profiled boards such as tongued and grooved flooring.

Pallets or bundles of boards are easily handled by forklift trucks either into their place of storage, onto or off transport, or into position for use. If the packaging system includes the use of metal bands, these should be cut as soon as possible to avoid any long-term deformation of the sheets. When handling pre-finished boards it is essential to avoid any contamination of the surface likely to cause permanent damage. Surfaced boards should always be lifted from the pack to avoid damage, and never slide.

Storage

Particleboard and MDF like other wood based products and many other building materials, expands on taking up moisture from the surrounding air and shrinks on losing it.

Wood panels are manufactured to very close dimensional tolerances allowing close fit to be achieved on jointing and placing the boards into position. Careful storage is therefore very important if the board is to be maintained in the correct condition for its subsequent use. The storage area should be protected from sun, rain and wind that would otherwise bring about rapid changes in temperature and humidity. The stack should be kept dry and clear of the ground and placed so that it will not be exposed to mechanical damage. All packs should be evenly supported at each end and at intervals in between to maintain sheets in a flat condition. Spacing of supports should not exceed 600mm.

If wood panels must be stored in the open, they should be covered with a waterproof sheet, supported on battens laid on top of the pack so that air can circulate around and over the pack and at the same time protect its sides. To avoid staining and fading, the sheets should not be exposed to the weather while awaiting installation. It is essential to fully protect Standard Particleboard and MDF from rain and accidental soaking, and care should be taken with MR and Flooring types of boards to ensure that exposure is kept to a minimum. Where wood panels are to be used in dry warm areas the moisture content should be kept as low as possible to avoid unacceptable shrinkage after installation.

The moisture content of Particleboard and MDF when it leaves the factory is usually 7-10%. The following table gives approximate levels for different relative humidity of the surrounding air.

Relative Humidity	Approximate Moisture Content
30%	6 - 8%
45%	7 - 9%
65%	9 - 11%
75%	10 - 12%
90%	15 - 16%

These levels can only be taken as a general guide and will vary with type and density of board.
Long term storage in damp conditions can cause roughening of the surface and damage to the edge of the board.

Once boards are laid they will gradually attain the moisture content dictated by the atmosphere within the building. Although it is not possible to give precise levels the figures below give a general indication of the moisture content of boards in various conditions.

Building with central heating	7 - 9%
Building with intermittent central heating	9-10%
Unheated new building up to	14%

Any increase in moisture content will cause some slight expansion in the boards although again this cannot be precisely defined, as a rough guide an increase in moisture content:

- from 9% to 12% will increase length and width 1mm per metre run
- from 12% to 16% a further 1mm increase per metre run

Design precautions necessary to accommodate movement of the board are contained in the relevant Application & Installation sheets, available from the EWPAA web site.

Storage Conditions

Boards should preferably be stored in an enclosed dry building. Where temporary storage outside cannot be avoided then the stacks should be covered with heavy-duty polythene or tarpaulin keeping all boards well clear of the ground.

If boards are to be stored in the building or room in which they are to be used it is recommended that they are conditioned by stacking each sheet to allow free circulation of air. This will allow them to achieve a moisture content in balance with the surrounding air.

Surface Treatments

Boards can be given protective surface treatments to avoid damage by water and dirt. These boards should be handled and stored as for untreated and other pre-finished boards. Particleboard and MDF will readily accept paint as a surface protection, however wood preservatives and water repellents should not be applied to wood panels unless specifically recommended by the board manufacturer.

Protective Measures

Reference has already been made to the protective measures that should be taken against weather. It is important to note that similar measures should be adopted to protect boards installed in position against moisture and dirt.

Particleboard will readily accept paint as a surface protection, however wood preservatives and water repellents should not be applied to wood panels unless specifically recommended by the board manufacturer.

Cleaning Up

Excessive wetting should be avoided when cleaning boards. Manufactures should be consulted before any proprietary cleaners are used. Boards may be lightly sanded to remove dirt stains. Wherever possible boards should not come in contact with moisture, however where this situation might occur the edge should be adequately sealed.

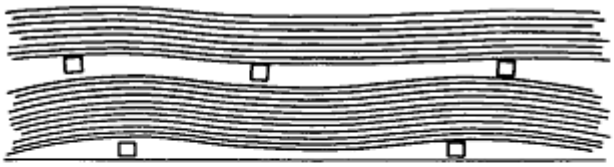
Stacking

Boards should be laid flat on a level surface, clear of the ground, adequately supported on bearers and with all four edges flush. Stacking on edge should be avoided whenever possible.

The ideal base is a close-boarded or slatted pallet, however, if these are not available, board should be carefully stacked on bearers suitably spaced to maintain the flatness in the sheets. Spacing of bearers should not exceed 600mm. Where packs are multiple stacked it is essential that bearers are positioned vertically one above the other. It is advisable to cover the top of the stack with a protective board or cover to prevent warping of the topmost sheet.

Where space will only permit edge stacking then the edges should not be permitted to come in contact with the floor and haphazard leaning against walls should always be discouraged.

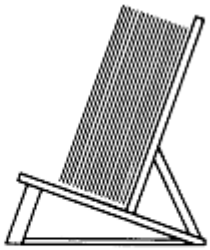
Where thin boards are being stacked it is recommended that support be provided for the entire area of the board by placing a thick board (18mm) at the base of the pile.



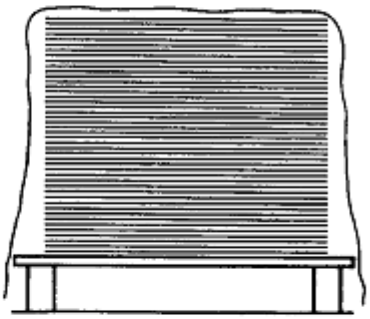
Incorrect stacking

This results in distorted boards and damaged edges

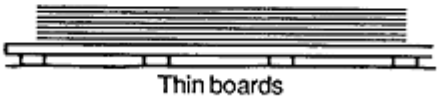
Correct stacking



Edge stacking



Temporary cover (tarpaulin)



Thin boards

Health & Safety Information

Refer to the Material Safety Data Sheet (MSDS) from the manufacturer. These are generally available from the manufacturers web sites. Refer to the back page for a list of these web sites.

Revision History

Revision	Changes	Date	Who
3	• Updated logos and member list	06-02-2012	MB
2	• Created this brochure from several Data Sheets from the Woodpanels.org.au web site.	15/04/2010	MB
1	• Initial Release		

EWPAA Members

Plywood and Laminated Veneer Lumber (LVL)

Member Name	Location	Phone	Fax	Web
Ausply	NSW	+61 2 6926 7300	+61 2 6922 7824	www.ausply.com
Austral Plywoods Pty Ltd	QLD	+61 7 3426 8600	+61 7 3848 0646	www.australply.com.au
Big River Group Pty Ltd	NSW	+61 2 6644 0900	+61 2 6643 3328	www.bigrivergroup.com.au
Carter Holt Harvey Woodproducts Australia (Plywood) – Myrtleford	VIC	+61 3 5751 9201	+61 3 5751 9296	www.chhwoodproducts.com.au
Carter Holt Harvey Woodproducts Australia – Nangwarry LVL	SA	+61 8 8739 7011		www.chhwoodproducts.com.au
Carter Holt Harvey Woodproducts - Marsden Point LVL	NZ	+64 9 432 8800	+64 9 432 8830	www.chhfuturebuild.co.nz
Carter Holt Harvey Woodproducts (Plywood) - Tokoroa	NZ	+64 7 885 5999	+64 7 881 5614	www.chhwoodproducts.co.nz
Fiji Forest Industries	FIJI	+67 9 881 1088	+67 9 881 3088	
IPL (West Coast) Ltd	NZ	+64 3 762 6759	+64 3 762 6789	
Juken New Zealand Ltd (Gisborne)	NZ	+64 6 869 1100	+64 6 869 1130	www.jnl.co.nz
Juken New Zealand Ltd (Wairarapa)	NZ	+64 6 370 0650	+64 6 370 0653	www.jnl.co.nz
Nelson Pine Industries Ltd	NZ	+64 3 543 8800	+64 3 543 8890	www.nelsonpine.co.nz
PNG Forest Products Ltd	PNG	+67 5 472 4944	+67 5 472 6017	www.pngfp.com
RH (PNG) Ltd	PNG	+67 5 325 5600	+67 5 325 6165	www.rhpng.com.pg
Valebasoga Tropikboards Ltd	FIJI	+67 9 881 4286	+67 9 881 4154	
Wesbeam Pty Ltd	WA	+61 8 9306 0400	+61 8 9306 0444	www.wesbeam.com

Particleboard and MDF

Member Name	Location	Phone	Fax	Web
Alpine MDF Industries Pty Ltd	VIC	+61 3 5721 3522	+61 3 5721 3588	www.alpinemdf.com.au
Borg Panels Pty Ltd	NSW	+61 2 6339 6111	+61 2 6339 6220	www.borgs.com.au
Carter Holt Harvey Woodproducts Australia	NSW	1800 891 881	+61 2 9468 5793	www.chhwoodproducts.com.au
D & R Henderson Pty Ltd	NSW	+61 2 4577 4033	+61 2 4577 4759	www.drhenderson.com.au
Laminex	VIC	+61 3 9848 4811		www.thelaminexgroup.com.au
Tasmanian Wood Panels (Aust)	TAS	+61 3 9460 7766	+61 3 9460 7268	
Weathertex Pty Ltd	NSW	1800 040 080		www.weathertex.com.au

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