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Industry Standards

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Engineered Flooring Industry Standards

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Prepared by

David Hayward

Australian Timber Flooring Association

with the assistance of 'atfa' member companies and organisations who provided information and photographs.



Care is always necessary to assess the flooring product, the subfloor and the environment in which the floor is to be laid

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Introduction

Scope

This publication provides a reference guide for the installation of engineered flooring laid as floating floors or by direct adhesive fix to structural subfloors. Generally floors of this type are of laminated solid timber with a decorative veneer or lamella on the exposed face of the boards. Other types of engineered flooring are also being developed which may contain the decorative veneer or lamella adhered to the likes of fiberboard or plastic composites. The guidelines cover all these types of engineered flooring that fit together with either a tongue and groove joint or a profiled locking system and products that are pre-finished or site-sanded and coated. When installing an engineered floor many aspects must be considered and this includes assessing the house design, environment in which the floor is to be laid and the desired appearance of the finished floor. These aspects are covered and also aspects relating to product selection, board widths, and finish systems applied.

The flooring process and board characteristics

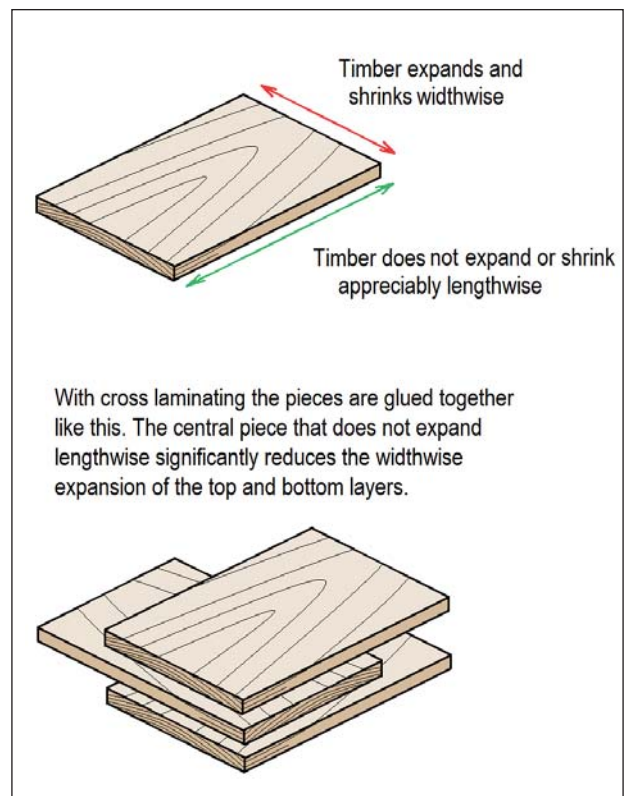
Some engineered flooring is manufactured in Australia but much of it is manufactured in Asia with face veneer or lamella from both Australian and species from other countries. As product construction can differ significantly between products there are a range of manufacturing practices that are too varied to explain in detail.

However, what is common among all engineered flooring is the veneer or lamella of solid timber on the exposed face of the board. Veneers are typically up to about 2mm thick while a lamella is thicker and often 2.5mm to 6mm in thickness. In producing this decorative layer it can be peeled, sliced or sawn.

When we consider a solid piece of timber it is said to be hygroscopic. That is, once it has been appropriately dried it will still absorb moisture from the air during times of high humidity and during times of low humidity it will lose moisture to the air. With these changes in moisture content the timber will swell with increased humidity and shrink with reduced humidity. However, another property of timber is that swelling or shrinkage only occurs in the width of the board and not to any appreciable degree in its length. This property is used to advantage in many engineered floors by cross laminating with the grain direction in each layer alternating at 90 degrees. Through this process the natural width movement of each layer is restrained and a floorboard is created that is more stable in width movement resulting from moisture content changes. Although the cross laminating does significantly reduce the width movement that often results in gapping at board edges with solid timber flooring in dry weather, it does introduce a small amount of lengthwise movement in the board with changing moisture content. Such movement is accommodated with expansion allowance at installation.

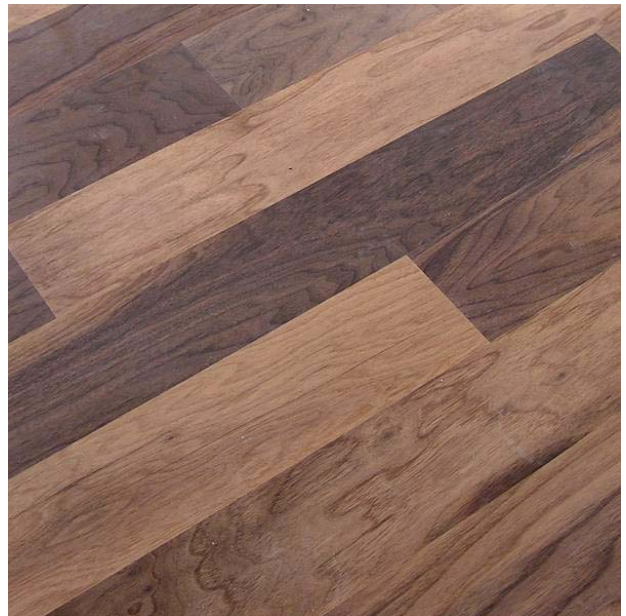
Another benefit inherent with engineered flooring is better utilization of resources in that the thin high quality face veneer or lamella is often adhered to plywood or other timber species that are of a more plentiful resource. This process therefore provides a high quality board with a solid timber exposed face, with reduced in-service width movement.

Engineered flooring is mostly supplied pre-finished. The surface exposed to view in the floor is generally a UV cured coating system that may have additives to make the coating tougher. Once board blanks are produced and exposed surface coated they are machined to provide the tongue and groove or glueless joint system to the edges and ends of the boards. A limited number of manufacturers supply boards for site sanding and coating. Various quality checks are applied throughout the process and the product is finally packed for shipment.



The owner's choice

Aspects relating to what customers desire is of paramount importance and should not be taken lightly. They are relying not only on the expertise of those who have manufactured the product but also advice on the range of products available, difference between installation methods and ongoing care and maintenance. Each of these aspects can influence the owners' satisfaction with their floor. Owners are much more aware and have much more access to information than ever before, however they are unlikely to have the same depth of knowledge as those dealing with engineered flooring on a day to day basis. It is important to accommodate customer preferences, however this should not be to the detriment of the performance of the floor or its final appearance. Where customer preferences cannot be accommodated then these need to be brought to their attention. Colour variation between showroom samples or production batches and the product provided and provision of expansion joints are two areas which affect appearance and may necessitate specific discussion with the owner. With engineered flooring the blend of colour and figure in the boards, as shown in the photos below, has its own natural beauty.



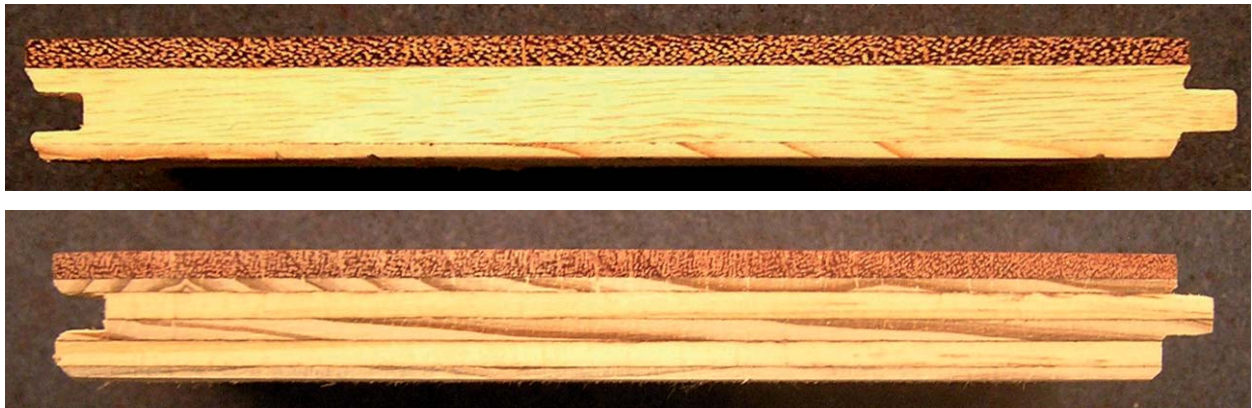
Some of the rich blend of colours available with engineered flooring

1.0 Product types & installation methods

As indicated above engineered flooring is manufactured with a decorative layer of solid timber bonded over layers of other timber or other materials beneath which not only provides some additional stability but also maintains all the appearance and characteristics associated with solid timber flooring. Engineered floors can differ markedly in their construction, may be laid as floating floors, glued to a subfloor as an overlay or in some cases fixed as a structural floor. These aspects will be discussed below.

1.1 Constructions

Board construction varies significantly between products and a number of product types currently in the market will be considered. Product types that have been in the market for some years are generally of two types; the first type contains a face lamella, core block layer and stabilization layer and the second containing a face lamella over a plywood base (typically referred to as 3 layer).

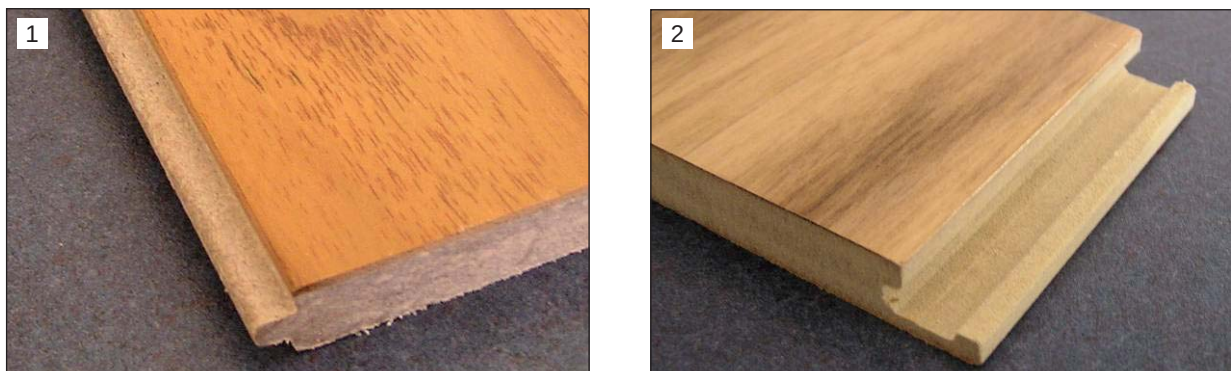


Different constructions of engineered flooring

However even with a plywood base there can also be differences in that base. Below are three different plywood constructions. Photo 1 shows a hardwood lamella on a 5 ply softwood base, photo 2 a hardwood lamella on a 10 ply softwood base and photo 3, a 5 ply hardwood construction with the same timber species top and bottom.



More recently products have been developed that differ from the construction above and may include a fiberboard base or other composite material. This type of engineered flooring is less common at present. The first photo shows the timber veneer on a wood/plastic composite base and the second a veneer on a fiberboard base.



From the photos above it is also evident that the thickness of the veneer or lamella layer also varies from product to product. In the photos numbered 1 to 3 above the lamella thicknesses are respectively 2.75 mm, 3.0 mm and 2.5 mm and in the photos numbered 4 & 5 the veneer thickness is 1.3 mm and 1.0 mm.

One issue that needs to be considered regarding this is that when it comes time to consider refurbishing a floor, those with thin veneers will not be able to be sanded back to bare timber without risk of penetrating into the base. However with a thin veneer the stability of the product is much more influenced by the base layer whereas a high density thicker lamella can influence aspects of product performance (e.g. crowned appearance, checking) due to the strength of the lamella under certain environmental conditions. Concerning the hardness of these products the thicker the face lamella the more it will determine the hardness of the board. When the face timber is a veneer it is the hardness of the base that dictates hardness.

Although all products can provide good performance in the marketplace there are situations, as outlined above, where product differences occur and where some products are more suited to certain installations and more severe climatic conditions than others.

1.2 Board size and strip construction

A wide range of board widths are available in engineered flooring with narrower boards down to about 90 mm in width up to board widths of about 200 mm, although widths in excess of 200mm are also now becoming available. Manufacturers provide a range of board widths and there are no standard widths: for medium width boards one manufacturer may produce a board width of 127 mm, another manufacturer 130 mm and another manufacturer 133 mm. Engineered flooring is typically supplied at an advertised length of 1200mm up to 2400mm. However, it will normally include a quantity of short boards in the form of “nested lengths”. These are normally included in the floor as starting or finishing pieces and will generally not detract from the random appearance of the floor. The quantity of short boards can be up to 50% or more of the stock in square meter terms, while the minimum length can range from 600mm down to as short as 300mm! If board length is of particular concern to the consumer, then specification regarding short boards should be sought. Reference is at times given to the terms ‘one strip’, ‘two strip’ and ‘three strip’. This refers to the number of widths of lamella covering the base layer. The adjacent photo illustrates a two strip floor as evident from the board edges being defined in the lower left hand corner of the photo.



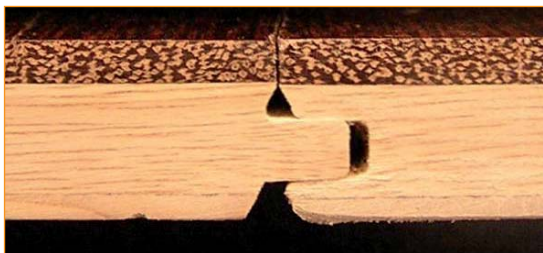
Two strip construction

1.3 Direct adhesive fix and floating installation

There are two main methods in which engineered floors are laid. Many floors are direct adhesive fixed to the subfloor which may be concrete or sheet flooring such as particleboard or plywood. A direct adhesive fix floor provides a solid feel under foot and with some products is considered to be more suited to higher humidity environments. Floating floors as the name suggests indicates that there is no fixing of the flooring to the subfloor. The boards are fixed to each other and they rest on an underlay. Correct sub-floor preparation along with careful underlay selection, will ensure a solid foot feel and sound. Note also that a very limited number of products have been tested for installation and direct fixing to floor joists or battens over concrete slabs.

1.4 T&G and glueless installation

There are two profile types available in the market. The first is the 'tongue and groove' or T&G profile similarly found in traditional solid timber flooring and then there are the interlocking or glueless joint systems. These two systems are shown in the photos below.



T&G and glueless joining systems

The T&G profile is used for direct adhesive fix applications where adhesive is used to bond the lower surface of the boards to the subfloor. This profile is also used for floating installation and in this application adhesive is applied to specific locations within the T&G joint. Note that some T&G is only designed for direct adhesive fixing.

1.5 Coating system and gloss levels

With most engineered flooring prefinished in the factory, a very high standard of finish is achievable. In many products the coating to the exposed upper surface consists of a multi-stage system including fillers, sealers and final coats with additives such as aluminium oxide to provide a tough wear resistant surface. Coloured stains may also be used in the coating system to add different colours or tones to the boards. The coating is done in a controlled environment with UV curing that provides a fully cured finish at the end of the process. Products are available in different gloss levels from a satin or low sheen finish to a full gloss level. It should however be noted that not all suppliers may provide both in the range of products they sell.

From some suppliers product is available unfinished so that it can be sanded and coated on site. Sanding and coating on site can be beneficial in permitting the final appearance to be achieved at the end of the project when floor installation is required beforehand. It also provides for coating choice. Although a high standard of finish is achievable, site sanded and finished floors generally contain some imperfections and where such imperfections have a limited effect on the appearance of the floor, the imperfections are considered acceptable.

Provided below is a photo of an engineered floor that was sanded back to bare timber and coated. The appearance is quite acceptable even though at an oblique angle in reflected light the surface is not as smooth as the original pre-finished boards. This is shown in the inset.

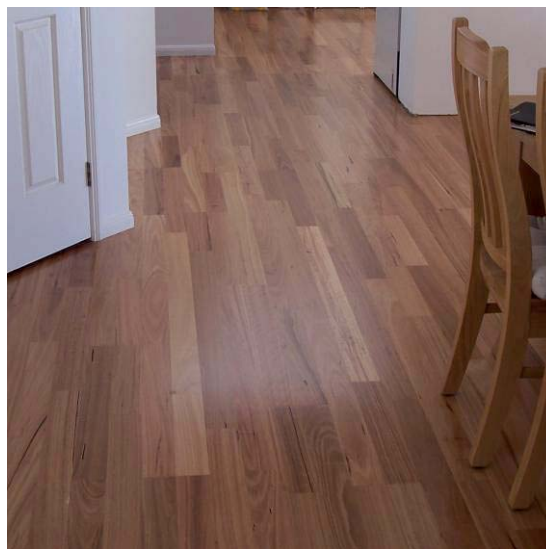


When site sanded and finished minor finishing imperfections are acceptable.

2.0 General properties

2.1 Timber species in the face lamella or veneer

A wide range of species and species mixes are available as the face lamella or veneer including both Australian and overseas species. Often trade names are applied to products when a stained coating is applied and therefore in this instance selection may be on board colour rather than species. A number of Australian species are, however, referred to by their common names due to familiarity of these species in the Australian marketplace. Australian species and species mixes such as Spotted Gum, Blackbutt, Sydney Blue Gum, Jarrah and Tasmanian Oak are often available and some manufacturers may also have species such as Tallowwood, Brushbox, Red Mahogany, Alpine Ash and Stringybark available. Some Australian wood varieties are grown overseas, and as such may present with different colours and features e.g. Spotted Gum, Flooded Gum. Similarly, overseas species such as Oak, Maple, Merbau, Hevea and Kempas are also available under their common species names. Names of overseas species that are less familiar include the likes of Jatoba, Nyatoh, Lapacho, Pyinkado and Cabreuva.



A range of colours from creams to deeper browns

2.2 Colour variation

The face lamella or veneer on all engineered flooring is natural and subject to the natural colour variations within the species. Colour or tone variations are less apparent in some species than others but no two packs of flooring will be identical. This is part of the beauty of choosing a natural product in that it is unique. Purchasers need to be fully aware of the natural colour variations will occur between boards of the same species and also that one pack may contain a different blend of colours to another pack, particularly if they were not manufactured at the same time. Some suppliers suggest boards from different packs need to be blended into the floor during installation but with others suppliers, preference is not to open more than a few packs at a time.

The customer needs to be fully aware and accepting of the fact that colour variation occurs. If there are significant concerns regarding the supply of the flooring it must be raised with the supplier prior to laying. Normal colourations between boards do not provide grounds for replacement and any concerns need to be raised prior to laying.

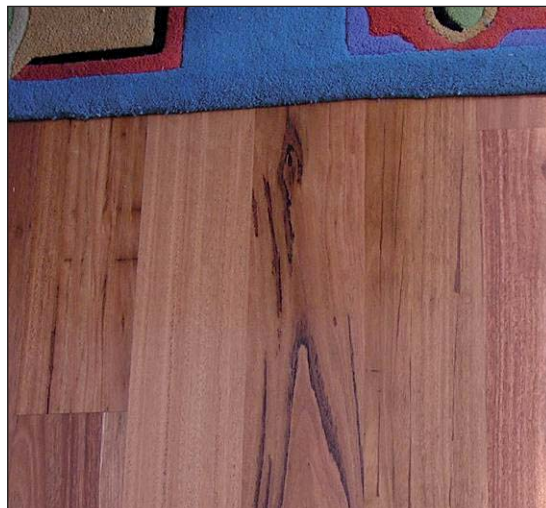


With natural light the colour of wood can undergo a significant colour change. Here from a brown to a red.

Retailers and consumers should also be aware of the large amount of colour change that can occur in wood due to exposure to natural light. This can often mean that there is a highly contrasting variation in colour between the in-store sample (which may be some years old) and the newly delivered flooring. The adjacent image shows a piece of Jatoba, where the left half of the sample has been exposed to natural light for 3 months and the other half covered. Some species are prone to more intense colour changes than others. As can be seen, the potential for argument and disappointment on inspection of the new flooring is substantial, but may be avoided by proper education of the retailer and consumer. Colour changes will also occur after a floor is laid, particularly in rooms receiving greater natural light (Also refer to section 7.0). When this effect is more pronounced, floor mats and rugs should not be used for up to 6 months, noting that greater care at external doors may be necessary during this period to prevent grit entry from footwear. Similarly, some items of furniture may need to regularly moved a little if it is desired to minimise this effect. Colour change is natural and does not relate to a product defect.

2.3 Grade

In engineered flooring when we refer to the grade of a floor, we are referring to the size and number to features that are present in the boards. These grades are manufacturer specific for which written descriptions should be available. Features include such things as gum veins, knots and past borer activity. Aspects relating to board colour or length are not covered by grading. With much of the engineered flooring that is of imported species, no features are present and therefore product is sold by species or common name only. (Solid Australian hardwood flooring has a tradition of being sold with features in it as many like the character that gum veins and the like provide in a floor, considering that it looks more natural. In the adjacent photo, gum veins add natural character to this Blackbutt floor.) When the face lamella or veneer of engineered flooring is of an Australian species a grade name often accompanies the species or common name. Some grades names are associated with flooring where the features are more dominant and others where the features in the floor are less dominant. With some products the same grade descriptions used for solid hardwood flooring in AS 2796 Timber - Hardwood - Sawn and milled products are used. Where products contain grade features, customers need to be familiarized with what may be present and that in different species the type of feature predominating will often differ.



Again, it is prudent to open packs of flooring prior to installation and for the customer to be fully aware and accepting of the grade features at that time and, similarly, that selection and placement of boards to provide an even blend throughout the floor can be achieved by selecting and laying from multiple packs. Boards that are within grade do not provide grounds for replacement and any concerns need to be raised prior to laying.

2.4 Timber species hardness

Hardness of timber in Australia is a measure of a board's resistance to indentation. The test undertaken is known as the Janka hardness test and it measures the force that it takes to press a steel ball a certain depth into the timber. The test was derived for solid timber and as a force is being measured, the units of measurement are in kN (kilonewtons). Due to this some care is necessary when applying this to engineered flooring as often the hardness being quoted relates to the species of timber in the surface lamella or veneer. As this becomes thinner, it will be more the resistance to indentation of the core layer that governs a product's resistance to indentation. This is not to say that flooring will not indent as stiletto heels will indent most timber floors irrespective of whether engineered or solid. As such it becomes a matter of sensible footwear management and similarly if furniture, appliances or the like are dragged or dropped on the floor it can be expected to indent, bruise or scratch.

2.5 Wear

Like all floor coverings, factory coated engineered timber floors will show signs of wear over time depending on the amount of use the floor receives. Some coating systems with additives such as aluminium oxide provide a very tough coating system which can be expected to take longer to show signs of wear. If floors are site sanded and coated, as with the one in the photo, then wear relates to the products used to coat the floor. By implementing a regular cleaning and maintenance program, you can ensure your floor remains in the best condition possible. Note that coating and surface finish warranties can be quite specific in what they cover and can exclude high wear areas. The warranty is more to cover a problem with the manufacture or initial application of the factory coating rather than aspects relating to normal wear in the floor. It is also normal for a wear warranty to require proper maintenance of the wood flooring for a claim to be valid. Note that guidelines may include the re-coating of the floor when it shows signs of wear and due to this a valid warranty claim for wear would be unlikely.



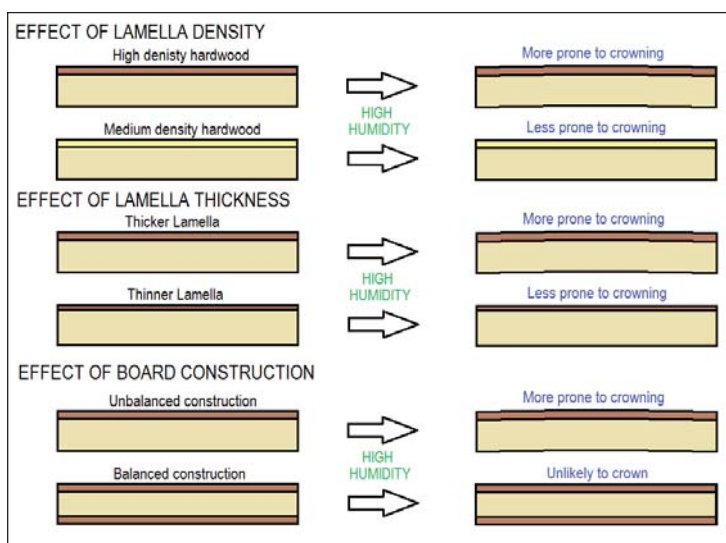
Site sanded and coated engineered floor

2.6 Expansion characteristics

It has been outlined above that one of the main characteristics of engineered flooring is that cross lamination and fiberboard or other cores provide increased stability in the width movement of the board to changes in relative humidity. As a result, with the same change in moisture content to that of a solid timber floor, the width movement in a cross laminated engineered board may be reduced to as little as a tenth of solid flooring. However, whereas a solid timber floor has no appreciable expansion in the length of the board, the cross laminating does introduce a small amount of movement down the length of the board. This movement, therefore, needs to be catered for at installation through expansion allowance. Also requiring consideration are the other engineered flooring products on the market with a fiberboard or other core layer. Although the core layer will provide a similar increase in stability, the expansion characteristics of such products can also be expected to differ individually from product to product. In particular with these products the expansion characteristics should be known by the manufacturer and expansion provision requirements provided. It is also important to note that floating engineered floors form a very large engineered panel of wood that tends to behave as a panel. This requires certain consideration and anticipation about how this large panel will behave, particularly in regard to how much perimeter gap will be required, and in which direction the panel will tend to expand or contract. Consequently, the positioning of expansion joints between areas of a floor that will expand differently is very important and floors need to be cut around heavier benches and the like to permit free movement of the flooring.

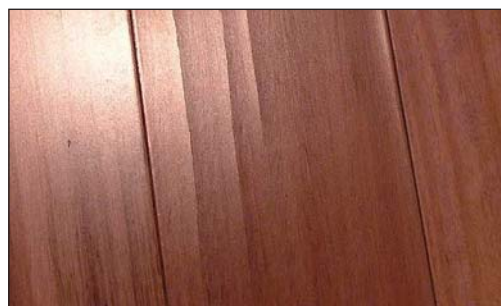
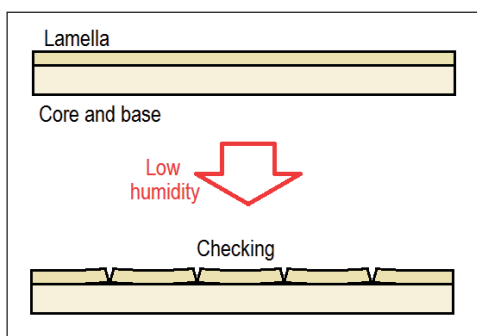
2.7 Effect of humidity on products

Engineered flooring performs through a wide humidity range and is generally manufactured at lower moisture contents. When in service in uncontrolled naturally ventilated environments, the flooring can be expected to absorb moisture from the humidity in the air. This will often cause some swelling of the face lamella, but the overall effect on the board will differ depending on the construction of the board, the thickness of the face lamella and also on the strength of the species in the face lamella. Such effects are much less apparent with the thin veneers. These concepts are outlined in the diagram below and slight crowning, due to arching of the boards, is shown in the photo.



Crowning

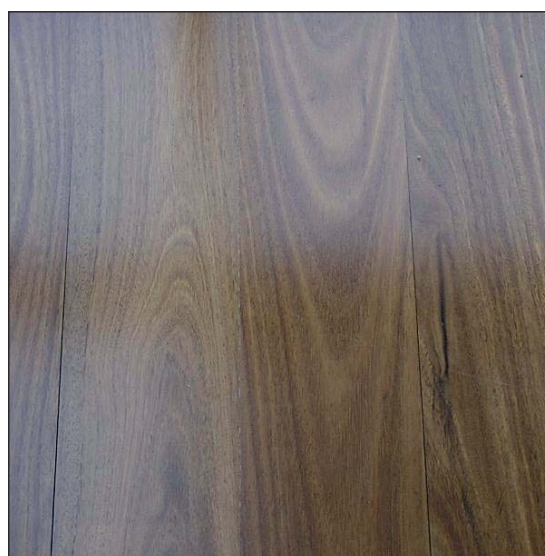
If the humidity is very low, which can be brought about by the likes of high use of heating in a room or flooring that is too high in moisture content at manufacture, then moisture from the board can be lost to the air resulting in the face lamella shrinking. This can cause checking or splits through the face lamella as shown in the diagram and photo below.



Checking

Also with direct heat sources such as areas of more intense sun exposure on floors, as shown in the adjacent photo, or with under floor heating there can be small amounts of shrinkage that can result in slight separation of board joints. Generally this is minor as the floor simply reflects the natural properties of timber. When conditions change and there is more humidity in the air such gaps will often lessen in size or close. In some instances with T&G floors the glue bond can let go and result in some irregularly spaced wider gaps.

It is evident from the aspects discussed above that different products and different "species" of the same product may behave differently in a particular environment, with some products performing better in more extreme environmental conditions. Manufacturers usually have a humidity range that their products are best suited to for optimal performance and therefore it is important that these be followed.



Gapping

3.0 Pre-installation

3.1 Locality, dwelling environment and product choice

As outlined previously it is mainly the relative humidity that influences the moisture content of flooring and different products will be more suited to some localities and internal environments than others. The table below indicates the moisture content that timber will approach under set conditions of relative humidity and temperature. As an example, if the conditions above a floor were maintained at a temperature of 20°C and the relative humidity maintained at 55%, then in time the flooring moisture content would settle to about 10%. At this temperature a rise in relative humidity to say 65% would result in board moisture content rising over a period of time to about 12%, conversely a lowering in relative humidity to a very low 35% would cause the moisture content to reduce to about 7%.

Temperature		Moisture content at various relative humidities																		
°C	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	
0	1.4	2.6	3.7	4.6	5.5	6.3	7.1	7.9	8.7	9.5	10.4	11.3	12.4	13.5	14.9	16.5	18.5	21.0	24.3	
10	1.4	2.6	3.6	4.6	5.5	6.3	7.1	7.9	8.7	9.5	10.3	11.2	12.3	13.4	14.8	16.4	18.4	20.9	24.3	
20	1.3	2.5	3.6	4.5	5.4	6.2	7.0	7.7	8.5	9.3	10.1	11.0	12.0	13.1	14.5	16.0	18.0	20.5	23.9	
30	1.2	2.4	3.4	4.3	5.2	6.0	6.7	7.5	8.2	9.0	9.8	10.6	11.6	12.7	14.0	15.5	17.5	20.0	23.4	
40	1.1	2.2	3.2	4.1	5.0	5.7	6.4	7.1	7.9	8.6	9.4	10.2	11.1	12.2	13.4	15.0	16.8	19.3	22.7	

Within a dwelling there are many things that influence the relative humidity and a comfortable living environment is not as extreme as the conditions outside the dwelling. In cold climates the internal environment is moderated by heating when cold wet conditions cause high humidity outside and in summer months when conditions can be hot and humid, refrigerative air-conditioning is often used which moderates the high external humidity. In places experiencing hot dry summers, evaporative coolers add moisture to the air thereby also moderating the conditions. Furnishing such as curtains and rugs also tend to moderate the internal environment by not only reducing heat gain in the floor but also absorbing and emitting moisture depending on the humidity, similar to the floor. Generally, in the conditions that we feel most comfortable, the engineered floor will also perform the best.

Care is necessary not to create conditions within the dwelling that we would feel particularly uncomfortable in. More extreme use of heating and cooling systems, unfurnished dwellings and permitting hot humid conditions for extended periods inside the dwelling can all have a detrimental effect on engineered floors.

Differences in the construction of engineered products have been outlined above and associated with these there will be differences in the performance of products in particular environments. Most engineered products are well suited to drier conditions with manufacturers and suppliers often indicating suitability down to about 35% relative humidity. For the main populated coastal cities humidities may drop below this for only short periods in very dry conditions such as during bush fire days but the period over which this occurs is not generally sufficient to affect the floor.

However with higher humidity conditions greater care is necessary. Often during the building phase when the dwelling is not being lived in internal conditions tend to more closely reflect external conditions. Floor installation at the end of the building process, particularly if the building is during a humid time of the year, is therefore necessary. Other humid localities include the tropics, buildings within a few hundred meters of the coast, areas with large expanses of grass around them such as farmland, gullies with tall surrounding trees and where the dwelling is often shaded and often near a watercourse (as indicated in the photo), and elevated hinterland and ranges where conditions are often cooler and more cloudy and misty.

Regarding this some products are only recommended for internal environments up to about 65% relative humidity for floating floor applications and 70% for direct adhesive fix applications. Similarly, although short periods exceeding these values will not affect the floor, even in localities such as Brisbane, and more so in the northern tropical locations, relative humidity in a naturally ventilated dwelling will frequently and consistently exceed 70%.



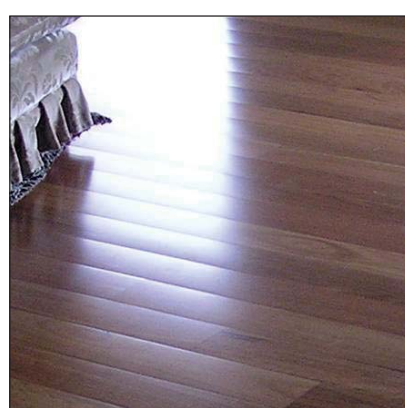
Higher humidity is experienced in houses in bushy gullies

Product choice is therefore very important in higher humidity locations. There are engineered floors to suit humid dwelling environments but some particular species and constructions will not provide adequate performance. It is important to check both the manufacturer's installation recommendations and warranty conditions that the product being considered is designed for the dwelling environment.

The adjacent photos cover two situations in which there was inadequate care in the choice of flooring product, inadequate evaluation of the site environment and less robust installation method, resulting in poor floor performance with high levels of expansion and crowning. The seaside environment provides a higher humidity environment and some wet trades were also present after the floor had been installed. Lack of protection of the prefinished product also resulted in damage to the flooring.



In the second two photos we have a tropical location which by nature is a higher humidity environment. The dwelling is in a country area, elevated and naturally ventilated, so the floor is exposed daily to higher humidity conditions. In this instance the floor was floated, which with some products is also a less robust method of fixing in higher humidity environments.



As such it is emphasized that each site and dwelling environment needs to be correctly assessed.

3.2 Building site conditions

With regard to the exterior of the building or dwelling, all gutters, downpipes and drainage systems need to be in place and operational prior to laying the floor. Similarly, ground work needs to be sufficiently completed to ensure water drains away from the building and that no ponding of water occurs either adjacent to slabs and footings or beneath the building.

Higher humidity internal environments resulting in crowning

Prior to product being delivered to site the building needs to be weather tight with all windows and doors in place. Wet trades including plastering, tiling, painting and plumbing should be complete and the building or dwelling then given time to dry from higher levels of moisture released from these trades.

3.3 Storage and handling

All products should be handled with care and unopened cartons should be stored in dry conditions and elevated at least 100 mm off ground floor slabs. Conditions within the dwelling should resemble as closely as possible the in-service conditions of the completed building or dwelling. If the normal in-service conditions of a building is that it is air-conditioned or heated at the time of the year when the floor is being installed then if possible these conditions should be replicated prior to floor installation and then maintained. Temperatures in the 20s and relative humidity of 40% to 60% are indicative of moderately dry conditions that are best suited to floor installation with many of the products available. The focus should be on comfortable indoor conditions.

3.4 Acclimatisation

Prior to laying the floor some consideration needs to be given to acclimatising the product. Although the word acclimatise is used, it often has a different meaning to that used with solid timber flooring and therefore individual manufacturer details need to be considered. In some instances manufacturer recommendations state that no acclimatisation is necessary, others indicate that acclimatisation by the processes used with solid timber flooring should be undertaken while others state that storage for 7 to 10 days in the installation environment is all that is necessary to acclimatise or accustom the product to the installation environment. In general, the intention of these guidelines is to bring the temperature of the new flooring close to that of the indoor environment. This means that the panels are not subjected to temperature shock and distortion on opening.

4.0 Subfloors

4.1 Appropriate subfloors

For both floating and direct adhesive fix applications a wide range of subfloors can be laid over provided the subfloor is in a suitable condition to accept the flooring as outlined below. In the case of direct adhesive fix applications the structural integrity of the subfloor must be adequate to withstand forces associated with board expansion.

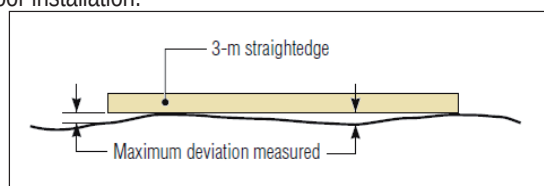
In most instances subfloors are going to be concrete slabs or sheet floors of plywood or particleboard. Underlay, which could be acoustic, can provide an intermediate layer. Other subfloors suitable to some product manufacturers also include existing timber floors, Masonite, resilient flooring and ceramic tiles (or similar). There are also a limited number of products that can be fixed direct to joists or battens. For the specifics relating to the preferred installation method, the product supplier's installation recommendations need to be viewed and then recommendations adhered to.

In accordance with the Building Code of Australia, engineered flooring is not to be installed in wet areas such as the bathroom, toilet and laundry. Kitchen and food preparation areas are not deemed to be wet areas.

4.2 Subfloor construction, flatness and cleanliness

All subfloors need to be sound and structurally complying with relevant Australian construction standards (i.e. the supporting timber or concrete which may also have been overlaid with tiles or resilient flooring etc.). Any determined problems with an existing subfloor or overlaid product (e.g. squeaks in an existing timber or sheet subfloor or tile fixing integrity) that may affect the performance or appearance of the installed engineered floor need to be corrected prior to floor installation.

All subfloors need to be sufficiently flat to accept the flooring system (floated or direct adhesive fix). For floating floors this generally does not exceed 3 mm beneath a 1 m long straight edge. For direct adhesive fix applications 3 mm beneath a 3 m long straight edge applies.



Excessive variation in the sub-floor may lead to excessive deflection of a floating floor panel with foot traffic. Such movement may also lead to excessive noise, therefore proper preparation is critical in order to achieve a solid and quiet floor underfoot.

Specific recommendations for individual flooring products or as recommended by adhesive manufacturers may be tighter than this and in such cases will apply. Where concrete subfloors are not sufficiently flat, leveling compounds, grinding or other means to level the subfloor need to be undertaken. With timber subfloors, packing of joists and sanding of sheet subfloors may be necessary.

The surface on which the flooring is to be adhesive fixed must be free from all contaminants that could prevent or reduce the effectiveness of the adhesive. In particular the surface needs to be free from any waxes, grease, paint, sealers and other similar substances. Sanding or grinding with concrete slabs may be required to provide a suitable surface. Some adhesive manufacturers will on request perform bonding tests.



Subfloor flatness needs to be within the required tolerance

For floors direct adhesive fixed to concrete subfloors the following additional provisions apply:

- Any intermediate layer between the flooring and the subfloor (e.g. ceramic tiles over a slab) needs to be removed or if permitted to be laid over by the engineered flooring manufacturer, it needs to be tested to ensure it is adequately adhered to the subfloor. If adhesive fixing to an intermediate layer the flatness provisions outlined above apply

- When leveling compounds are used on a concrete slab they are to be applied to manufacturer recommendations and care is needed to ensure sealers used in conjunction with the product are completely covered by the leveling compound. Sealers can prevent adhesion. The leveling compound also requires sufficient tensile strength to accommodate the expansion forces from the adhered flooring. Leveling compounds with low tensile strength are not sufficient for adhesive fixed floors. The leveling compound in the photo can be gouged with a steel ruler.



Leveling compound with insufficient strength

4.3 Concrete slab subfloors – Protection from moisture

Irrespective of whether the floor is floated or direct adhesive fixed, steps need to be taken to prevent possible moisture uptake into the flooring from the concrete subfloor. Moisture absorption from beneath the floor can result in greater levels of expansion resulting in buckling, adhesive bond failure and a cupped or crowned appearance.

It is important to ensure that slabs have under slab moisture retarding barriers that comply with AS 2870 - Residential Slabs and Footings. These barriers separate the concrete from possible sources of moisture that may delay or could prevent the concrete from drying adequately. Provided they are installed correctly, water vapour transmission through them is minimal. It has been shown that such barriers form close contact with the slab preventing moisture movement between the barrier and slab. Puncturing, gaps or in-ground piers can result in localised areas of higher moisture and slab edge dampness also needs to be considered.

With normal N20 house slabs laid in accordance with AS 2870, three months drying should be sufficient for a 100 mm thick slab drying from one surface only, a 150 mm thick slab requires six months and for a 200 mm thick slab 12 months. If drying from both sides of the slab, then these times are halved. However relying only on slab age is not sufficient as experiences have indicated that in some instances moisture related problems have still occurred.

The water cement ratio and placement of the concrete have a direct bearing on the permeability of the slab. Hence a slab that is many years old is not necessarily a dry slab. Slab moisture can also change seasonally with changes to the water table level. Higher strength concrete more often used in high rise developments is less permeable and presents less risk. Elevated slabs also present less risk than slabs that are on ground. A slab that is below grade, cut into an embankment or where the slab is near the



The puddles indicate low areas in this slab

same level as patios or the ground level outside, presents the greatest risk. With additions to houses, the joint between new and old slabs also presents a very high risk and needs to be attended to in order that moisture and moisture vapour do not affect the floor.

At the time of floor installation the installer will generally not be aware of what the actual water-cement ratio was (or if water had been added on site), how well the ground moisture vapour barrier was installed or how well the concrete was placed. The presence of beams also needs to be considered. The weather, including wind, temperature and humidity variations, also influences drying. Therefore, regardless of the age of the slab, its moisture levels require further assessment prior to laying an adhesive fixed, engineered floor.

Slab moisture can be assessed with concrete moisture meters as well as in-slab relative humidity tests. Such measures along with assessments of the risks outlined above are necessary for all slabs.

When moisture meters are used new slabs may give readings with a concrete capacitance moisture meter of about 6% a few days after placement. Within 3 months the readings may be down to about 4% and after two years readings may settle to about 1.5%. Once a slab is known to be reducing in moisture content like this and at least 3 months old, other means of protecting against possible slab moisture can be employed if considered necessary. Some engineered flooring manufacturers will leave the onus on the installer while others recommend an applied moisture retarding barrier or similar as an added safeguard. Note that a slab that is, for example, 6 years

old and giving readings of perhaps 4% is a high risk slab because after this period of time moisture meter readings should have been lower. Note also the limitations of concrete moisture meters. They measure moisture near the top of the slab and once a floor is laid moisture levels generally increase toward the top of the slab.

In-slab relative humidity measurement is a method of slab moisture assessment that is increasing in popularity throughout the world and is considered to provide a more accurate assessment of the potential for slab moisture to affect a floor. The test takes into account that moisture in a slab increases toward the top surface of the slab once an engineered floor is laid. In-slab relative humidity remains relatively high in all slabs and information from overseas suggests that in-slab relative humidities of about 80% are at a level where timber based flooring products can be considered. In-slab relative humidity requires holes to be drilled in the slab, the holes plugged and readings with a hygrometer taken some time later (72 hours to meet US Standards). Again other means of protecting against possible slab moisture may also be part of engineered flooring manufacturer recommendations and should be followed.



Concrete capacitance moisture meter

Therefore prior to laying a direct adhesive fix floor the level of moisture in a slab needs to be assessed and when down to suitable levels an applied moisture vapour barrier, if directed by the flooring product manufacturer, is to be used. If the floor is being laid on battens a 0.2 mm polyethylene plastic over a slab should be used.

With floating floors an underlay and moisture retarding layer is a standard recommendation of engineered flooring manufacturers. Many engineered flooring products have specific underlays that are to be used and contain an integral moisture retarding layer.

Engineering flooring product supplier recommendations concerning the desired system are to be followed and underlay or applied moisture vapour barrier products are to be applied in accordance with manufacturer recommendations.

4.4 Timber and sheet subfloors – Protection from moisture

Engineered flooring can be laid over particleboard or plywood subfloors on joists and often on solid timber flooring on joists as either a floating floor or an adhesive fixed floor. It is necessary to ensure possible moisture in either the sheet or timber subfloor and the subfloor space beneath does not affect the flooring being laid.

Subfloor Spaces and Surrounds

The drainage system provided to the dwelling site needs to ensure that run-off water will drain away from the building perimeter (not towards it) and that run-off water is prevented from entering the subfloor space. The ground beneath a suspended floor should also be graded and closed drainage systems used if necessary so that no ponding is possible. The subfloor space must be free from all building debris and vegetation. Landscaping, patios and the like should not limit air-flow around the external perimeter of the subfloor space, and structural elements should also not limit air-flow.

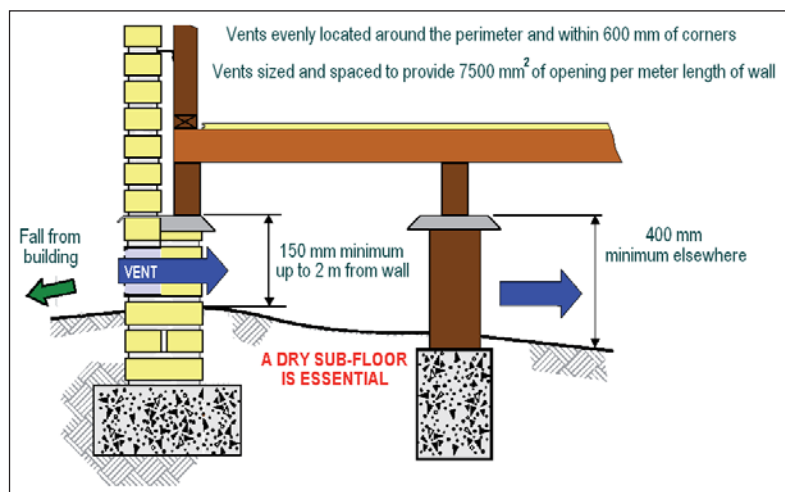
Where the subfloor space is enclosed the same provisions for solid timber flooring apply. Ventilation to the subfloor space is a requirement of the Building Code of Australia (BCA). If recommended natural ventilation cannot be provided to subfloor spaces (e.g. due to adjoining decks or where foundations are cut in), a mechanical ventilation system should be installed which replaces all of the air in this space on a regular basis, and prevents the formation of 'dead-air' pockets. Where ventilation is compromised (e.g. subfloor obstructions, fences and adjoining structures) consideration should be given to the use of more than the minimum number of vents thus ensuring that cross flow is achieved.

If there are doubts over the subfloor humidity (areas of high water table or reduced airflow etc.) a polyethylene membrane laid over the soil should also be considered (taped at joints and fixed to stumps and walls), in addition to increased ventilation. With dwellings on sloping blocks, the possibility of seepage should be taken into consideration and appropriate control measures taken prior to the installation of the floor.

Subfloor ventilation through permanent vents that exceeds minimum Building Code of Australia (BCA) requirements is recommended where any timber floor is installed. The levels outlined in the BCA (6000 mm² per meter length of wall in moderate to higher humidity

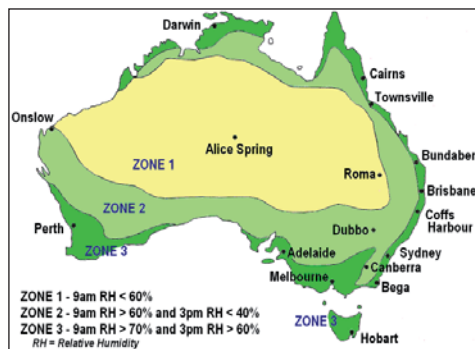
areas) are primarily to limit the moisture content of subfloor framing timbers, which can generally tolerate greater fluctuations in moisture content. The recommended minimum ventilation is 7500 mm² per meter length of wall, with vents evenly spaced to ensure that cross ventilation is provided to all subfloor areas (refer to the adjacent figure).

BCA relative humidity zones and associated BCA ventilation requirements are also provided below.



BCA Sub-floor Ventilation Requirements		Min. Sub-Floor Ventilation mm²/m of wall	
CLIMATE ZONE, CONDITIONS & SELECTED LOCATIONS		No membrane	Ground sealed with impervious membrane
1	Average 9am RH < 60%	2000	1000
2	Average 9am RH > 60% and 3pm RH < 40%	4000	2000
3	Average 9am RH > 70% and 3pm RH < 60%	6000	3000

Source: BCA 2005 Vol 2



In some localities, to meet constraints associated with energy efficiency, it may be decided to reduce ventilation levels to the values provided in the BCA. The BCA also outlines that a moisture barrier over the soil beneath the building reduces ventilation requirements and this approach is equally applicable to timber floors (refer to the table above). If ventilation below the recommended level is used, due consideration should be given to alternative measures as outlined above and particular attention should be paid to ensuring that the subfloor space remains dry throughout all seasons. The type of vent may also need to be considered with buildings in bushfire areas which limits the mesh size used in vents. It should be noted that the maximum vent spacing irrespective of net ventilation area is 2 m and that any screens that may be necessary in bushfire areas or for vermin proofing may restrict airflow and this may need to be compensated for.

Moisture Content of the Subfloor

It is necessary to check that the existing timber or sheet floor moisture content is appropriate to accept the new floor. The cause of any excess moisture (wetting during construction, leaks, inadequate subfloor ventilation, etc) needs to be addressed prior to installation of the new floor. Moisture meters are unpredictable in sheet flooring and this may necessitate oven dry testing. Due to the adhesives in sheet products, resistance moisture meter readings in these products as a subfloor, some time after installation, are generally higher than oven dry moisture contents. Resistance moisture meter testing of subfloor joists can also provide an indication of general sheet subfloor moisture contents. Sheet subfloors should not be more than a few percent higher than the expected average in-service moisture content. For example in main coastal major cities the average in-service moisture content is about 11% and therefore the subfloor should be no more than 13%. In tropical locations timber may average 14% and therefore 16% in the subfloor could be expected.

4.5 Other subfloors and those requiring acoustic rating

Engineered flooring may also be installed over subfloors not specifically outlined above, but as these are less common the flooring product manufacturer should be consulted on advice regarding the product and installation system to be used.

A degree of acoustic isolation is achieved with either floating installation on underlay or with some adhesive fixed systems. However, in apartment development there is a requirement to meet not only BCA requirements of an L_{nTW} (plus a modification factor C_i) to be not more than 62dB for floors separating dwellings but also the provisions under the Strata Schemes Management Act where the Body Corporate can set its own requirements.

For comparative purposes it should be noted that carpet will generally achieve an L_{nTW} of about 40dB and for bare concrete with a 175 mm slab a L_{nTW} may be about 70dB. Note that sound pressure is measured in decibels (dB) and an increase or decrease is perceived by us as a change in loudness. Most of us would notice a change of 3dB and a reduction of 10dB would sound about half as loud.

Due to these requirements specific underlays and installation practices need to be employed to achieve the required sound isolation. Aspects relating to the thickness of concrete subfloors play a significant roll and thinner timber floors generally result in less sound transmission than thicker flooring. Underlay performance relates more to the design of the underlay rather than the thickness. Timber flooring systems including acoustic underlays often provide about 10 to 20 dB attenuation (reduction in noise).

Hence with such applications advice from the flooring product manufacturer and others will likely be necessary.

4.6 Heated slabs

As engineered flooring differs considerably in its construction between manufacturers not all products are suitable for installing over heated subfloors. Therefore if installing a floor over a heated subfloor it is necessary not only to choose the correct product but also to follow the specific manufacturer installation instructions.

Products are available that can be both floated and glued down over heated concrete slab subfloors. Provided below is an outline of principles that need to be considered although installation practice must follow manufacturer guidelines.

The suitability of the slab for floor installation must first be assessed in terms of slab integrity, flatness and initially at a moisture level suited to floor installation over unheated slabs (refer to sections 3.2 & 3.3). Following this further drying is necessary. If this is not done heating of the slab will drive remaining moisture out after the flooring is installed, affecting its performance. Hence the heating system must be operational prior to floor installation and further drying of the slab achieved by applying heat for about 72 hours and then letting it rest for 24 hours. At this time a moisture vapour barrier may be considered for added protection.

Engineered flooring can then be laid as either a floating or adhesive fixed installation in line with standard practices for the product being installed including recommended expansion allowance in both floor width and length. Forty eight hours after installation the heating system is to be operated and temperature increased equally over a five day period up to a maximum temperature of 27°C and then maintained at this temperature for at least a further two weeks.

If the flooring is not prefinished and is to be sanded and coated then the floor needs to be cooled for about 3 days after installation and following the heat stabilization sequence, standard sanding and coating practices can be used. Note however that care should be exercised in the choice of coating that it is not prone to edge bonding and tram lining.

The system may then be used but be aware that timber floors should not be subjected to sudden changes and therefore temperatures should be either increased or decreased over a period of days to reach desired operating temperature with a maximum of 27°C. Some seasonal movement in the floor is to be expected and it should also be borne in mind that the floor is now accustomed to dry conditions which should be maintained when external humidity is high. Ideally an internal humidity between 35% and 55% will generally provide conditions for best performance.

5.0 Underlays

With floating floors the underlay provides a cushioning effect between the engineered floor and the subfloor over which it is laid. As such it also allows the floor to also accommodate the minor acceptable tolerances in the flatness of the subfloor. Many underlays also provide the role of a moisture vapour retarder and have this built into them with a plastic layer to prevent moisture vapour from affecting the flooring. However, this is not provided with all underlays and therefore moisture vapour transmission may need to be considered separately, such as by placing a 0.2 mm polyethylene plastic sheet over the subfloor first. In such instances the plastic sheeting is usually overlapped by about 200mm and the joints taped.

The underlay can also influence not only the noise transmission through a floor (refer to section 3.5) but also the noise emitted from the floor when walked on. Consequently, underlays come in a variety of materials depending on the properties that the manufacturer desires to achieve. Underlay products include expanded foams, polyesters, cork and rubber. In commercial applications where heavier loading may occur, a more dense product may be used.



Underlay with integral moisture retarding layer

6.0 Installation

As outlined above the construction of engineered flooring can differ significantly between manufacturers and therefore the subfloors over which the product can be laid and the environmental conditions most suited to the individual products will also differ. Consequently it is essential that it be determined that the chosen product is suitable for a specific locality and micro climate (e.g. coastal or bushy gully), that the subfloor is suited to the specific product and that the installation method is suited to both the product and installation environment. The installation must therefore be undertaken to the product manufacturer's recommendations.

Provided below is a general overview of the installation of floating floors and adhesive fixed floors. It is a description of the general process only, noting that it is the individual manufacturer recommendations that are to be followed with the actual floor installation.

6.1 Equipment required to install the floor

The equipment necessary to lay the floor will differ a little depending on whether the flooring is to be floated or direct adhesive fixed and with floating floors whether it is T&G profile or glueless joint system. However boards need to be cut and drop saws, circular saws and jig saws are often used. General carpentry tools including tape measure, pencil, string line, hammer and carpenter's square are required. Specific to floor installation are tapping blocks, pull bars and means to assess subfloor moisture. Adhesives of various types may be necessary with T&G floating floors generally using a cross linked PVA and direct adhesive fixed floors generally using a polyurethane flooring adhesive. Similarly, cleaning cloths and products for dealing with excess adhesive are also necessary. With direct adhesive fix applications subfloor leveling equipment, applied moisture retarders and sanding and grinding equipment or leveling compounds may also be required. Correct glue trowels are also needed and are specific to the adhesive manufacturer. Systems which include a moisture vapour retarder and adhesive generally need to be from the same manufacturer to maintain warranty of these products.

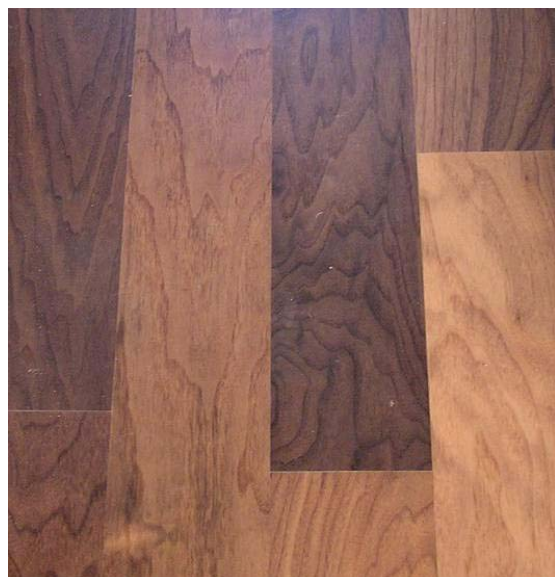
6.2 Safety

Safety is a priority and therefore correct use of power tools and use of products associated with the floor installation need to be in accordance with the manufacturer's guidelines, safety instructions and application instructions as applicable for the equipment and products used. The work area also needs to be kept clean. Note that wood and wood dust can be an irritant and that wood dust has been classified as a nasal carcinogen in humans by the International Agency for Research on Cancer (IARC).

6.3 For all installations

The flooring, irrespective of whether it is pre-finished or to be site sanded and finished, is to be checked at the time of laying for manufacturing imperfections that could become a concern in the finished floor. This includes aspects of grade, imperfections in board shape or damage to boards as well as coating imperfections. Manufacturers and suppliers expect to be notified of any such product at this time in order that any concerns can be addressed promptly and not necessitate remedial work to a completed floor. Affected boards should be set aside and not laid.

The installer is responsible for the placement of the boards in the floor in terms of colour and length distribution. Some boards may blend better to existing moldings and placement of boards that create sharp contrasts that do not blend should be avoided. Ends joints need to be spaced and a minimum of 100mm is recommended by some manufacturers while others may recommend 300mm to 500mm, as shown in the photo. Some flooring with set length boards is laid to a pattern with a set stagger while in other cases manufacturers recommend cutting starting boards to varying lengths.



Boards are staggered so that ends do not cluster

All floors require expansion allowance at skirting and around fixed objects. Intermediate expansion allowance can be required in both the length and width of floors. The length and width at which intermediate expansion allowance is needed will depend on the individual product. With longer floors expansion joints are required at doorways due to the differential movement of different sized floors in different rooms.

A neater job is provided when door casings and jambs are cut for the floor to pass beneath which negates the need for more difficult scribe cutting. Similarly, any other molds etc. should be removed and replaced after floor installation.

In preparation for the installation, the direction that the floor will be run needs to be considered. Often for the preferred visual effect and for expansion reasons the floor is run parallel to the longer walls and down the length of longer hallways. If however there is strong incoming light on the floor this may affect the choice of direction with consideration being given to installing in the direction of incoming light. Light at oblique angles across the board widths can highlight minor variations in the board surface and between boards.

6.4 Floating floor installation

It should be noted that two products types may be floated over an underlay i.e. the T&G profile and the glueless joint system (refer section 1.4).

Aspects relating to the product chosen, on-site storage and acclimatisation, the in-service environment, subfloor condition, underlay to be used, safety aspects and equipment needed to complete the installation should all have been considered and be in accordance with the manufacturer recommendations, prior to the point of floor installation.

Some general points with floating floor installation are as follows:

- All floors are laid on underlay which generally has a pre-attached moisture retarding barrier and manufacturers generally require the inclusion of a moisture retarding barrier
- Floating floors are not to be fixed to the subfloor at any point. It needs to be ensured that the floor is free to move in all directions. That is, the floor is not to abut any vertical surfaces which include doorways, other adjoining floor surfaces, pipe work, benches or staircases. Similarly the likes of kitchen benches are not to be placed on the floor, but the floor is to be cut around them
- Manufacturer recommended expansion allowance to all vertical surfaces is to be provided noting that in more humid environments greater expansion can be expected and therefore expansion allowance toward the upper end of the manufacturer range is prudent. Similarly wider or longer floors should be provided with more than the minimum
- It is to be ensured that intermediate expansion joints are provided where recommended and that appropriate expansion joints at doorways are also provided. Subfloor expansion joints and construction joints running parallel to the direction of laying should be mimicked in the engineered floor above. Construction joints in slabs need to be sealed from vapour transmission.

The installation process differs a little between manufacturers but is generally as follows:

- The underlay is rolled out onto the subfloor with integral moisture retarding barrier facing the subfloor as applicable. Joints in the underlay are butted together and taped to provide a continuous layer
- The first row of boards is laid with the groove side facing the starting wall and ensuring the recommended expansion allowance has been provided. Blocks or wedges can be used in the expansion gap to maintain the correct allowance. If the wall undulates then this row of boards will need to be scribed and cut so that the expansion allowance is even down the length of the wall. Also, consideration may need to be given that on the opposite wall the floor will not finish with a very narrow board. This can be another reason for cutting back the first row of boards.



Underlay is cut neatly around corners

T&G profile installation:

- Where the flooring has a T&G profile some manufacturers indicate that the first few rows should be initially 'dry fitted' (without adhesive), so that it is then possible to check that floor is straight, that the required expansion allowance has been achieved to the starting wall and side walls, and that end joints are appropriately spaced - a minimum of 100 mm and preferably 300 mm to 500 mm apart. It can also assist in providing a straight floor to have the first board in the first row shorter than the adjacent first board in the second row
- Once this is done the rows are disassembled and then boards glued together from the initial starting position, and boards consecutively glued together in a staggered pattern. An unbroken bead of adhesive is placed in all T&G joints to the product manufacturer's directions. This is necessary to provide the required bond strength and a degree of moisture resistance. The location of the bead or beads is important, it can differ between manufacturers and may differ over the first few rows of boards to the main body of the floor
- During the time when the adhesive is drying, often about an hour, the floor should not be walked on before proceeding with the installation of the remainder of the floor
- Throughout the installation both a tapping block, with groove fitting over the board tongue, and pull bar are used to gently tighten all joints. Clamps may also be used
- Also throughout the installation all traces of adhesive to the board surface must be cleaned off. A cotton cloth and regular changing of rinse water is necessary to prevent glue haze on the board surface
- It is likely that the final row of boards will need to be cut lengthwise, again ensuring an even expansion gap to the recommend size is provided to the external wall. Wedges are also to be placed in the expansion gap to hold the final row of boards tight as the adhesive sets. When dry, the wedges are removed
- It is also important throughout the installation to consider the overall floor area and where intermediate expansion joints and joints at doorways may need to be provided, with appropriate trims being used to permit floor expansion movement.



Use of a tapping block

Glueless joint system installation:

- Where the flooring has a glueless joint system the process is similar to the T&G installation outlined above except that no adhesive is required. The choice of starting wall, possible need to cut the first row of boards lengthwise to provide an even expansion gap and staggering of joints etc. is all the same
- Some manufacturers suggest laying three rows of boards. The first row laid by rotating the end joints together and subsequent two rows rotating the edge joints together and then using the provided blocks to gently tap end joints together. Once three rows are fitted this flooring section can be slid on the underlay to achieve the final correct positioning and expansion allowance spacings. The installation of the main body of the floor and possibly cutting of the final board are similarly executed.

6.5 Direct adhesive fix installation

A T&G profile that permits a sliding fit and allowing small movements at board joints is used for direct adhesive fix applications.

Aspects relating to the product chosen, on-site storage and acclimatisation, the in-service environment, subfloor condition, underlay to be used, safety aspects and equipment needed to complete the installation should all have been considered and be in accordance with the manufacturer recommendations, prior to the point of floor installation.

Some general points with direct adhesive fixed flooring installation are as follows:

- Flooring manufacturers will often recommend a particular adhesive be used with their product and therefore it is important that such recommendations are followed as the properties of polyurethane adhesives differ between manufacturers. With floors on

slabs a moisture vapour retarder compatible with the adhesive (generally of the same brand as the adhesive where applicable) will be specified. On plywood and particleboard subfloors no moisture vapour retarder is usually necessary as these subfloors should be within a suitable moisture range prior to floor installation. However, installers must still check the subfloor moisture conditions. (Problems often result from assuming prior trades have provided correct conditions)

- It is also important to use polyurethane adhesive in accordance with the flooring and adhesive manufacturers' guidelines and particularly in terms of the trowel size, spread rate, open times, curing times and weather conditions that could affect bonding. Surface preparation and testing as outlined in Section 3 also being particularly important
- Floors are generally laid to a chalk line about 450 mm out from either end of the starting wall. The exact distance being a multiple of the board widths plus the expansion allowance to the wall as recommended by the flooring manufacturer. However, consideration also needs to be given to walls that may undulate and rooms that are not square which may influence the positioning of the string line and necessitate cutting of the first row of boards lengthwise to suit. The required expansion allowance at walls needs to be maintained
- The first rows of boards should be installed, seated in the adhesive with the groove edge lined up to the string line and the tongue edge facing the starting wall (longer and straighter boards being preferred for this row of boards). Note also that some manufacturers require board end T&G joints to be adhesive fixed with a PVA adhesive.
- When laying it is usual to engage the end T&G joint with the side T&G's of the boards as close as possible. The side T&G's are then engaged with a minimal amount of sliding movement. This ensures minimal displacement of the adhesive and possibility of pull back from memory effects
- Laying from the first row of boards will initially commence toward the starting wall. This row of boards can be held in position with a sacrificial row of boards nailed to the subfloor on the groove side of the boards. The board to the starting wall, if not otherwise trimmed, will likely need the tongue removed to provide adequate expansion allowance
- Laying can then continue away from the starting wall with the same method as outlined above. It should be noted that working on the flooring just laid should be avoided as it can create numerous drummy spots when the floor is completed. If unavoidable in some areas a kneeling board to distribute the weight should be used
- During installation the transfer of adhesive can be checked by removing smaller floor boards after laying and checking the back of the board. If adhesive skins and transfer is inadequate the bonding will be compromised. Some recommendations require the floor to be weighted to achieve even transfer. Weather conditions affect the open time and care is necessary not to spread the adhesive too far ahead of the work area
- Any adhesive on the board surface needs to be cleaned off during the laying with the cleaner recommended by the adhesive manufacturer and cleaning cloths need to be frequently changed to prevent an adhesive haze to the board surface
- During laying, joints should be continually checked to ensure that they are tight, that the floor is aligned and that board lengths are chosen to achieve a staggered appearance with a minimum of 100mm but preferably with board ends 300mm to 500mm apart
- Heavy foot traffic should be avoided for at least 24 hours and it should be noted that at this time the adhesive will not have fully cured. Even so it is permitted to lift heavier items of furniture or benches back into place after this time
- The final row of boards will likely need to be cut lengthwise, again ensuring an even expansion gap to the recommended size is provided to the external wall. Wedges are also to be placed in the expansion gap to hold the final row of boards tight as the adhesive cures. When dry the wedges are removed
- It is also important throughout the installation to consider the overall floor area and where intermediate expansion joints, and joints at doorways, may need to be provided with appropriate trims being used to permit floor expansion movement.



Sharp saw blades are a necessity

6.6 Other installation methods

The above outlines the most common forms of floor installation. Some products may also be suitable for installation by other methods such as mechanical fixing to a timber or sheet subfloors or mechanical fix to a batten system over concrete. At times floors are also adhesive fixed over ceramic tiles or similar. When laying on a subfloor over joists, with some flooring it is also preferred that boards are laid at right angles to the direction of the joists, as this prevents the possibility of the visual effects from minor sagging of the subfloor between joists from being a concern. Procedures will be contained within the individual flooring manufacturer's installation guides for these installations and such methods should only be used for the products intended by the manufacturer.

6.7 On completion

After the flooring has been laid, and in order to complete the installation, skirtings of sufficient size to cover expansion allowance provided at walls etc. need to be fitted and fixed to the walls. Where floors are laid with the skirting in place a fillet mold is usually used to cover the expansion allowance. In some spaces elastomeric filler can be used.

When prefinished floating floors are completed they should be thoroughly cleaned using the appropriate cleaning products (see section 7) and any scuffing or minor scratches attended to prior to handover. At times minor imperfections may also be present in the floor and these can usually be filled with an appropriate colour matched filler or a hot wax repair. If the floor has been damaged and cannot be repaired to an acceptable condition, the individual board or area of flooring may need to be replaced.

Similarly the above applies to adhesive fixed floors and those that are sanded and coated on site. However, depending on the individual installation, a period up to 10 days would be required for the adhesive to cure and for a sanding and coating process to be undertaken. Sanding and coating processes are outlined in ATFA publication 'Timber Flooring' where the general process is described. It is important to note that both during the installation process of an adhesive fixed floor and then any subsequent sanding and coating, no one should walk on the floor except the contractors themselves. Similarly, actions such as just opening a door can introduce unwanted dust onto a freshly coated surface. Minor imperfections with site sanded and finished floors often occur but do not necessarily require remedial work.



Expansion trim



A completed site sanded and coated floor

7.0 Caring for your floor

7.1 General care

Engineered timber floors are considered to be easy to maintain but like all floor surfaces they do require regular cleaning and few precautionary practices to maintain their appearance and preserve their service life.

On a regular basis floors should be dry mopped with a static mop, soft bristle broom or by vacuum cleaning, provided that a brush or felt head is used and any wheels can rotate freely. Ensure with such cleaning that nothing hard rubs on the floor as it may mark it. These practices not only pick up any lint and dust but also grit that can be damaging to the floor surface. Similarly, if pets are to be inside it is necessary to ensure that nails are trimmed and paws clean, thereby not introducing excessive grit. Any spill needs to be wiped up as soon as it occurs. Failure to do so can dull or discolour the finish and if left for a long period can damage the flooring.

Rugs and floor mats are also effective in trapping grit at doorways, both inside and out, and reducing wear in high traffic areas. However do note that both the coatings and timber colour can change under the effect of UV light and this can cause colour differences under rugs. For this reason it is prudent to not use rugs for the first six months or so. Alternatively, moving rugs on a more frequent basis and at times furniture over this initial period and ensuring curtains and window covering filter sunlight, can assist in reducing these effects. Rugs should also not be rubber backed or have similar impervious backing. Not only can such products affect the mar the floor finish but they can also prevent the floor's natural exchange of moisture vapour through the board surface. All rugs and floor mats also require regular cleaning.



Use of correct cleaning equipment is essential

Legs of moveable furniture such as dining room chairs need to have protective felt pads to prevent scratches from occurring. When moving heavy objects such as furniture or appliances they need to be lifted into position to prevent bruising or scratching of the floor surface. Foot ware with high point loads such as stiletto heels will also damage timber floor surfaces and therefore management of this is necessary.

In addition to the above there are a number practices not appropriate for engineered floors and these are as follows: Do not use cleaning methods or products not designed for timber floors such as scouring pads or cleaners that may contain abrasives, soaps, waxes, ammonia or silicon. Specific timber floor cleaning products are available and should be used. Do not use steam mops (irrespective of what the product sales people may say) or any form of scrubbing machine. Do not use floor mats or rugs over heated subfloors.

7.2 Refurbishment

With many flooring products a maintenance coat may be used periodically, applied by homeowner or maintenance personnel. These provide a sacrificial coating that protects the floor finish and can also mask scuffing and minor scratches. However in time it may be desired to fully refurbish the floor through buffing or sanding back and recoating. If the finish has not worn through to the timber surface, and this is quite likely with the coating additives often used, then the floor can usually be buffed back and recoated. Some floor products suit traditional coating systems but those with wear resistant additives generally require a specific coating available for pre-finished flooring and if not used rejection and a poor appearance can result. It must also be considered that if cutting back cannot achieve an even dull appearance across the full face of the boards, due to minor crowning with board edges lower, then on recoating boards, board edges can appear glossier than the rest of the board area and be of concern to owners.

In other instances it may be desirable to sand back to bare timber, however it must first be ascertained that the flooring product has a sufficiently thick lamella or veneer for this to be possible. Other aspects such as the evenness of the floor surface would also need to be considered. Site sanded and finished floors generally provide a high standard of appearance but most contain some imperfections (e.g. dust particles and visual grain effects) not found in an original factory coated floorboard. Such imperfections, if minor in nature, are acceptable to the industry. The coating may also not be as long lasting as the factory finish and will therefore require attention a little more frequently.

8.0 Warranties

Most products are provided with warranties relating to the manufacture of the board and the coating system applied. The extent of the warranties often differs between residential and commercial floors. In addition to this, warranties relating to the installation also need to be considered and purchasers need to determine what is covered with respect to this as it will relate to individual installers. It should not be assumed that because product manufacturer warranties are being provided that installation warranties necessarily apply.

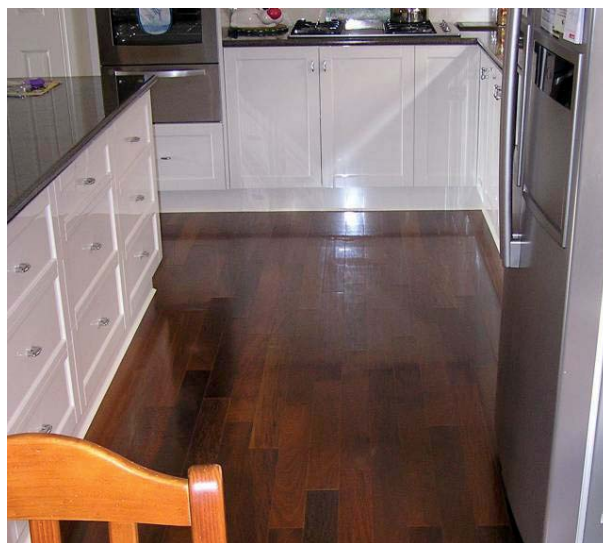
Warranties relating to board manufacture are generally very specific in nature and only cover a manufacturing defect such as delamination of the veneer or lamella. A condition of warranties is often that boards are to be inspected for possible faults at the time of installation and therefore only defects that develop and are not visible at that time may be covered. Product warranties on all timber flooring do not cover ingress of moisture as the effects are well known and to be guarded against. Also when moisture ingress occurs through the likes of building and appliance leaks, insurance policies are available to cover such events.

However it is evident that many warranties do not cover changes to the product that can occur through humid conditions encountered both at the time of installation and when the floor is in service. Such aspects can significantly alter the appearance of the floor and control of such conditions can also be difficult. Nevertheless such conditions can result in non-compliance with warranty conditions.

With regard to non-compliance, this includes such things as the dwelling not being permanently habited, the internal environment not being maintained within tight limits on humidity even in localities where moderate to higher humidity would be considered normal, flooring not being laid in areas that could become wet and the effects of exposure to direct sunlight. Similarly, aspects relating to damage to the flooring during transport or installation are also not covered by product warranties.

In many instances where a floor may exhibit a high degree of crowning, raised joints, checking, squeaking or other visual effects from board shape changes, they are often influenced by environmental conditions and there should be an awareness that these are not automatically covered by product warranties. Aspects relating to product moisture contents, product construction and profiling tolerance can also influence the way a floor performs and contribute to the above but this requires sufficient evidence which can be difficult to obtain.

Concerning coating system warranties, they relate to the coating system performance only and not aspects such as changes in the colour of the board or tone of the coating which often happens over time. Similarly, scratches, scuff marks and indentations are not covered. Aspects of gloss variation and wear that will occur with time particularly in high traffic areas are also not generally covered. Warranties therefore only relate to the original factory coating and generally only a defect in the coating system that could, for example, result in the likes of delamination of the coating.



Be aware of what warranties do and don't cover

9.0 Glossary of commonly used terms

Acclimatisation – Some product suppliers indicate that flooring should not be installed immediately after it is delivered to site. However with engineered flooring, acclimatisation can have different meanings. In many instances it refers to storing the flooring in the installation environment in its boxes for a period so that it can become accustomed to the temperature within the dwelling. In a few instances acclimatisation may be referring to unpacking and equilibrating the flooring to the internal relative humidity. Also see relative humidity.

Buckling – This refers to a group of boards arching off the subfloor generally due to the expansion allowance provided being exceeded. Also see expansion allowance.

Checking – This refers to fine splits in the surface coating and decorative timber layer beneath. Some species are more prone to this and both very dry and very humid climates can make it more pronounced.

Construction joint – At times concrete slabs are joined (e.g. house extensions) but if the joint is not properly sealed, moisture vapour or even moisture from capillary action can pass through such a joint and affect the flooring above. Installers need to be aware of the potential risks of construction joints, however work to appropriately seal these joints, unless specified, is the responsibility of others. Subfloor expansion joints and construction joints running parallel to the direction of laying should be mimicked in the engineered floor above.

Cross lamination – When the veneer or lamella and layers beneath are adhesive fixed and each layer alternates 90 degree in grain direction, this is known as cross lamination. This process provides additional stability to board width changes as the relative humidity varies. See also veneer, lamella, stability and relative humidity.

Cross linked PVA – When T&G flooring is laid as a floating floor adhesive is applied to board joints. This is usually PVA adhesive and when cross linked it becomes less susceptible to breaking down under the effects of heat and moisture from a spill or similar. See also tongue and groove and floating floor.

Crowning – This refers to boards that have arched across the width of the board resulting in board edges being lower than the centre of the board.

Cupping – This refers to boards that have a dished appearance across the width of the board resulting in board edges being higher than the centre of the board.

dB – Noise transmission through a floor is measured in decibels with the abbreviation dB. Most of us would notice a change of 3dB and a reduction of 10dB would sound about half as loud. Choice of underlay can affect the noise transmission through a floor but there are also many other factors that contribute, including the likes of the thickness of the slab subfloor. See also underlay and subfloor.

Engineered floor – Flooring manufactured with a decorative layer of timber bonded over layers beneath. This not only provides additional stability but also maintains the appearance and characteristics associated with solid timber flooring. Also see stability.

Evaporative cooler – These are generally associated with a rectangular box-like structure fixed to the roof of a dwelling. When water is evaporated off a surface there is a cooling effect and it is on this principal that these units operate. They introduce cool higher humidity air into the dwelling and with high use without appropriate venting can raise the relative humidity in a dwelling, causing a more moist internal environment. This type of air-conditioning is more common in drier climates. Also see refrigerative air-conditioner, relative humidity and in-service moisture content.

Expansion allowance – Due to the hygroscopic nature of timber flooring products, all floors require expansion allowance. With small floors this may only be required at the outer edges of the floor and be covered by skirtings or beading. However many floors will also require intermediate expansion allowance provided at doorways and at times within the floor due to the greater width of length in those floors. See also hygroscopic.

Flatness – It is important that the surfaces on which floors are laid are flat. Flatness differs from how level a floor is. A floor can be flat, not undulate up and down but may not be level in that it slopes from one side of a room to the other.

Glueless joint system – This refers the jointing system where the profile machined along the edges and ends of boards enable installation without the need to glue the board joints. At the factory, wax is at times applied to the joint to reduce possible squeaking from rubbing in the joints. Also see tongue and groove.

Grading – This is a process of sorting boards based on the features such as gum veins and knots present in them. Therefore one grade of a specific name may have fewer and smaller features than another grade of a different name.

Grading does cover board length or colour.

Hardness – In Australia timber hardness is a measure of a board's resistance to indentation. The test undertaken is known as the Janka hardness test and it measures the force that it takes to press a steel ball a certain depth into the timber. In engineered flooring the core layer and veneer or lamella thickness can affect the hardness of the board and it is important to be aware that the hardness quoted is of the timber used in the face veneer or lamella. Also see veneer and lamella.

Hygroscopic – A material that is hygroscopic will absorb water vapour from the air or release water vapour to the air depending on its moisture content and the relative humidity of the air. Both timber and concrete are hygroscopic materials. Also see relative humidity and moisture content.

In-service moisture content – The moisture content that timber attains is dependent on the relative humidity and temperature within a room. In naturally vented houses the average moisture content is generally a little less than if the timber was under cover and outside. However the likes of heating and air-conditioning can have a significant effect on the average moisture content of a floor. In-service moisture content refers to the range of moisture contents the floor will experience as a result these effects. These include internal conditions that may also be modified by heating and cooling systems. Also see moisture content, relative humidity, refrigerative air-conditioner and evaporative.

In-slab relative humidity – The surface moisture in a slab may be assessed using a moisture meter, however to assess the moisture deeper in a slab and possible future effect on an engineered floor the measurement of relative humidity within the slab can provide additional guidance. This test method is growing in popularity. Also see moisture meter and relative humidity.

Lamella – With engineered flooring this refers to the layer of decorative timber on the face of the board and is often thought of as being thicker than a veneer. A lamella is often up to 2.5 to 6 mm thick. Also see veneer.

Micro climate – All house sites differ, so even though weather patterns may relate to a specific locality, aspects such as whether the house is on a hill or in a gully can affect the performance of the floor. Micro climate refers to the humidity and temperature effects specific to building location.

Moisture content – This is a measure of how much water a material such as timber or concrete contains. At a particular relative humidity the moisture content of two hygroscopic materials will differ. At 60% relative humidity timber attains a moisture content of about 11% whereas concrete attains a moisture content about 2%. Also see hygroscopic and moisture content.

Moisture meter – Due to flooring and subfloor materials being hygroscopic, meters have been developed to assess the moisture content of these materials. Meters have their limitations and the interpretation of readings should be by someone with experience. Also see hygroscopic and moisture content.

Moisture retarding barrier – Where the engineered floor is direct adhesive fixed to a slab, this refers to an applied product over the slab where the purpose is to reduce moisture vapour transmission from the slab to a level that will not affect the flooring. Note that these are not moisture proofing membranes.

Prefinished – Many engineered floors are sold with the coating system already applied. If this is the case and the flooring after installation does not require sanding and coating then it is a prefinished product. Also see UV cured.

Refrigerative air-conditioner – Often referred to as reverse cycle, split system or ducted air-conditioning, this type of air-conditioning extracts water vapour from the air inside the building and drains this away outside. High usage can reduce the relative humidity inside and cause a drier internal environment. This type of air-conditioning is more common in more humid climates. Also see evaporative cooler, relative humidity and in-service moisture content.

Relative Humidity – This is a measure of the capacity of the air to hold invisible water vapour at a particular temperature. Under high relative humidity conditions some of this water vapour can be absorbed by the flooring causing board expansion and under low relative humidity conditions water vapour can be released from the flooring back to the air causing board shrinkage. Relative humidity is expressed as a percentage (%) where 30% and below would represent very dry conditions and 80% and above very moist and humid conditions. Also see hygroscopic, stability and moisture content.

Scuffing and scratching – Although coatings provide a floor with a good wear resistant surface they can mark with grit or objects drawn across them. More flexible coatings will tend to show dull marks known as scuffing and harder brittle coatings will tend to show scratch marks. All floors require normal care provisions.

Stability – In terms of timber flooring, a more stable flooring product is one which undergoes only small changes in its dimensions (width and length) as a result of moisture vapour uptake or loss from the air. Consequently expansion and shrinkage of the product in response to changing environmental conditions is small. Also see hygroscopic, relative humidity and moisture content.

Strip construction – Reference is at times given to the terms 'one strip', 'two strip' and 'three strip'. This refers to the number of widths of lamella covering the base layer, i.e. a two strip floor will have what would appear to be two board widths adhered to a single layer beneath. Also see lamella.

Subfloor – The term subfloor is the structural surface over which an engineered floor is laid. This can be concrete, particleboard and plywood or in some instances joists. Also see underlay.

Tongue and Groove – This is often abbreviated as T&G and refers to a board profile that slides together at edges and ends. When used with floating floors adhesive is applied to the joints. Also see glueless joint system.

Underlay – With floated floors it is necessary to provide a cushion between the flooring and subfloor. This is the underlay which is generally a thin foam but which often contains a moisture retarding barrier. Also see subfloor.

UV cured – When prefinished flooring is manufactured the coating system applied in the factory is cured by ultra violet light and as this is almost instant, boards can be handled immediately at the end of the coating line. This process enables wear resistant layers to be added to the coating system and provides a very high standard of finish. Also see prefinished.

Veneer – With engineered flooring this refers to the thinner layer of decorative timber on the face of the board. A veneer is often up to 2 mm thick but may also be thicker. Also see lamella.



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