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Introduction

Scope

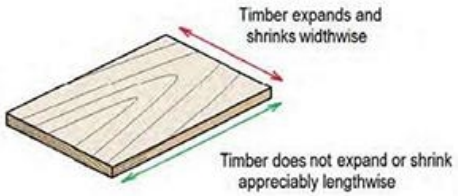
This publication is the industry standard for the installation of engineered flooring laid as floating floors or by direct adhesive fix to structural subfloors. Generally, floors of this type are of laminated solid timber with a decorative veneer or lamella on the exposed face of the boards. Other types of engineered flooring are also available which may contain the decorative veneer or lamella adhered to the likes of fiberboard or plastic composites. The standard covers 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 including assessing the house design, the environment in which the floor is to be laid and the desired appearance of the finished floor. These aspects are covered in addition to aspects relating to product selection, board widths, and finish systems applied.

The flooring process and board characteristics

Most engineered flooring is not manufactured in Australia or New Zealand but in Asia, with some from Europe and the USA, although face veneers or lamellas from Australian species are commonly available, along with exotic species and it is also worth noting that European or American Oak is popular. As product construction can differ significantly between the different 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, often 2.5mm to 6mm in thickness. In producing this decorative layer it can be peeled, sliced or sawn and as a result the surface may be smooth, textured or brushed.

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. But another property of timber is that swelling and 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.



With cross laminating the pieces are glued together like this. The central piece that does not expand lengthwise significantly reduces the widthwise expansion of the top and bottom layers.

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 in more plentiful supply. This process therefore provides a high-quality board with a solid timber exposed face, and 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 or the finish may be a UV or air cured oil. 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 before 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, differences 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, but this should not be to the detriment of the performance of the floor or its final appearance. Where customer preferences cannot be accommodated this needs to be brought to their attention. Colour variation between showroom samples or production batches and the product provided along with 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. Product types and Installation methods

As described 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.

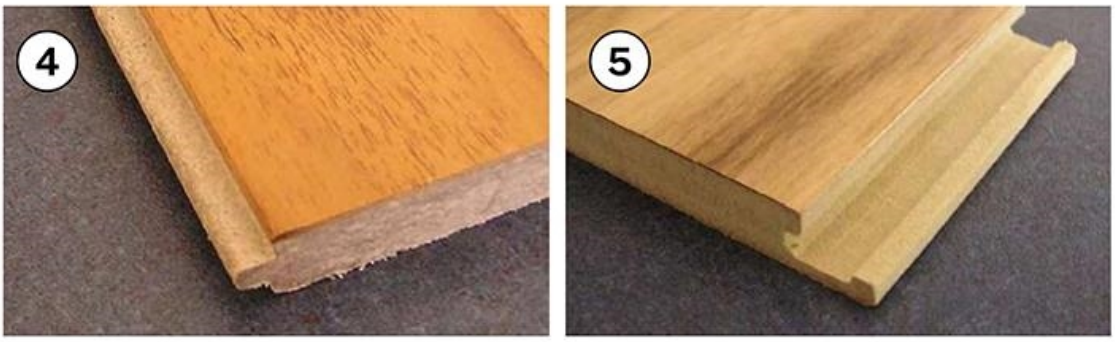
1.1 Constructions

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, the second contains 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 shows a hardwood lamella on a 10 ply softwood base and in photo 3, a 5 ply hardwood construction with the same timber species top and bottom.

Products that differ from the construction above may include those with a fiberboard base or other composite material. This type of engineered flooring is less common at present. The fourth photo shows the timber veneer on a wood/plastic composite base and the fifth 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 whereas in the photos numbered 4 & 5 the corresponding veneer thicknesses are 1.3 mm and 1.0 mm.

One aspect 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 better 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 boards ranging from as narrow as 90 mm up to board widths of approximately 200 mm. In addition, widths of up to about 350 mm are available in higher end Oak flooring. Manufacturers provide a range of board sizes and there are no standard widths. For medium width boards one manufacturer may produce a board of width 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, although again some higher end flooring may be of longer lengths. Most flooring packs will normally include a quantity of short boards in the form of "nested lengths".

Two-strip construction

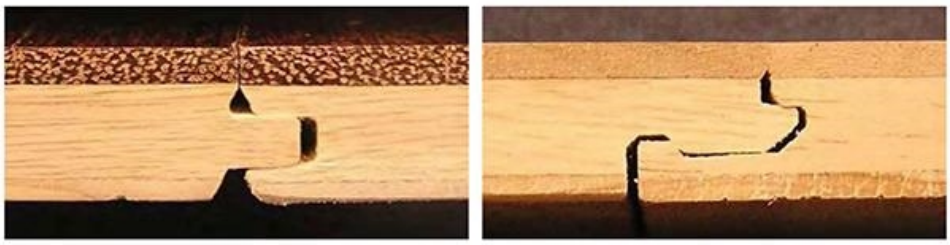
These are normally included in the floor as starting or finishing pieces and will generally not detract from the random appearance of the floor. The quantity of short boards can be up to 50% or more of the stock in square meter terms, while the minimum length can range from 600mm down to as short as 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.

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 subfloor preparation, along with careful underlay selection, provides a softer feel under foot.

1.4 T&G and glueless profiles

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 jointing systems. These two systems are illustrated in the photos below.



T&G and glueless joining systems

Traditionally the T&G profile was used for direct adhesive fix applications as well as floated floors when adhesive was applied to board joints. Note that some T&G is only designed for direct adhesive fixing. The glueless was designed for floating floor applications but more recently many manufacturers now permit direct adhesive fixing.

The jointing systems vary and are often patented designs with names including Uni-clic, 3G and 5G. Some systems utilise a sprung tongue at board ends with each having its own individual profile. Although many of the products imported into Australia will use one of these edge and end profile designs, other designs will also be used. It is important that the jointing system has sufficient strength and provides sufficient locking force to prevent separation. It should be noted that strength, fit, ease and speed of installation varies substantially between locking systems.

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. More recently flooring and particularly with Oak lamellas, the surface is both wire brushed and oiled. Oil finishes require more routine maintenance and, can be easier to repair but can also be more prone to staining. 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 but 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. 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 and grain pattern rather than species. Most Australian species are referred to by their common names due to familiarity of these species in the Australian marketplace. Australian species such as Spotted Gum, Blackbutt, Sydney Blue Gum and Jarrah and species mixes such as Tasmanian Oak are often available. Some manufacturers may also have species such as Tallowwood, Brushbox, Red Mahogany, Alpine Ash and Stringybark available. It is worth noting that Australian wood varieties are grown overseas and as such may present with different colours and features e.g. Spotted Gum and Flooded Gum. Similarly, overseas species such as Oak, Maple, Merbau, Hevea and Kempas are also available under their common species names. More recently, the versatility of Oak has been more recognised, not only for its performance characteristics allowing wider boards, but also in providing many staining and surface treatment options, enabling a wide range of appearances. Due to this it has become very popular.

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 that 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. Many manufacturers recommend that boards from different packs are blended into the floor during installation, but with some suppliers the preference is not to open more than a few packs at a time.

A range of colours from creams to deeper browns

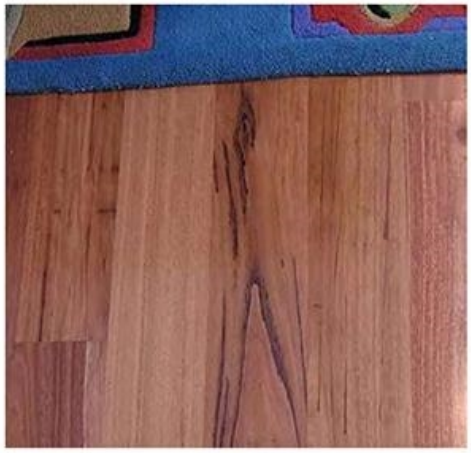
The customer needs to be fully aware and accepting of the fact that colour variation occurs. If there are significant concerns regarding the supply of the flooring it must be raised with the supplier prior to laying. Normal colourations between boards do not provide grounds for replacement and any concerns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

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 dispute and disappointment on inspection of the new flooring can be substantial, but may be avoided by proper education of the retailer and of the consumer. Colour changes will 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 be regularly moved if it is desired to minimise this effect. Colour change is a natural occurrence and is generally not considered to relate to product quality.

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

2.3 Grade

In engineered flooring when we refer to the grade of a floor, we are referring to the size and number of features that are present in the boards. 'Feature' includes gum veins, knots and past borer activity. Aspects relating to board colour or length are not covered by grading. Grades are often manufacturer specific, for which written descriptions should be available, although in many instances when the flooring is free of feature, it is just sold by species or common name. 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. For Australian species, grades may align to AS 2796.2 *Timber-Hardwood-Sawn and milled products* grade descriptions or specific manufacturer grade descriptions may apply. Where products contain grade features, customers need to be familiarised with what may be present and that in different species the type of feature predominating will often differ. European and American Oak will often contain moderate amounts of feature and grading from the USA, Europe and Asia may or may not apply. A more common Oak grade name is ABCD grade which contains boards that are fairly heavily featured.



Feature in Blackbutt flooring

ABCD Grade Oak flooring

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. Similarly, the 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 also 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. Such damage does not relate to product quality.

Oak is not a hard timber and in some high traffic commercial applications it can indent significantly.

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. Implementing a regular cleaning and maintenance program will ensure the 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

There are an increasing number of floors with oil finishes and this is particularly so with oak flooring that may also have a brushed or textured finish. With factory coatings, the oils are generally UV cured. An oiled finish can have the advantage of it being more easily refurbished, but it should be noted that the cleaning regime is more specific and products used periodically that rejuvenate the oiled surface are an integral part of the cleaning process. Hence wear with properly maintained floors can be less of a consideration. However, due care is necessary with oiled floors as they can also be more prone to discolouration from spills, especially in areas like kitchens. As with other coating types they are also prone to colour variation under floor mats.

Oil finish – Severe staining due to insufficient care.

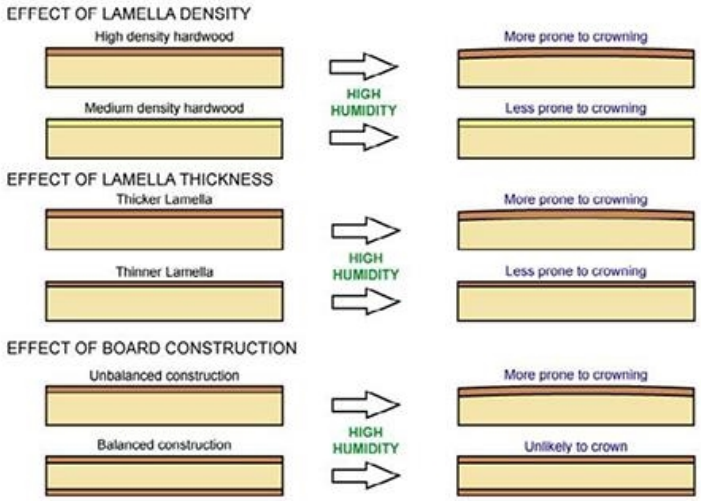
2.6 Expansion characteristics

It was 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 resulting from changes in relative humidity. As a result, with the same change in moisture content, the width movement in a cross laminated engineered board may be reduced to as little as a tenth of that of a solid timber floorboard. However, whereas a solid timber floor has no appreciable expansion or shrinkage in the length of the board, the cross laminating does introduce a small amount of movement in the length of the board with changes in moisture content. 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 and movement of the panel as a whole, needs consideration. It is for this reason that floated floors are compartmentalised into a number of adjoining panels to make up the floor. This therefore requires certain consideration and anticipation about how the panels 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 relatively 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 high use of heating in a room or high levels of direct sun exposure or if there is 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. If severe, this can cause checking or splits through the face lamella as shown in the diagram and photos below.

Checking – moisture content high at manufacture

Checking – intense sun exposure

Also, with moderate heat sources such as areas of more moderate sun exposure on floors, or with under floor heating, there can be small amounts of shrinkage that can result in small separation gaps of board joints, as shown in the adjacent photo. Generally this is minor as the floor is simply reflecting 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 requiring attention.

Gapping

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 under more severe 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 given due consideration. These recommended humidity ranges can at times be quite different from the seasonal averages in many geographical locations. As such, communicating these parameters and any possible ongoing climate control requirements to the end user is paramount. At times, alternate products may be necessary to ensure the flooring is fit for purpose.

2.8 NCC requirements - fire properties and slip resistance

For commercial class 2 to 9 buildings (shops, offices, hotels, age facilities, apartments, hostels and public buildings etc.) the National Construction Code (NCC) in Australia requires certain fire hazard properties for timber flooring (including floating floors) to be met. Note that this does not apply to single dwelling domestic houses. The properties that need to be assessed for exposed timber floors under NCC Specification C1.10a relate to the critical radiant flux (CRF) and the Smoke Development Rate (where appropriate).

The NCC specification sets out the deemed-to-satisfy requirements for floor materials and floor coverings. A floor material or covering is required to have a Critical Radiant Flux (CRF) equal to or greater than specific values that are dependent on the building class, location in the building and whether a complying sprinkler system is installed or not. Where the building does not have a sprinkler system the Smoke Development Rate must also not exceed a certain value.

For engineered flooring used in these applications, it is important to use a product where the fire hazard properties have been tested, noting that different fire properties are used in different countries. As such, it is important to check that the fire properties relate to Australian use. Companies will often have test data or reports on their website.

When we refer to slip resistance with timber flooring products we are generally referring to the slip resistance of the exposed surface of the product which, in engineered flooring, is often the pre-finished coating. In Australia there are a significant number of accidents from slips, trips and falls and therefore occupational health and safety requirements outline duties for safe designs which include the specification and supply of floor surfaces. Under the National Construction Code and with reference to the Australian Standards, it states that paths of travel for most new commercial buildings shall have a slip resistant surface. To assess the slip resistance of new surfaces, we are guided to AS/NZS 4586 – Slip Resistance Classification of New Pedestrian Surface Materials and the associated handbook HB 198: – Guide to the specification of slip resistance of pedestrian surfaces. This handbook is seen as best practice for satisfying slip resistance requirements for new floor surfaces. With recent changes to the National Construction Code (NCC), slip resistance requirements for domestic stairs have been introduced. In effect, these changes state that either the treads or a nosing to the treads must have the appropriate slip resistance.

Wet pendulum test equipment

Where engineered flooring is used in commercial applications and on stairs, it is important that the appropriate slip resistance provisions are provided for. Companies will often have test data or reports on their website or in terms of domestic stairs may have nosing options (including slip resistant tapes) that comply. Again, it is important to ensure that any test data or report relates to Australia.

3. 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 solid 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, for example, 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 dry 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. In late December and early January, Perth and Adelaide can experience longer periods of very hot dry weather and greater care, particularly if the dwelling is unoccupied, is needed at these times.

In locations with higher humidity conditions at times of higher temperatures, due care is also 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 construction is occurring during a humid time of the year, is therefore necessary. 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 or near a watercourse (as indicated in the photo), and elevated hinterland and ranges where conditions are often cooler and more cloudy and misty.

Higher humidity is experienced in houses in bushy gullies

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%.

Product choice is therefore very important in higher humidity locations. There are engineered floors that suit more humid dwelling environments, but some species and constructions will not deliver 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 intended 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 a less than 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 warm 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 less robust than adhesive fixing where the internal environment is both warm to hot and of moderate to high humidity.

Higher humidity internal environments resulting in crowning

Therefore it is emphasised 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.

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 environment 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 the moderately dry conditions that are best suited to floor installation for 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 and will more often relate to areas where there are extremes or large fluctuations in temperature, which could affect the flooring during storage or transportation. This means that the panels are not subjected

to temperature shock and distortion on opening.

4. 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.

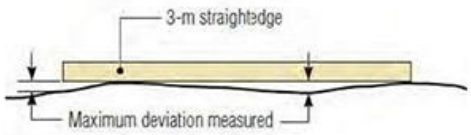
In most instances subfloors are going to be concrete slabs or sheet floors of plywood or particleboard. Underlay, which could be acoustic, can provide an intermediate layer. Other subfloors suitable to some product manufacturers also include existing timber floors, Masonite, resilient flooring and ceramic tiles (or similar). 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 National Construction Code (NCC), engineered flooring is not in most instances to be installed in wet areas (the bathroom, toilet and laundry). Kitchen and food preparation areas are not deemed to be wet areas in Australia. In New Zealand, the New Zealand Building Code outlines provisions for floor coverings in wet areas but this includes kitchens in addition to bathrooms, toilets and laundries. A wet area floor covering can experience periodic wetting and needs to prevent penetration of water into the subfloor. Due to the nature of engineered flooring being a jointed product, its use in wet areas is not encouraged by BRANZ, although some homes do have engineered flooring in wet areas with sealing to floor edges.

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 problems determined 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 3mm beneath a 1.5m long straight edge. For direct adhesive fix applications, 3mm beneath a 3m long straight edge applies.



Subfloor flatness needs to be within the required tolerance

Excessive variation in the subfloor 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 should be followed. 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.

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.

All slabs, where engineered floors are installed, should have under slab moisture retarding barriers that comply with applicable AS and NZS standards. 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 house slabs (usually 20MPa compressive strength) laid in accordance with applicable standards and for a 100mm thick slab drying from one surface only, moisture levels should have reduced sufficiently after three months of drying, following the slab being protected from the weather, to be able to consider floor installation. It is longer for thicker slabs unless drying is from both sides of the slab. However, it is still advisable to take precautions due to the variability in both slab drying rates and slab construction (thicker beams). Note that the water cement ratio and placement of the concrete also have a direct bearing on the permeability of the slab and can result in moisture fluctuations in the slab over time. Therefore, both applied and plastic sheet moisture vapour retarding barriers are recommended for use with all floor installations and this added protection also allows most floors to be installed after two months, under adequate drying conditions for the slab.

The puddles indicate low areas in this slab

It must also be taken into account that a slab that is many years old is not necessarily a dry slab. Higher strength concrete more often used in high rise developments is less permeable and presents less risk. Elevated slabs 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 same level as patios or the ground level outside, presents the greatest risk to moisture effects.

With additions to houses, the joint between new and old slabs also presents a 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 of an adhesive fixed engineered floor, 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 below slab moisture vapour barrier was installed, how well the concrete was placed or what slab thickenings may be present. The weather, including wind, temperature and humidity variations, also influences drying. Therefore, regardless of the age of the slab, moisture levels when adhering to a slab, require further assessment prior to laying to ensure these levels are not excessively high. With an applied moisture vapour retarding barrier there is generally an upper moisture limit to which they will provide protection and they will not protect against hydrostatic pressure.

Slab moisture is assessed with concrete moisture meters, in-slab relative humidity tests and above slab relative humidity testing. Such measures along with assessments of the risks outlined above are necessary for all slabs.

Concrete impedance moisture meter. The inset shows the meter detecting slab edge dampness.

When moisture meters are used, new slabs may give readings with a concrete impedance 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 below 2%. Once a slab is known to be reducing in moisture content in this manner and at least 2 months old, other means of protecting against possible slab moisture can be employed. For a floor that is adhesive fixed to a slab and as indicated, an applied moisture vapour retarding barrier provides the added safeguard against uncertainty over future moisture fluctuations. Note however, that a slab that is, for example, 6 years old and giving readings of perhaps 4% to 5% is considered a higher-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 RH measurement

In-slab relative humidity measurement is a method of slab moisture assessment that is becoming more established 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 in a new slab that is drying, moisture 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 suggests that in-slab relative humidities of about 80% are at a level where timber-based flooring products can be considered. Some specific applied moisture vapour barriers will, however, be suitable when the in-slab RH is above this. 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 standard ASTM 2170). The in-slab RH measurement therefore provides guidance on the level of slab moisture protection needed.

Aboveslab RH measurement

Particularly in New Zealand (to a much lesser degree in Australia), above slab RH testing is used to assess slab moisture. In New Zealand, during the construction period, temperatures are often low and relative humidity high, which slows the drying of concrete slabs. The test is used to assess moisture passing through an applied moisture vapour barrier when direct adhesive floors are installed. That is, after the application of the moisture vapour retarding barrier, the humidity in an insulated chamber sealed to the slab is determined and if no more than 70% then it is considered satisfactory to lay the flooring. If readings are higher then there is a necessity for an additional one or two applications depending on subsequent test results.

Therefore prior to laying a direct adhesive fix floor, slab moisture needs to be assessed and, when down to suitable levels, an applied moisture vapour retarding barrier is to 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 which also contain an integral moisture retarding layer. Floating floors are part of the DIY market and in many instances slab moisture will not be assessed. If this is the case, then 200um plastic sheeting should be used for slab moisture protection. With this, the plastic sheeting is overlapped by 300mm and joins taped with a water-resistant tape, the plastic at the floor perimeter being brought up to at least the height of the floor. Also, if the underlay has no plastic layer of at least 150um and with joints lapped with 'peel and stick' joining, or there are other potential concerns that slab moisture could affect a floor (e.g. a below grade slab), then 200um plastic should also be used.

Engineered flooring product supplier recommendations concerning the desired system are to be followed and underlay or applied moisture vapour barrier products are to be laid or 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.

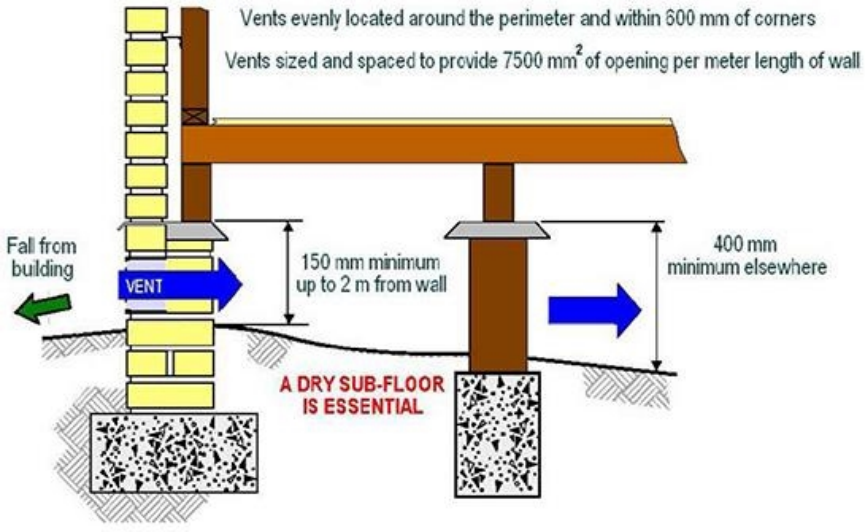
Subfloor spaces and surrounds

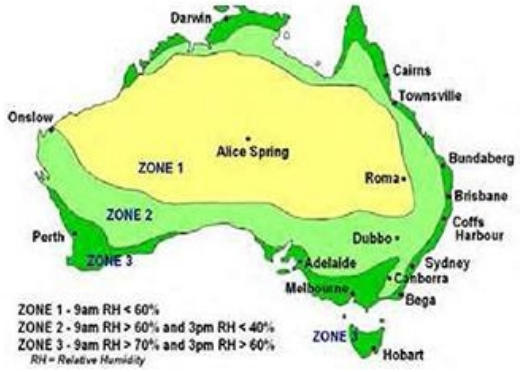
The drainage system provided to the dwelling site needs to ensure that run-off water will drain away from the building perimeter (not towards it) and that run-off water is prevented from entering the subfloor space. The ground beneath a suspended floor should also be graded and closed drainage systems 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 National Construction Code (NCC) and the New Zealand Building Code. 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 may need to 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 also be taken into consideration and appropriate control measures taken prior to the installation of the floor.

Subfloor ventilation through permanent vents that exceeds minimum NCC requirements is recommended where any timber floor is installed. The levels outlined in the NCC (6000 mm^2 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 where a timber floor is installed 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). NCC relative humidity zones and associated NCC ventilation requirements are also provided on the next page.





Source: NCC Vol 2 Figure 3.4.1.2

NCC Subfloor Ventilation Requirements CLIMATE ZONE, CONDITIONS & SELECTED LOCATIONS		Minimum Subfloor Ventilation mm^2/m of wall	
		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

In some localities, to meet constraints associated with energy efficiency, it may be decided to reduce ventilation levels to the values provided in the NCC. The NCC also outlines that a moisture barrier over the soil beneath the building reduces ventilation requirements and this approach is equally applicable to all 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 2m 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.

Ventilation requirements in New Zealand

Site sanded and coated solid floors in New Zealand should be provided with subfloor ventilation that meets the New Zealand Building Code. With subfloor ventilation a balance with insulation requirements also needs to be considered as too much ventilation can lead to unwanted heat loss. Vents to enclosed subfloor spaces should be within 750mm of corners, evenly spaced between and up to 1.8m apart. The ventilation requirement is 3500mm2 for each square metre of floor area.

Therefore, a building with 120m^2 floor area would require 120 x 3500 = 420,000mm^2 of open vent area. If the building is 10m x 12m then install vents no more than 750mm from corners and spacing up to 1.8m. Each 10m long wall would require six vents and the 12m walls require seven vents. The total number of vents is 26 and each vent would need a clear opening of 16,150mm^2 which is a little over 160 x 100mm for each vent. Soil vapour barriers may also be used to reduce soil moisture evaporation into the subfloor space.

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 if there are possible concerns. 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 solid timber 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 often about 11% and therefore the subfloor timbers should be no more than 13%.

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 NCC requirements of an L_{nTw} 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.

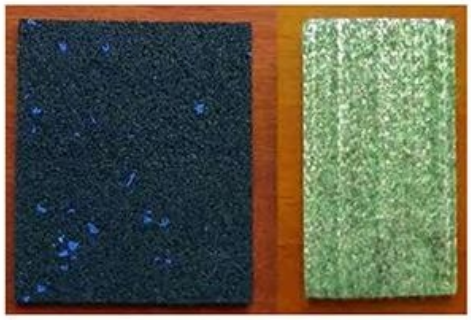
For comparative purposes it should be noted that carpet will generally achieve an LnTw of about 40dB and for bare concrete with a 175mm slab a L_{nTw} may be about 70dB. Note that sound pressure is measured in decibels (dB) and an increase or decrease is perceived by us as a change in loudness. Most 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 flooring generally results in less sound transmission than thicker flooring. Underlay performance relates more to the design of the underlay rather than the thickness. Engineered 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. The diagrams below show typical details for floating and fixed floor installations where greater acoustic performance is required.

The foam underlays used with floating floors have different acoustic properties and it is important to choose an underlay appropriate to the purpose.

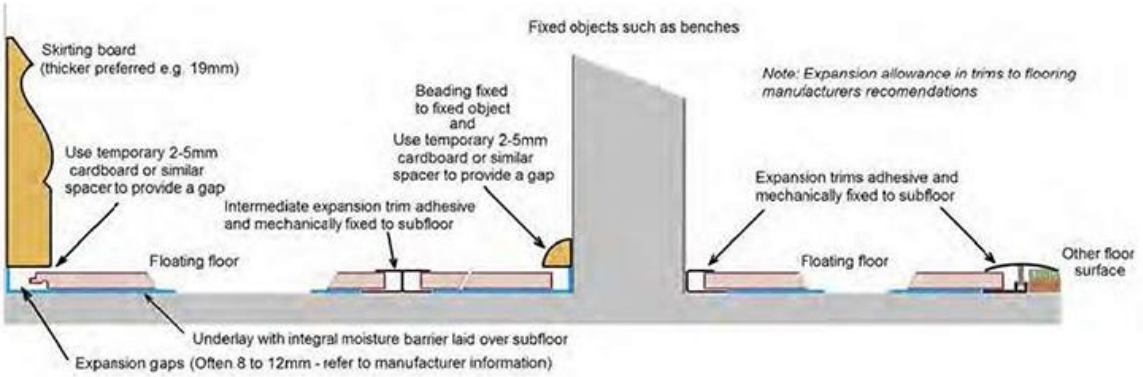
Illustrated are two acoustic underlays used. The first is a 3mm thick rubber-based product used where moderate attenuation is required, the second an acoustic membrane specifically designed to limit sound transmission. Others for adhesive fixed applications include 'slotted mat' systems.



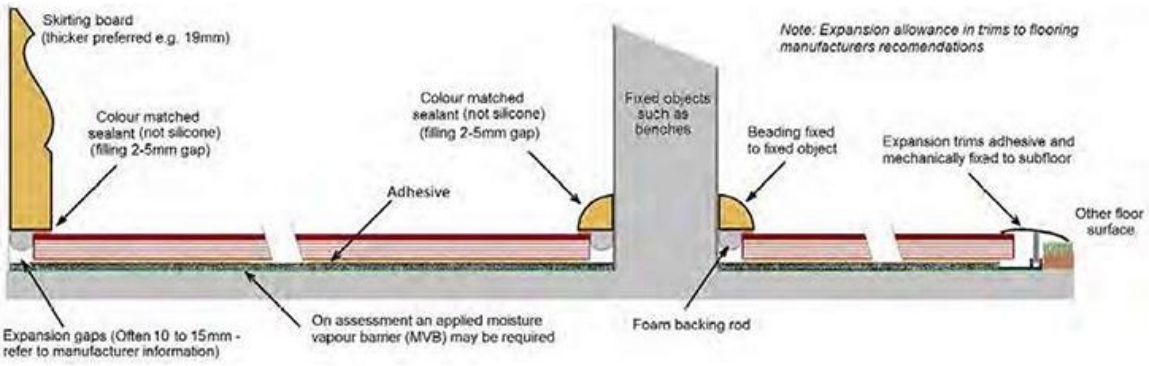
Acoustic underlays

Ultimately what is necessary is to achieve the required sound reduction and the underlay, although an important part of the solution, is one of a number of aspects that will affect the design. Again, the importance of gaining appropriate advice from consultants and companies experienced in floor acoustics is advised. Provided below are typical details for floated and adhesive fixed systems.

Foam underlay with floating floors



Adhesive fixed underlay



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 that it is initially at a moisture level suited to floor installation over unheated slabs (refer to sections 4.2 & 4.3). 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. Accessories

5.1 Underlays for floating floors

The underlay provides a cushioning effect between the engineered floor and the subfloor. It allows the floor to accommodate the minor acceptable tolerances in the flatness of the subfloor as well as adding acoustic performance if needed. Many underlays also provide the role of a moisture vapour retarder and have this built into them with a plastic layer to prevent subfloor 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 0.2mm (200 micron) polyethylene plastic sheet over the subfloor first. In such instances the plastic sheeting is usually overlapped by about 300mm and the joints taped. Note also that not all underlays have sufficient thickness of the plastic layer.

An underlay showing the moisture vapour barrier overlap to one edge and the 'peel and stick' adhesive tape to the other. The foam does not overlap on installation.

The underlay can also influence 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. Many types of underlay are available and it is important that the underlay used complies with the flooring manufacturers' requirements. Often suppliers of the flooring will also have their own underlay or recommended products with a maximum thickness. Underlays are often 2 or 3mm thick, supplied in rolls about 1.0 to 1.6m in width and are made from foams such as polyethylene or polyolefin that provide the necessary compression.

5.2 Trims

Engineered flooring is generally provided with a wide range of accessories and trims not only necessary for the floor installation but also complementing the flooring installed. As such the trims can come with the same décor wood finish as the flooring. This is illustrated in the photo.

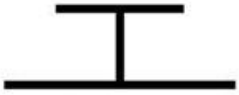
Trim complementing the colour and grain

Trims are available for a number of different purposes including transitions to vertical surfaces, transitions to other floor coverings, control joints within a floor and the likes of stair nosing.

Concerning transitions to other floor surfaces the variety of trims cater for different heights as well as being adjustable in height. Trims are made to suit different board thicknesses.

The diagram shows three trims that are most widely used.

End trim - used to adjoining floor surfaces at the same height or along sliding patio door tracks.



'H' trim - provides a low profile joint within a floor. It provides for expansion as well as locating the flooring.

'T' trim - used to provide a smooth transition to two different floor surfaces that are at different heights.

In addition to trims there are also scotia and fillet molds that are used with floating floors. Scotia and fillet molds are used mainly around vertical surfaces other than walls with skirtings such as island benches. If floating flooring is laid up to skirtings or greater floor movement (expansion and shrinkage) is expected, they are also used along walls as shown in the photo. Scotia is to be fixed to the vertical surface, not the floor.

Scotia fixed to the skirting

6. 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 both 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. Some products are, however, sold with no installation instructions,

insufficient or conflicting information. In such instances the following provides a generic set of instructions that should suit most flooring and may be used for guidance.

6.1 General aspects for floating and fixed floors

6.1.1 Measuring the flooring and products required

Prior to installation it is necessary to determine the amount of product needed. The area of each room is calculated (length (m) x width (m) = area (m2)) and added to obtain the net total area. To this a minimum of 5 to 7% should be added to account for boards being cut, irregular shapes and some wastage. If some spare boards for possible future repairs are desired, then this is additional to this allowance. If the total calculated area where the flooring is to be laid was 80m2, then 5% more means that 84m2 should be ordered. In addition to this, products may be needed for floor leveling in addition to moisture vapour retarders, adhesives, underlays and trims as applicable.

6.1.2 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 all used. General carpentry tools including tape measure, pencil, string line, hammer and carpenter's square are required and cleanup with broom and vacuum cleaner. Specific to floor installation are tapping blocks, pull bars, spacers or wedges to provide the required expansion allowance at walls and a 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 using a polyurethane or polymer flooring adhesive. Additionally, cleaning cloths and products for dealing with excess adhesive are also necessary. For all installations grinding equipment and/or leveling compounds may be required and with direct adhesive fix applications, applied moisture retarders. Also, with direct adhesive fixing, correct adhesive trowels are needed and are specific to the adhesive manufacturer. Systems that include a moisture vapour retarder and adhesive, generally need to be from the same manufacturer to maintain warranty of these products. Similarly, this relates to coating systems if the product is to be site sanded and coated.

6.1.3 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). Personal protective equipment is to be used where appropriate.

If laying an engineered floor where existing vinyl flooring is present, then be aware that vinyl flooring manufactured in Australia before 1 January 1984 contains asbestos. Advice must be sought, and appropriate measures taken to avoid potential harm in such circumstances.

6.1.4 Preparing the subfloor and rooms

With existing dwellings, it needs to be decided whether the floor covering is to be removed or whether the flooring will be laid over the existing surface, as permitted by the flooring manufacturer. Irrespectively, it must be checked that the subfloor or surface is sufficiently flat, dry and sound to accept the product (refer Section 4). Any issues with the subfloor need to be corrected at this time.

In existing dwellings, any trims or skirtings can be removed to permit the flooring to be laid with adequate expansion allowance to walls or other vertical surfaces. Some manufacturers do have trims to enable floors to be laid up to skirtings without them being removed. At doorways, the architraves need to be undercut at the new floor height to enable the flooring to pass beneath and provide a neat and tidy installation. This can be achieved by placing a hand saw flat on an offcut of flooring with underlay beneath as guide to ensure the architrave is cut to the correct height. Undercut saws specific to this purpose are also used. Door heights should also be checked to ensure the flooring will pass beneath them. If not, the doors will need to be removed and bottom planed to the point where adequate clearance can be achieved (about 10mm).

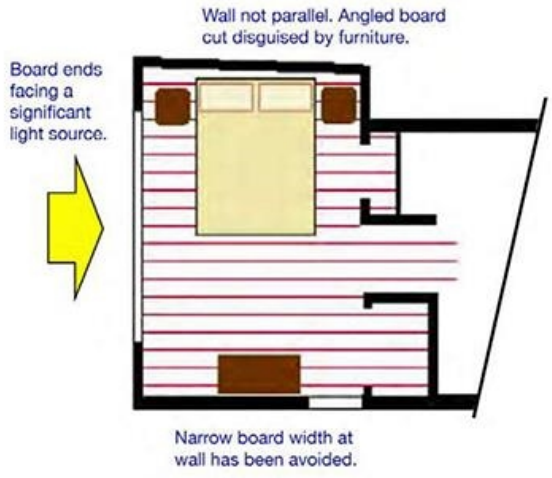
If installing either adhesive fixed or floating floors into a room which contains a fire or smoke door, consideration needs to be given to ensuring that the gap between the bottom of the existing door and the new floor is correct. If after installing the floor the gap is insufficient, arrangements will have to be made to get the door trimmed at the bottom by a fire door installer. If the gap is over the threshold then either an approved trim can be fitted at the bottom of the door to make it compliant

(not always possible), or a new door would have to be installed. This is the responsibility of the building owner, however they should be made aware of this prior to installation. Note that any modifications to a floor which changes the gap at the bottom of the door needs to be notified to a fire door installer to be checked and modified if necessary, and re-certified. Certification stickers can be found on the edges of all fire doors.

On completion of preparation work, the area needs to be cleared of debris and vacuumed cleaned. At this time, it is also important to look for signs of building leaks which may include visual water stains. Although stains may be dry, it should be investigated because any moisture ingress will affect the flooring. Prior to laying, the subfloor surface should be clean, dry and flat and other areas around doorways and walls prepared.

6.1.5 Laying direction

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 onto 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. It is important to consider that within rooms, walls are not always parallel or perpendicular to each other. Keeping this in mind, also be aware that having narrow or very short pieces of flooring adjacent to walls should be avoided. Therefore, with reference to the diagram, some planning is necessary to obtain the best solution.



6.1.6 Product assessment and board placement

The flooring needs 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. End joints need to be spaced and a minimum of 100mm is recommended by some manufacturers while others may recommend 150mm to 500mm, as shown in the photo. If guidance is not provided, then a minimum of 300mm should be used. 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. If laid to a pattern, then this should be discussed with the owner for their acceptance, as it is not regarded as normal practice.

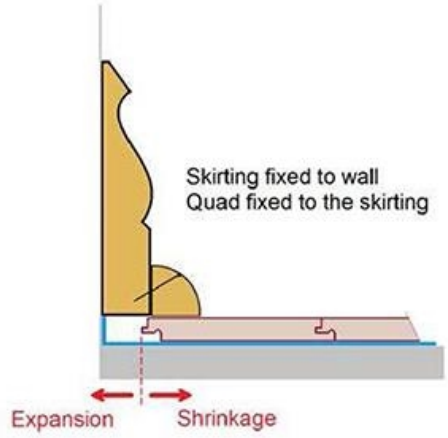
Boards are staggered so that ends do not cluster

6.2 Floating floor installation

Two of the most important aspects with the installation of floated floors relate to having an acceptable subfloor as detailed in Section 4 and in providing the necessary allowances for expansion and shrinkage as outlined below.

6.2.1 Perimeter expansion allowance and to fixed objects

All floating floors require expansion allowance at skirtings and around fixed objects. Note that manufacturers may require assessment of the expected internal humidity, with floors in more humid localities requiring additional expansion allowance. The gaps at walls are to be covered by skirting or fillet molds. Where more movement is expected than can be accommodated by the skirting, or a thin skirting has been used, a combination of both skirting and fillet mold may be used. It is necessary to provide sufficient overlap to ensure that both floor expansion and shrinkage from seasonal movement can be accommodated.



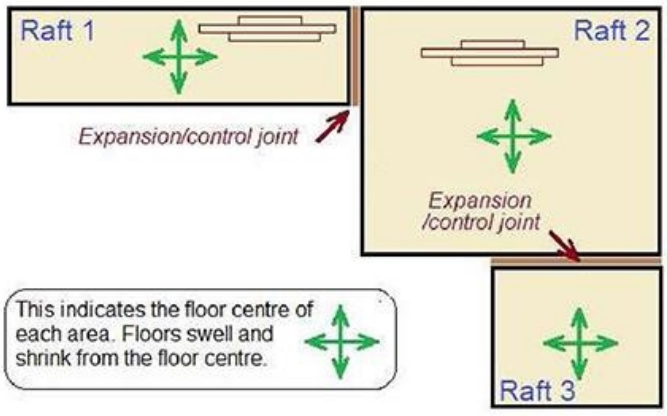
Where insufficient guidance is provided, the minimum expansion allowance at the floor perimeter and to vertical objects shall be 10mm in lower humidity internal environments (averaging about 55% relative humidity or below) and 14mm in high humidity or where greater seasonal movement is experienced.

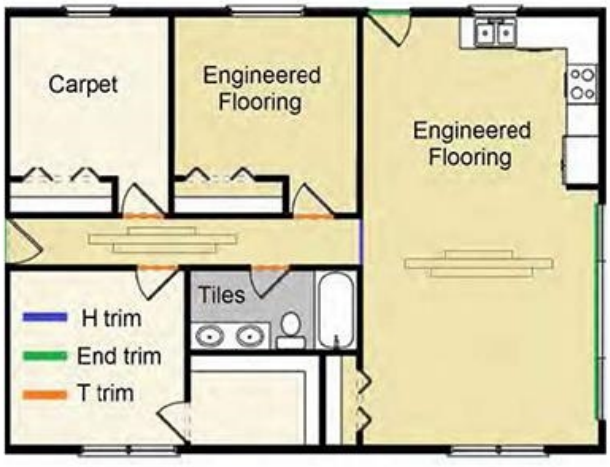
6.2.2 Control joints and intermediate expansion allowance in floating floors

As boards are not fixed to the subfloor with floating floors but fixed to each other, this creates a panel of flooring that is also known as a 'raft' (a raft floats on water and these floors 'float' on an underlay). It is the movement of the raft that must be accommodated with expansion allowance and control joints.

The movement of a raft can be significant and the rafts will seasonally expand and shrink in both width and length. It therefore needs to be considered, not what is happening to the boards, but what is happening to the rafts. With floating floors, compartmentalisation is where the total floor area is divided into a number of smaller rafts, separated by expansion or control joints using trims. If this is not done, the movement of one raft area can interfere with the movement of another and if the floor is not separated into enough individual rafts then movement can result in buckling, separation at board joints and flooring moving out from beneath skirtings. An understanding of this is very important and is shown diagrammatically where each raft will shrink and swell in both directions from the centre of the raft. With engineered flooring, width movement is generally greater than length movement. With longer hallways adjoining living rooms at one end, the total floor length can be quite long, which is why expansion allowance is generally required at the end of a hallway. Also note that heavy objects such as kitchen benches cannot be laid on top of floating floors as they hold the floor in that location and all expansion and shrinkage of the raft is from the fixed point, created by the bench, rather than the centre of the floor. The floor needs to be cut around island benches, whilst other items of heavy furniture may also be unsuitable, for example, pool tables. However, this does not include items such as beds and lounge furniture.

Compartmentalisation into three rafts





When considering this further, it also becomes apparent that adjoining floor areas are generally different sizes. A 15m long by 1m wide hallway may, part way down the hall, adjoin a bedroom floor that is 3m long by 3m wide. As such, the hallway floor under high humidity conditions would expand more in its length than the bedroom floor. Consequently, there will be a difference in the movement of the two floor areas where they meet. To prevent one floor area from having an adverse effect on the other, it is necessary to separate the two floor areas. Therefore, with rooms leading off hallways, control joints need to be added as part of the compartmentalisation. A further example with applicable trims is shown in the diagram. With these joints, one floor area can no longer impair the movement of the other.

Control joint at the end of the hallway

The next aspect to consider is the overall size of the room or floor area that may also extend from one room to another through an opening. With large rooms the floor area may need to be segmented into smaller areas or rafts and this is referred to as intermediate expansion allowance. Manufacturers' installation instructions require intermediate expansion joints if the floor area is over a certain size. This can be 10m in length and 8m in the width of the floor, which in some instances may influence decisions regarding the laying direction. Floor width is the distance measured wall to wall across the board widths and can differ from what would be considered the room width. It is important, however, that the specific manufacturer's instructions are followed regarding this as a different manufacturer may, for example, specify 8m in both floor width and length. If this is not specified then intermediate expansion allowance should be provided when floor width or length exceeds 8m.

6.2.3 Floating floor installation practice

It should be noted that two product types may be floated over an underlay i.e. the T&G profile and the glueless joint system (refer section 1).

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 taken into account and be in accordance with the manufacturer recommendations, prior to the point of floor installation. For both glued and glueless systems 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. If information is not available from the manufacturer, guidance on these aspects is provided in sections 3 to 6.2 above.

Some general points with floating floor installation are as follows and should be used for guidance if no installation instructions are provided, they are insufficient or conflicting:-

Glueless joint system installation:

- 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, i.e. 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.
- It must be ensured that control and intermediate expansion joints are provided where required 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 or protected from joint vapour transmission.
- All floors are laid on underlay which generally has a pre-attached moisture retarding barrier. If the underlay does not have an integral moisture vapour-retarding layer, or one that is equivalent to 0.15mm (150 microns) polyethylene, or if there is uncertainty over slab moisture (it has not been

Underlay with integral moisture vapour barrier layer

tested or a below grade slab etc.), then polyethylene 0.2mm (200 microns) is to be laid over the subfloor or surface. The polyethylene sheet is to be overlapped 300mm and joints taped with 50mm wide moisture-resistant PVC or polyethylene tape. At walls and vertical surfaces, the polyethylene sheeting is brought up the walls and vertical surfaces, where it can later be cut off at the height of the floor once it is laid.

- The underlay is rolled out onto the subfloor with an integral moisture vapour-retarding layer, if present, facing the subfloor. The underlay is fitted within the walls and joints in the underlay are butted together and taped if a self-adhesive overlap is not integral to the underlay. This provides a continuous layer where the underlay is not overlapped.

Underlay is cut neatly around corners although it is recommended to have it raised at walls to at least the height of the floor.

- If the wall undulates then the first row of boards will need to be scribed and cut so that the expansion allowance is even down the length of the wall. At this time, consideration may need to be given to the opposite wall so that the floor will not finish with a very narrow board. This can be another reason for cutting back the first row of boards. To scribe the boards with an undulating wall or where opposite walls are not parallel, the row of boards can be temporarily laid in a straight row a short distance from the wall and a small board offcut with marker pen over the boards, run down the wall. This will mark the position of the wall on the boards. Each board can then be cut down the marked line and placed in position against the blocks or wedges to provide the necessary expansion allowance.
- Installation to manufacturer's instructions will also differ depending on the jointing system. As stated above, boards are to be inspected for visible defects. Some installation instructions indicate that the selection of boards should be mixed from different boxes (three or so), and when laying, end joints should show a random staggered pattern with end joints separated a minimum of 150mm to 300mm. In the process of laying, a pull bar and tapping block may be necessary. Where boards are cut to length ensure perimeter expansion allowance is maintained. When cutting boards with a power saw (circular and jigsaw), ensure the decorative side is facing down to minimise chipping of the decorative face. With hand sawing, the decorative side faces up.
- In laying the first row of boards, manufacturers differ as to whether the tongue side or groove side faces the wall. Installation usually starts in the left-hand corner and working from the left-hand wall to the right- hand wall, manufacturer's instructions are to be followed. If the tongue side faces the starting wall the tongue is removed from the board edges of the entire row and removed from the end of the first board. It is necessary to ensure that the recommended expansion allowance and control joints are provided including 10 to 14mm to walls and vertical surfaces, but also depending on the product and floor size. Blocks or wedges are generally used to create an expansion gap that maintains the correct allowance.
- The second row is laid to the first, and this can be both rows away from the wall and then slid into position ensuring expansion allowance to the wall is maintained. Each row should not start or end with a short board, although offcuts can often be used to start the next row provided they are long enough. The minimum length of a starting or finishing board should be about 300mm. It may require cutting a full-length board to obtain a board of sufficient length and to maintain staggered joints.
- In doorways, which should have been undercut, it is necessary to maintain the required expansion allowance. At times, pipes may also protrude though a floorboard. A hole saw is used to create a hole where the pipe will be. The hole needs to be larger than the pipe diameter to provide the necessary expansion allowance. After the hole is cut, the board is cut across its width so that it can be laid around the pipe and pipe trim covers, fitting around the pipe, are available to cover the expansion allowance. Similarly, ensure the necessary control joints are installed. Control joint trims allow one edge of the floor to be slotted into it (maintaining expansion allowance) with the trim then fixed to the subfloor before continuing.

- The last row of boards will generally need to be scribed and cut as described with the first row. However, in this instance the final row of boards is placed directly over the last row laid. This time the small board offcut can have a piece added to its edge equal to the width of the expansion allowance. Therefore, after cutting the boards down the scribed lines, they will fit and include the necessary expansion allowance.
- Following this, the blocks or wedges can be removed and the floor should look complete except for finishing around vertical surfaces etc.

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 the 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 - preferably not less than 300mm 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, with the boards consecutively glued together in a staggered pattern. An unbroken bead of adhesive (cross-linked PVA) is placed in all T&G joints to the product manufacturer's directions. This is often to the top of the groove and 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, often designed to have a groove fitting over the board tongue, and pull bar are used to gently tighten all joints. Care is needed so as not to damage board edges. Clamps may also be used.
- Throughout the installation all traces of PVA adhesive on the board surface from gluing board joints 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 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 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 control joints at doorways etc. may need to be provided, with appropriate trims being used to permit floor expansion and shrinkage movement.

Use of a tapping block

6.5 Direct adhesive fix installation

Manufacturers of T&G jointed flooring and many with glueless jointing profiles indicate that their flooring may be adhesive fixed directly to the subfloor. If it is intended that a glueless jointing profile is direct adhesive fixed, it is therefore necessary to ensure that the manufacturer permits this installation option.

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. For both T&G and glueless profiles 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 then replaced after floor installation. If information is not available from the manufacturer guidance on these aspects is provided in sections 3 to 6.1 above.

6.5.1 Expansion allowance to the floor perimeter and to fixed objects, and control joints

An adhesive fixed engineered floor is more akin to an adhesive fixed solid timber floor. It does however have the benefit of experiencing less seasonal movement (shrinkage and swelling) than solid timber, however due to its construction there is some lengthwise expansion, and with hallways leading into living areas, or similar, longer floor lengths can occur. The adhesive restricts board expansion and the resulting pressure in board ends can lead to peaking at board end joints in longer floors unless this is accommodated. It is for this reason that manufacturers will have requirement for intermediate expansion allowance in both floor width and length, for adhesive fixed engineered floors. Control joints at the end of hallways are also frequently needed. In terms of expansion allowance and control joints manufacturer instructions are to be followed.

All adhesive fixed floors require expansion allowance at skirtings and around fixed objects. Note that manufacturers may require assessment of the expected internal humidity, with floors in more humid localities requiring additional expansion allowance. The gaps at walls are to be covered by skirting or fillet molds. Where more movement is expected than can be accommodated by the skirting, or a thin skirting has been used, a combination of both skirting and fillet mold may be used.

Where insufficient guidance is provided, the minimum expansion allowance at the floor perimeter and to vertical objects shall be 10mm in lower humidity internal environments (averaging about 55% relative humidity or below) and 14mm in high humidity or where greater seasonal movement is experienced.

6.5.2 Direct adhesive fixed floor installation practice

Some general points with direct adhesive fixed floor installation are as follows and should be used for guidance if no installation instructions are provided, they are insufficient or conflicting: -

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

- With adhesive fixed floors the subfloor must be clean, sound, dry and flat and therefore the subfloor requires preparation prior to floor installation. Note that particleboard often has a wax coating that needs to be removed as it affects adhesion. Surface preparation and testing as outlined in Section 4 also being particularly important. If information is not available regarding slab flatness, then the slab should be flat to no more than 3mm beneath a 3m long straight edge.
- 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 or polymer 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) shall be provided.
- 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).
- Full bed adhesive application is to be used with polyurethane or polymer adhesive in accordance with the flooring and adhesive manufacturers' instructions and particularly in terms of the trowel size, spread rate, open times, curing times and weather conditions that could affect bonding. Some flooring manufacturers will permit a tight bead pattern of adhesive to the back of the boards and greater care is needed with this method to minimise 'drummy' spots in the floor. If instructions are not available, insufficient or conflicting, a full bed of adhesive should be used.
- For T&G products (not glueless profiles) floors are generally laid to a chalk line about 450mm 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. For glueless profiles the process is similar but the floor is laid from the starting wall.

Sharp saw blades are a necessity

- Where the wall undulates the first row of boards will need to be scribed and cut to provide for an even expansion gap down the length of the wall. At this time, consideration may also need to be given to the opposite wall so that the floor will not finish with a very narrow board. This can be another reason for cutting back the first row of boards. To scribe the boards with an undulating wall or where opposite walls are not parallel, the row of boards can be temporarily laid in a straight row a short distance from the wall and a small board offcut with marker pen over the boards, run down the wall. This will mark the position of the wall on the boards. Each board can then be cut down the marked line and placed in position against the blocks or wedges to provide the necessary expansion allowance.
- 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 (not edge joints) to be adhesive fixed with a cross linked PVA adhesive.
- When laying boards with T&G profiles (not glueless profiles), it is usual to place the edge and end as close as possible to the board it will engage to, before final engagement. 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. With glueless profiles boards are usually placed tight to the adjoining end and then folded down.
- 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 150mm but preferably with board ends 300mm to 500mm apart. The installer should also be mindful of colour and grade to ensure a reasonable distribution is achieved.
- For T&G products (not glueless profiles) 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 at the starting wall, if not otherwise trimmed, will need the tongue removed to provide adequate expansion allowance. As indicated, with glueless profiles installation is from the starting wall and similarly the 'tongue' is removed if the boards are not otherwise trimmed.
- With the initial row in place some will leave overnight to allow the adhesive to part cure before proceeding further. Care must be taken to clean up any excess adhesive.
- Laying can then continue away from the starting wall with the same methods as outlined above. It should be noted that working on the flooring just laid should be avoided, particularly with thin boards, 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. Dried adhesive on the board surface cannot usually be removed without surface damage.
- 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.

Expansion trim

- It is also important throughout the installation to consider the overall floor area and where intermediate expansion joints and control joints at doorways etc. may be required, with appropriate trims being used to permit floor movement.

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 of 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 negative 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, 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 greater seasonal floor movement is expected, a scotia or fillet mold may be added to the skirting. With floors laid and with the skirting in place, a scotia or fillet mold is used to cover the expansion allowance.

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 'Solid 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.

A completed site sanded and coated floor

7. 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 a few precautionary practices to maintain their appearance and preserve their service life.

Appropriate cleaning products

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 when it occurs. Failure to do so can dull or discolour the finish and if left for a long period can damage the flooring. Cleaning practices that include damp mopping should only be as provided for by the flooring or coating manufacturer. Note that oiled floors generally have a specific cleaning regime that includes periodic oil replenishment.

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 coating 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 (and at times furniture) on a more frequent basis over this initial period and ensuring curtains and window coverings 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 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.

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. Footwear 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 silicone. Specific timber floor cleaning products are available and should be used and with site sanded and coated floors the recommendations of the coating manufacturer need to be adhered to. This is particularly so with oiled finishes that can be more prone to staining. 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 metalised polish maintenance coat may be used periodically, applied by the 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.

For flooring with non-textured surfaces and a UV cured polyurethane, where the finish has not worn through to the timber surface (quite likely with the coating additives often used), then the floor can usually be cut back and recoated. Some floor products suit traditional coating systems but those with wear resistant additives may require a specific coating system 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 flatness of the boards, evenness of the floor surface and removal of the bevel if present, 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. Oak engineered flooring often has a textured surface (e.g. wire brushed) and colouring to an oiled surface. This flooring is not suited to sanding back to bare timber if these appearance characteristics are to remain, but oiled surfaces are rejuvenated through the cleaning regime and due to this, less of a need for future sanding.

8. 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 engineered flooring do not cover ingress of moisture as the effects are well known and to be guarded against.

Be aware of what warranties do and don't cover

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 or very dry 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.

Regarding 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 to 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.

9. 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. Also see 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. Also see 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. Also see 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 moister 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. Also see 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 to 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 the wood. Therefore, one grade of a specific name may have fewer and smaller features than another grade of a different name. Grading does not 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 of 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 cooler.

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 effects 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 6mm 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 Relative humidity.

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 vapour 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 know 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 2mm thick but may also be thicker. Also see Lamella.