TIMBER QUEENSLAND

Technical Data Sheet

Tongue & Groove Timber Flooring - General Information 11

Recommended Practice / March 2006

Issued by: Timber Queensland Limited

Introduction

This data sheet outlines the product types covered in this and other data sheets on T&G flooring. It also includes information on timbers used in flooring, the nature of timber floors over various sub-floors, characteristics of floor finishes available and aspects relating to the natural movement that occurs in timber floors after they have been finished.

Product Types

The recommendations contained in these data sheets relate to timber floors that are intended to be sanded and finished after installation. Generally floors of this type are of solid timber or a product made up from layers of timber, bonded together.

Depending on the T&G sub-floor supporting system (e.g. joists, plywood etc), timber floors will both feel and sound differently when walked on. Generally T&G timber floors laid over joists or battens will have more spring under foot and there is likely to be some vertical movement at board edges and end matched joints when walked on. Some squeaks can therefore be expected from most timber floors of this type. Squeaks can occur from movement of one board edge against another or from boards moving on nails. Squeaks are often more prevalent during drier weather due to loosening at the joints. Floors that are laid over a plywood or similar sub-floor will have a firmer feel underfoot. Similarly when floors are glued directly to concrete, the feel is firmer, but some boards may sound 'drummy' when walked on.

Movement in Timber Floors

Timber is a natural product that responds to changes in weather conditions. During periods of consistently high humidity timber will absorb moisture from the surrounding air causing it to swell or increase in size. Conversely, during drier times when humidities are low, timber will shrink, reducing in size (refer Figure 1). Unless T & G flooring is placed in a permanently controlled environment, it will always move in response to changing environmental conditions. Gaps between individual T & G boards will occur as the floor shrinks in dry weather.

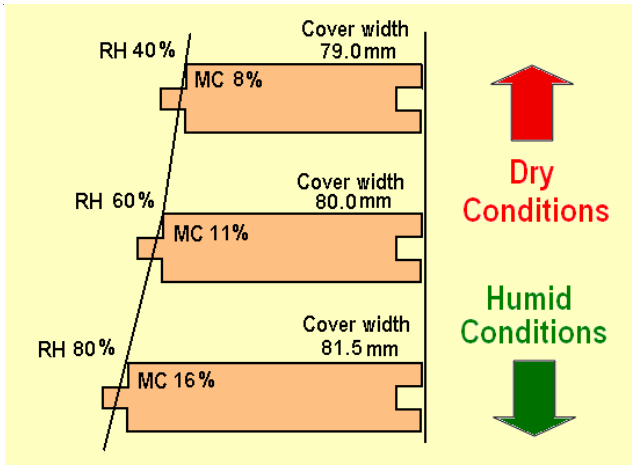


Figure 1 – Cover width variation with changing Relative Humidity

Therefore a 'continuous mirror finish' cannot be expected from floor finishes. Localised shrinkage may also occur when areas of flooring are exposed to heat sources such as fireplaces or sunlight through large doors or windows. The overall movement and rate of movement of timber varies depending on the timber species and cutting pattern of individual boards. Small moisture content variations in boards at the time of installation and differing conditions within the house (i.e. from sun exposure or fireplaces) will also cause variation in board movement.

Consequently, gapping across a floor can be expected and may be relatively even, depending on individual circumstances, but actual gap size between individual boards will vary. An uneven distribution of gaps detracts from the appearance of the floor and can occur if a number of boards are bonded together by the finish penetrating into the joints. Floor finishes will not prevent timber movement, but may reduce the rate of response to climatic changes. Applying a finish to the underside of a floor may further assist to reduce seasonal movement.

Timber Species and Characteristics

Species, Colour, Grade and Hardness

The species or species mix chosen will generally determine the overall colour of the floor. It should also be noted that species mixes may contain different species from one producer to another and may therefore appear different. As a guide, Table 1b indicates the range of colours that may be expected. The sapwood of many hardwoods can be much lighter than adjacent heartwood and some boards may contain both light and dark colours. Even within a single species large colour variations can occur, not only due to the age differences between trees but also between different growing locations. Also, older sample panels in showrooms generally darken with age. Colour should therefore be discussed with flooring suppliers.

Lyctid susceptible sapwood of some hardwood species e.g. spotted gum is required by some state legislation, including Queensland and New South Wales, to be preservative treated. Some treatments may impart a brown or green-grey tinge to sapwood, while boron preservative is non-colouring. LOSP treatment is also used. In this instance an H3 treatment may be used in lieu of H2 treatment to avoid the coloured from dyes often used with H2 LOSP treatments.

The character of the floor is influenced by the species characteristics and therefore the grade. Grading is a process that sorts boards according to the number and size of features present (e.g. gum veins and knots). Table 1 indicates the grades contained in relevant Australian Standards, but it should be noted that manufacturers often have their own grades.

Hardness indicates a species' resistance to indentation and abrasion. Damage to timber floors may occur due to continual movement of furniture, heavy foot traffic and in particular "stiletto-heel" type loading. The selection of a hard timber species ensures improved resistance to indentation and abrasion. Soft timber species in feature floors can be expected to indent and finishes do not significantly improve hardness.

Species	Colour	Hardness	Common cover widths (mm)	Thickness (mm)
Australian Hardwoods – to AS 2796 – Timber – Hardwood – Sawn and milled products Select Grade, Medium Feature Grade (Standard) and in some species High Feature Grade				
Spotted Gum	brown, dark brown, light sapwood	very hard	60, 80,130	19,12
Ironbark	dark brown or dark red brown	very hard	60, 80,130	19,12
Blackbutt	golden yellow to pale brown	very hard	60, 80,130	19,12
New England Blackbutt	straw to pale brown	very hard	60, 80,130	19,12
Forest Red Gum	dark brown or dark red brown	very hard	60, 80,130	19,12
Brushbox	mid brown even colour	hard	60, 80,130	19,12
Jarrah	dark red brown	hard	67, 80,125	19,12
Karri	rich reddish-browns to pale pinks	hard	67, 80,125	19,12
Rose Gum	straw pink to light red	hard	60, 80,130	19,12
Sydney Blue Gum	pink to dark red	hard	60, 80,130	19,12
Tallowwood	pale straw to light brown	hard	60, 80,130	19,12
Southern Blue Gum	pale brown with some pink	hard	63,80,85,108,133	19,12
Stringybark	yellow brown with pink tinge	hard	63,80,85,108,133	19,12
Messmate	Pale yellow to pale brown	moderately hard	63,80,85,108,133	19,12
Tasmanian Oak	pale straw to light brown, pink	moderately hard	85, 108,133	19,13
Victorian Ash	pale straw to light brown, pink	moderately hard	63,80,85,108,133	19,12
Manna/Ribbon Gum	pale straw pinks	moderately hard	63,80,85,108,133	19,12
Imported Hardwoods – to AS 2796 – Timber – Hardwood – Sawn and milled products Select Grade, Medium Feature Grade (Standard) and in some species High Feature Grade				
Kwila / Merbau	dark brown	hard	80,130	19
Northern Box	mid brown even colour	hard	80,130	19
Cypress – to AS 1810 – Timber – Seasoned Cypress – Milled products Grades No.1 and No. 2				
Cypress	straw sapwood, dark brown heartwood	moderately hard	62,85,98	20
Australian Softwoods – to AS 4785 – Timber – Softwood – Sawn and milled products except Araucaria (hoop pine) for which industry grades apply Standard Grade for AS 4785 Australian Softwoods				
Radiata	white to straw	soft	104	19, 21
Araucaria (Hoop)	straw	soft	87,89,102,133,152	19, 20, 21

Table 1 - Species Properties

Cover Widths, Profiles, Spans and End-Matching

Typical cover widths and thicknesses for T & G strip flooring are as shown in Table 1. Actual cover widths may vary from those shown and should be checked with individual suppliers. Typical T & G profiles are shown in Figure 2. Some profiles are produced with grooves or rebates on the underside. Where the underside of a floor forms a ceiling, the board edges may be arrised to form a 'v' joint profile. The secret nail profile is used for both top nailing and secret fixing. When secret fixing, the cover width should be limited to a maximum of 85 mm. The "standard profile" is used for face nailing and is the profile commonly found on wider boards. Some wider board flooring has the secret nail profile which allows temporary secret fixing prior to top nailing.

If the species or species mix contain a significant variation in colours the appearance of the floor will differ depending on the cover width. Narrower boards tend to blend the colour variations together. Gapping between individual boards during drier times is also less with narrower boards than it is with wide boards. A maximum board width of 100 mm is recommended to limit potential gap size and other movement effects such as cupping (edges of the board higher or lower than the centre).

End-matching is a process where a tongue and groove joint is provided at the ends of boards. This allows joints to be placed between joists, resulting in less wastage than plain end flooring, which must have its ends fixed over joists (refer Figure 3).

Figure 2

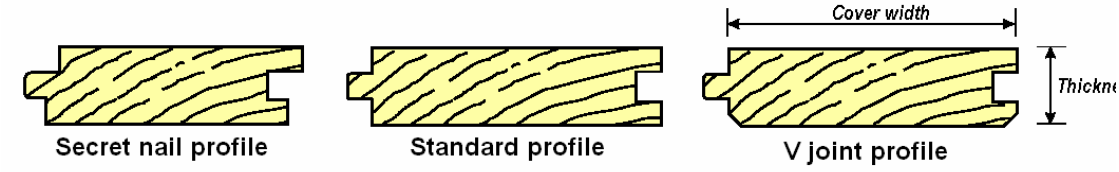
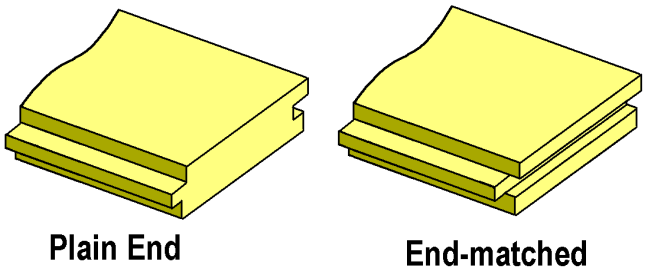


Figure 3



Ordering Flooring

When ordering timber flooring, the following details should be provided to the timber supplier: -

- species (or species mix)
- grade
- profile and end-joint type
- cover width
- thickness
- quantity (in linear metres)

Flooring should be supplied within the moisture content range from 9% to 14%, except for Cypress which should be supplied in the range of 10% to 15%. For larger jobs in specific environments a different range may be specified.

To calculate the linear metres of flooring required, the following method is recommended.

Total length of flooring required =
$\frac{\text{area of floor } (m^2) \times 1000}{\text{cover width (mm)}}$ + Wastage

Allowance for waste should be approximately 5% for end-matched flooring and 10% for plain end butt joined flooring.

Floor Finish Types and Characteristics

Timber Floor Finishes

Timber floor finishes can be grouped into the four broad categories. These are the oil-based finishes, composite finishes (mixes of oil-based and solvent based polyurethane finishes), solvent based polyurethane finishes and water based finishes. With time all finishes will change in colour and film build as the wears. Therefore the ability to touch up becomes more difficult with time, however all coatings can be restored by recoating. Inthe long term a resand and refinish may be necessary depending on the wear and age of the floor.

Oil-Based Finishes

Oil-based finishes (alkyd/oleoresins) are the more traditional types of finish manufactured by reacting a natural oil (e.g. linseed and tung) with another chemical. Varnishes and the traditional tung oils fall within this category and are associated with the polished and waxed timber floors of the past. These types of finishes are still available and require greater regular maintenance than the other finishes. However, with the use of acrylic floor polishes, they have become easier to maintain. These finishes will darken with time. They are unlikely to edge bond boards (defined in Table 2).

Composite Oil-Based/Solvent Based Finishes

Finishes containing oil-based alkyds with the addition of urethanes provide a finish with reasonably good abrasion resistance. Oil modified urethanes, which are one of the predominant floor finishes used in the USA and many of the 'tung oil' based finishes are of this type. The odour during application is very strong but dissipates as the finish dries. These finishes provide a subdued, satin to semi-gloss appearance and are unlikely to edge bond boards. They darken with time and require more frequent maintenance particularly in high traffic areas. Acrylic floor polishes may be used to protect the finish.

Solvent Based Polyurethane Finishes

Solvent based polyurethanes (one pack and two pack) provide a harder finish, generally with limited flexibility but much greater abrasion resistance. Consequently, this greatly reduces the level of routine maintenance. They currently provide some of the hardest finishes available today with gloss levels from matt through to a very high gloss. These finishes, as with the oil-based finishes, will generally darken with time. The odour during application is very strong with these products but dissipates as the finish dries. Due to their high strength and generally limited flexibility, edge bonding of boards can occur.

Water Based Finishes

Some water based polyurethane/acrylic mixes of moderate durability are available but straight one and two pack water based polyurethanes with very good wear resistance are gaining in popularity. These finishes are generally applied over a sealer (either solvent or water based), that not only enhances the colour of the timber but can significantly reduce the risk of edge bonding. Rapid shrinkage in the floor and the associated stretching of the finish at board joints has on occasions caused the appearance of light coloured lines at board joints. Matt through to gloss finishes are available and these finishes generally darken little with time. During application there is low odour associated with water based finishes. A curing additive (catalyst) may or may not be recommended by the manufacturer.

Refer to Table 2 overpage, which outlines the types of finish available and lists various characteristics of each.

Table 2 - PROPERTIES OF COATING SYSTEMS

Timber Floor Finishes							
Oil based Alkyds		**Composite**		**Solvent based**		**Water based**	
Tung oil	**Linseed oil based varnishes**	**Oil modified Urethanes (OMU)**	**Urethane oil/alkyd 'Tung oil'**	**2 pack Polyurethane**	**Single pack Polyurethane (moisture cured)**	**Polyurethane/ Acrylic**	**Polyurethane (Single and two pack)**
Less wear resistant finish requiring more frequent maintenance Unlikely to edge bond boards #				High wear resistant finish May edge bond boards#. There is a reduced risk of edge bonding when applied over an appropriate sealer.		Moderate to high wear resistant finishes Unlikely to edge bond boards # when applied over an appropriate sealer	
6-24 hour drying by solvent evaporation Some tolerance to waxes Moderate to strong odour on application Avoid inhalation and contact				1-4 hour drying by chemical reaction Not tolerant to waxes Strong odour on application Avoid inhalation and contact		2-4 hour drying by evaporation and reaction Not tolerant to waxes Minimal odour on application Avoid inhaling cross-linkers and hardeners	
Matt to gloss levels Darkens with age				Matt to very high gloss levels Darkens with age		Matt to gloss levels Less darkening with age	
Generally ready for use 2-5 days from completion*				Generally ready for use 2-3 days from completion*		Generally ready for use 2 days from completion*	
*Varies with weather conditions and product. Full curing may take a longer time. # Edge bonding relates to the finish acting as an adhesive and bonding board edges together. When board shrinkage occurs, this can result in wide irregularly spaced gaps at board edges or splitting of boards.							

Safe Working

Working with timber produces dust particles. Protection of the eyes, nose and mouth when sanding, sawing and planing is highly recommended. Refer to tool manufacturers for safe working recommendations for particular items of equipment.

Disposal of Offcuts and Waste

For any treated timber, do not burn offcuts or sawdust. Preservative treated offcuts and sawdust should be disposed of by approved local authority methods.

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Technical Data Sheet
Timber Floors Pre-Installation Assessment 17

Recommended Practice / March 2006

Issued by: Timber Queensland Limited

Introduction

This data sheet outlines aspects that should be considered prior to the installation of a timber floor. It includes aspects of storage and handling, evaluating the conditions in which the floor is to be laid and measures that may need to be taken prior to installation.

Storage and Handling Procedures

Flooring should be delivered by the supplier with plastic wrapping (to top, sides and ends) in good condition in order to maintain the flooring at the appropriate moisture content. It is the floor installers' responsibility to check that the timber is at the appropriate moisture content at the time of installation and therefore flooring products must be protected from weather exposure and other sources of dampness.

Ideally, flooring should not be delivered to site until it can be immediately stored under permanent cover. If this is not achievable, other precautions that are equally effective to prevent moisture uptake and excessive sun exposure, will be needed.

Plastic wrapping is easily damaged and should not be relied upon to keep the flooring dry. If moisture penetrates the plastic or timber is stored over a moist surface, subsequent moisture uptake can result in significant swelling of some boards. Flooring should not be laid in this condition, as wide gaps at board edges may result as boards re-dry. Wrapped packs should also be protected from excessive sun exposure as this too can have a detrimental effect.

Timber Standards & Specifications

When timber flooring is received on site it should generally meet the following:-

- Grade - flooring to be supplied to the specified grade, which may be a manufacturer's grade. Note that if a manufacturer has given a specific name to a grade, the product may be similar to one of the grades contained within an Australian Standard but it is likely to differ in some respects. This may or may not be important to customers and should be resolved prior to supply.
- Moisture content - should be in the range of 9% to 14% (10 to 15 % for Cypress) with the average moisture content for all pieces approximately 11% (12% for Cypress).
- Timber moisture contents should be checked. (Resistance moisture meter readings must be corrected for species and temperature, and may be affected by other factors. Corrected readings are approximate only. If in doubt confirm results by oven-dry tests.) Water marks or a significant variation in cover width within a board may be indicative that the timber has been moisture affected.
- Cover width - not more than 1 mm difference between one board and another. Cover widths should generally be within ± 0.5 mm of the nominal cover width. (This reflects changes to board dimensions that can occur after milling and prior to installation and therefore outside the limits of Australian Standards).
- Boards should not be visibly cupped although Australian standards allows for 1 mm in 100 mm.
- Tongue and groove tolerance - not to be less than 0.3 mm nor greater than 0.6 mm. Boards should slot together to form a 'snug' fit. The fit should not be loose and sloppy or overly tight.

Grading rules for solid T&G strip flooring are contained in the following Australian Standards:-

AS 2796 – Timber – Hardwood – Sawn and milled products

AS 1810 – Timber – Seasoned Cypress pine - Milled products

AS 4785 – Timber Softwood – Sawn and milled products

If the material supplied does not meet all the above criteria, **installation should not proceed until any problem is verified and rectified.**

Evaluating Site Conditions and the Installation Environment

Evaluating Site Conditions

Every site requires assessment prior to the installation of a timber floor. It is important to know the climate in the area where a floor is being laid. Relative humidity is the major influence determining whether timber flooring will absorb moisture from the air and swell, or whether it will lose moisture to air and shrink. If the moisture content of the timber flooring is close to the average in-service moisture content then subsequent seasonal changes in humidity will only result in small changes in moisture content. The climate can be assessed from 9 am relative humidity data available from the Australian Bureau of Meteorology website at www.bom.gov.au/climate/averages. Figure 1 shows annual relative humidity charts associated with a tropical climate, temperate climate and a dry inland climate. Approximate average external equilibrium moisture contents (EMC) are also provided on the graph for each climate. Equilibrium moisture content can be thought of as the moisture content that timber will approach under set conditions of relative humidity and temperature. It is evident from these graphs that the climate may result in moisture contents that can be either higher or lower than the average moisture content of the flooring that has been supplied.

Relative humidity graphs for the major capitals throughout Australia are provided in Figure 2. Seasonal variation about the average can be seen to be greater in some locations than others. For example the seasonal variation in Sydney is much lower than Melbourne. Where there is greater seasonal variations, greater seasonal movement (shrinkage and swelling) can also be expected.

Timber flooring is generally manufactured to suit temperate climates with average external EMCs of 12% to 14%. To provide assistance in assessing climatic influences Figure 3 outlines the general relationship between temperature, relative humidity and moisture content. Average internal EMCs are generally lower

than external by 1% to 2% without heating or cooling systems operating and can be 4% to 5% lower for the periods when such systems are operating. Therefore, in climates that have cold winters, heating systems often lower the humidity within the dwelling and reduce the effect of high external humidity on the floor. Similarly in tropical locations air-conditioning operated during hot humid times can also reduce the effect of high external humidity on the floor. Installation and finishing practices need to consider accommodating both the adjustment to climatic conditions associated with a locality and the seasonal movement that will occur in that climate.

In areas of higher elevation than coastal areas, average moisture contents are often higher due to the associated local weather patterns. Similarly, houses built in 'bushy' surroundings or gullies may experience higher average moisture contents. Moister conditions are also often experienced with houses on farmland or in rural type settings, particularly in coastal and hinterland areas experiencing higher or more consistent rainfall. Therefore, in these localities greater allowance for floor expansion is required at the time of installation.

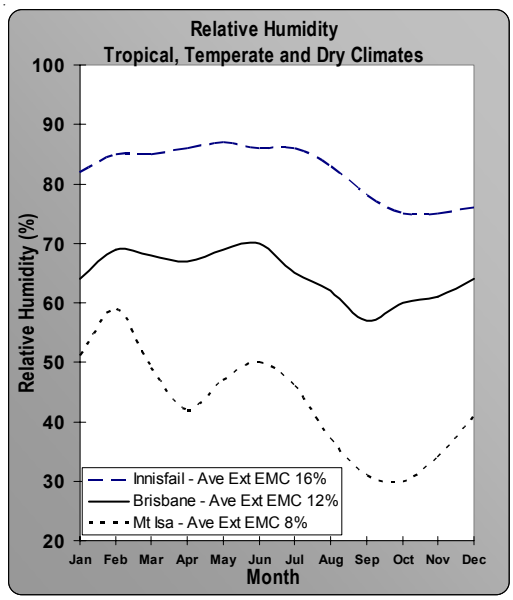

Figure 1 Climatic effects on timber floors

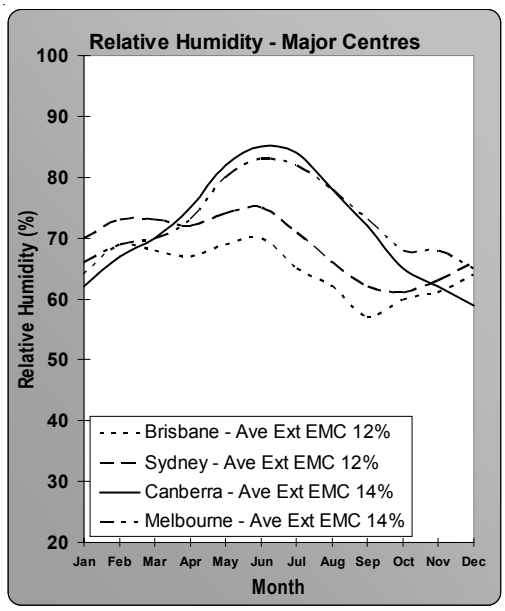

Figure 2 Major centre climates

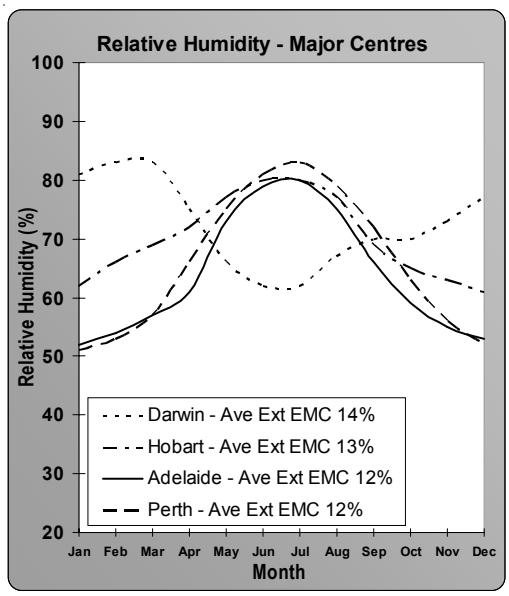

Figure 2 continued - Major centre climates

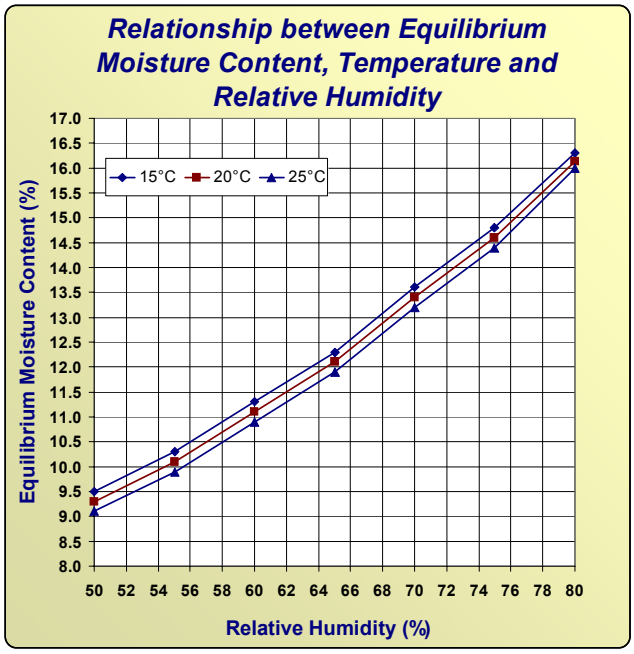

Figure 3 Temperature, RH and EMC

Building and Installation Considerations

Closed in Sub-floor Space

Many dwellings are 'bricked' in underneath and a lack of sufficient ventilation can result in high humidities in the sub-floor space. This may result in expansion and cupping of floorboards. Quoted figures for sub-floor ventilation (Refer to TDS18) are based on sub-floor spaces that are not subjected to seepage or where ventilation through the sub-floor space is inhibited. Where humidity remains constantly high beneath a floor, coatings to the underside of the boards will not reduce the moisture uptake into the flooring. 'Bushy' surroundings and dense gardens may also cause higher moisture contents and reduced airflow through the sub-floor space. Therefore this can affect the performance of the timber floor.

Houses with Open Sub-floors

Special precautions must be taken when timber floors are laid on joists in a house that is open underneath, particularly when built on steeply sloping land or escarpments. In such locations, very dry

winds or wind-blown rain or fog can directly affect the moisture condition of the lower surface of the floor. This can result in either extreme shrinkage or extreme swelling. In the latter case the floor may lift off the joists and structural damage to the building may occur. Also where there is little restriction to the prevailing wind, floors can react more rapidly to dry winds. The species used in the floor and board cover width affect the rate of movement and shrinkage that occurs. Depending on the severity of the exposure, options to protect the floor include providing an oil-based sealer to the underside of the floor, which may provide short duration protection to changes in weather, and installing a vapour resistant lining to the underside of the joists or building-in the underfloor space.

Internal Environment

Within a dwelling a number of differing climates can develop, causing areas of flooring to respond differently within the same dwelling. These include large expanses of glass, fireplaces, refrigerators, air-conditioners, appliances that vent warm air, the aspect of the house and two-storey construction, all of which can have an effect on the dimensional movement of floorboards. When floors are exposed to the sun through large glassed areas, protection should be considered before, during and after construction. Evaporative coolers add moisture to the air and raise the relative humidity, resulting in moisture contents in the flooring that are higher than under ambient conditions.

Araucaria (Hoop Pine) Flooring and Araucaria Floor Framing

Where Araucaria floors and floor framing are not fully enclosed it is necessary to seal the framing members and lower surface of the floor boards to prevent attack from the Queensland Pine Beetle. Attack is specific to the Araucaria species (including Bunya) and generally restricted to the area from Bundaberg to Murwillumbah and east of the Great Dividing Range. In this region exposed framing and floors (including ventilated sub-floor spaces) require sealing to meet the requirements of the QFS Technical Pamphlet No.1 and thereby the BCA. The sealer provided needs to be a film forming finish and this may also reduce the effects from rapid weather changes.

Considering the likely movement after installation

As discussed in Data Sheet 1, timber is a natural product that responds to changes in weather conditions with seasonal temperature and humidity changes in the air causing boards to shrink and swell at different times throughout the year.

The overall movement occurring in individual boards and rate of movement will depend on the timber species and cutting pattern. Small differences in moisture content between boards at the time of manufacture (refer to Datasheet 17 – Timber flooring standards and specifications) and variable conditions within the house (e.g. westerly facing room compared to southerly facing) will also cause further variation in board width. Consequently, it can be expected that small gaps will occur at the edges of most boards, particularly during the drier months, and that the actual gap sizes may differ across a floor.

In cases where shrinkage occurs after installation, wider boards (e.g. 130 mm) will result in larger gap sizes at board edges than if narrower boards are used. Air-conditioning or heating systems may increase the size of shrinkage gaps at board edges.

Some movement usually occurs in timber floors after laying as the floor adjusts to the climate and although floor finishes may retard moisture content changes, they will not prevent this movement. In applications where greater movement is expected after finishing (e.g. from seasonal changes, use of wide boards, air-conditioning installed after floor installation), particular care is necessary to ensure that the finish does not act as an adhesive and bond a number of adjacent boards together (known as edge bonding). With subsequent shrinkage, wide gaps between groups of four or five boards may occur or boards may split.

The way different timber species respond in a floor depends not only on their moisture content but also on the rate at which they take up and lose moisture, the associated movement and also their density. High density species are extremely strong and those that take up or loose moisture more quickly (such as Blackbutt) will also follow seasonal moisture changes more closely than slower responding species (such as Spotted Gum). Particular care is necessary to be able to accommodate expansion of the higher density species and in moist localities this may necessitate providing small expansion gaps every 10 or so boards during installation (refer TDS18, Fig. 2), in addition to normal expansion allowances in order to accommodate this movement. Lower density predominantly quartersawn hardwoods (e.g. Tasmanian Oak, Victorian Ash) and softwoods will to some extent compress at their edges when a floor expands. With these timbers, normal expansion allowance is more able to accommodate the expansion in moist climates.

Installation Moisture Content and Acclimitisation

The moisture content of timber is the percentage weight of water present in the timber compared to the weight of timber with all water removed. Moisture content varies with changes in the humidity and temperature in the surrounding air. To minimise the movement of a floor (swelling on moisture uptake, shrinkage on moisture loss) due to changes in moisture content it is important to lay and fix timber floors close to the average moisture content of timber in the environment where it is to be laid. Along coastal areas where higher humidities can be expected, moisture contents of flooring may vary from 9% to 14%. Timber flooring is usually supplied at an average moisture content between 10% and 12.5% and most boards can be expected to be within this range. Where conditions are drier, such as inland areas or in air-conditioned buildings, average moisture contents of flooring may vary from 7% to 12%. In these situations flooring may need to be acclimatised on-site. Where the average supplied moisture content of the flooring is near the expected average in-service moisture content, acclimatisation is not necessary.

In areas where higher average moisture conditions persist and where floors are expected to have higher moisture contents, additional allowance should be made for subsequent expansion. Such areas include tropical North Queensland and northern New South Wales, areas of dense bushland and rainforest, particularly at higher elevations and mountain areas.

Installation methods need to be considered to accommodate the difference between the average moisture content on delivery and the average expected in-service moisture content include either providing additional intermediate expansion joints or acclimatising the flooring.

Acclimatising is the process of allowing partial equalisation of the moisture content of the timber as supplied to the moisture content of the surroundings in which the timber is to be installed. Increasing the average moisture content of the flooring supplied will only be effective if the humidity in the air is sufficient to cause moisture uptake. Care must also be exercised as the rate of moisture uptake

differs from species to species. Some higher density species are very slow to take up moisture from the air (e.g. Spotted Gum) while others react more quickly (e.g. Blackbutt and Brush Box). If flooring is to be laid in a dry environment such as western Queensland or a consistently air-conditioned building, then acclimatising can be effective in reducing the average moisture content of the flooring prior to laying and thereby reducing gap sizes at board edges from board shrinkage. In such climates, future expansion of the floor must be allowed for to accommodate periods of wet weather.

Acclimatising relies on each board being exposed to the in-service atmosphere and therefore packs must at least be opened up and restacked in a way that allows airflow between each board. Acclimatising can only be effective in an air-conditioned building if the air-conditioning is operating at the time or in dry localities during drier periods. The species and period for which it is acclimatised will also influence effectiveness. For some higher density species that are slow to lose or take up moisture, acclimatising may have little effect. Acclimatising in dry climates does not negate the need to provide for floor expansion during periods of wet weather and will not overcome poor drying practices.

A simple guide to pre-installation considerations is provided in Figure 4, which should be referred to in conjunction with the preceding text.

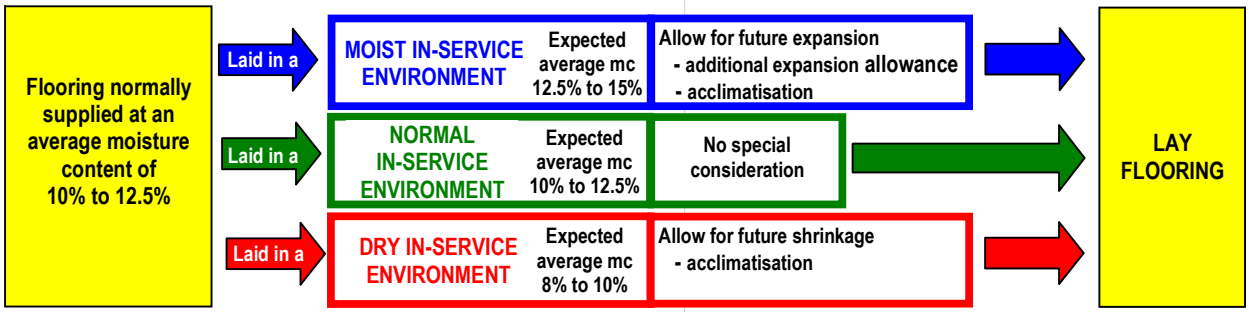

Figure 4 Pre-installation considerations

Safe Working

Working with timber produces dust particles. Protection of the eyes, nose and mouth when sanding, sawing and planing is highly recommended. Refer to tool manufacturers for safe working recommendations for particular items of equipment.

Disposal of Offcuts and Waste

For any treated timber, do not burn offcuts or sawdust. Preservative treated offcuts and sawdust should be disposed of by approved local authority methods.

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Technical Data Sheet
Timber Floors Recommended Installation Practices 18

Recommended Practice / March 2006

Issued by: Timber Queensland Limited

Introduction

This data sheet outlines the recommended practices for laying timber strip floors over timber and engineered timber joists (it does not include steel joists), structural sub-floors such as plywood, particleboard and concrete. When laying a timber strip floors over joists, either directly on the joists or on sheet flooring fixed to joists, adequate sub-floor ventilation is essential for the satisfactory performance of the floor. Sub-floor ventilation recommendations are therefore included in this data sheet. The data sheet provides minimum fixing recommendations. Note that top nailing is a more robust fixing method than floors secretly fixed with adhesives. Top nailed floors can therefore accommodate greater movement. Increasing the amount of adhesive used will also provide a more robust fixing. Where greater floor expansion is expected after installation the method of fixing chosen and associated spacing of fixings or amount of adhesive used requires consideration.

Concrete Slab Conditions

When the lower surface of timber floors or structural sub-floors (over which a timber floor is laid) are exposed to the ground and the space is enclosed (by brickwork etc), the sub-floor space must be adequately ventilated with permanent vents installed in the masonry during construction. The humidity in an enclosed sub-floor space can have a profound effect on the performance of a floor. If conditions are very moist, the lower surface of the boards may take up moisture, causing substantial swelling. Differential movement between the upper and lower surfaces of floor boards may also cause boards to cup. Similarly, caution needs to be exercised with timber floors laid in areas where the microclimate is often moist. In such locations the floor may reach higher moisture contents than in other nearby areas and additional allowance for expansion of the floor may be required (Refer Data Sheet 17 – Pre-installation Assessment). Timber floors should not be laid over moist sub-floor spaces, and structural sub-floors (e.g. plywood) cannot be relied upon to prevent moisture uptake in the T & G flooring if humidities in the sub-floor space remain high for extended periods. Sub-floor ground levels need to be graded and drainage provided so that in the event that any water should enter the sub-floor space, it can drain freely from it.

T & G floors should be provided with sub-floor ventilation that exceeds minimum BCA requirements. The levels outlined in the BCA (currently limited to 6000 mm^2 per metre length of floor for higher humidity areas) are primarily to limit the moisture content of sub-floor framing timbers, which can generally tolerate greater fluctuations in moisture content, than timber floors. The recommended minimum ventilation for T&G timber floors is 7500 mm^2 per metre length of wall, with vents evenly spaced to ensure that cross ventilation is provided to all sub-floor areas (refer Figure 1). In some localities, to meet constraints associated with energy efficiency, it may be decided to reduce ventilation levels to the values provided in the BCA. The BCA also outlines that a moisture barrier over the soil beneath the building reduces ventilation requirements and this approach is equally applicable to timber floors. 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 sub-floor 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.

If there are doubts over the sub-floor humidity (areas of high water table, reduced airflow due to minimum clearances between the sub-floor framing and ground, external structures etc.) a polyethylene membrane may be laid over the soil (taped at joints and fixed to stumps and walls). This can significantly reduce moisture uptake by the sub-floor air. Increased levels of ventilation should also be considered in such instances. With dwellings on sloping blocks that have enclosed sub-floor spaces, the possibility of seepage should be taken into consideration and appropriate control measures taken prior to the installation of the floor.

The drainage system provided to the dwelling site, should 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 sub-floor space. The ground beneath a suspended floor should also be graded so that no ponding is possible. Where springs or aquifers are present (e.g. exposed by earthworks on sloping sites) and cause water to enter the sub-floor space, a closed drainage system should be installed under the dwelling to remove this water. The ventilation system will not cope with this level of moisture in the sub-floor space.

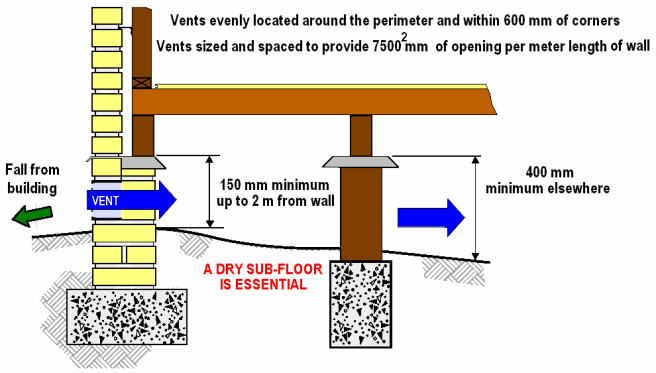

Figure 1 - Sub-floor Ventilation

Sub-floor Plywood and Battens

Plywood sub-floor material and battens need to be at a moisture content within a few percent of the flooring at the time of installation.

Moisture Content and Movement

At the time of installation the moisture content of strip flooring used along coastal Queensland should be between 10% and 15%. The average should preferably be between 11% and 13%.

Installation of Strip Flooring Over Joists

Construction Method

Where the timber floor is to be sanded and polished (i.e. feature floor) then fitted floor construction needs to be used. With this method, the timber flooring is installed after the roof cladding and external wall cladding are in place and the house is weather tight. This prevents initial degrade due to water and sunlight exposure and reduces damage from trades during construction.

Sub-floor Framing - Bearer size, floor joist size and flooring spans

The size of timber members used to support the flooring boards can be determined from AS 1684 - Residential timber-framed construction. For end-matched flooring profiles, joists with a minimum thickness of 35 mm may be used. Where plain end flooring is butt joined at floor joists, 45 mm or 50 mm thick joists are recommended to reduce splitting problems at butt ends.

If installing a secretly nailed floor over joists, seasoned timber or Cypress need to be used as secret nailing cannot be re-punched. If the joists shrink away from the floor, movement of boards on the fixings is likely to cause excessive squeaking.

Top (face) nailed floors may be fixed into either seasoned or unseasoned joists. If fixed into unseasoned joists they need to be of a species not exhibiting high rates of shrinkage and be in single or similar species. Species exhibiting high tangential shrinkage rates or prone to collapse or distortion should not be used unless seasoned. The potential effects of floor frame shrinkage require assessment prior to specifying or ordering unseasoned floor framing, and due allowance made in the building design and detailing. Similarly, after installation, the effects of both shrinkage and possible nail popping need consideration.

The allowable span of timber flooring is dependent on the timber species, density, grade, thickness and whether or not the flooring is end matched. Table 1 gives the acceptable joist spacing and maximum spans for various flooring products when fixed to timber joists. Maximum board span (the distance between where the timber is supported) needs to be considered in installations where flooring is at an angle to the joists, as this increases the board spans.

Laying

The moisture content, size and profile of the flooring should be checked (refer to Data Sheet 17 – Pre-installation assessment) prior to laying. If it is identified that the moisture content is not correct or the boards do not fit together properly, or are otherwise considered to not meet the specified grade, the installer should contact the supplier to resolve these issues before commencing laying. Similarly, any board found during laying that is considered outside the grade specification should not be laid.

In most instances boards are to be supported on at least three joists, however, there will be instances where some boards may not be (i.e. floor edges or the occasional shorter board within the floor), but this should be kept to a minimum. Flooring should be laid in straight and parallel lines. Butt joined boards must be cut to join over floor joists and joints in adjacent boards should be staggered. End-matched joints in adjacent boards should not occur within the same span between joists. It is essential that boards are in contact with the joists at the time of nailing, particularly when machine nailing is used, as this type of nailing cannot be relied on to pull the board down to the joist.

It is generally recommended that not more than 800 mm of flooring is cramped at any one time, however, this may be varied by the installer depending on the flooring used and conditions in which the floor is laid. The pressure used to cramp the boards together will differ from one floor to another, depending on the moisture content of the flooring at installation, the air humidity and the average moisture content conditions for the location. As a general rule, cramping should be sufficient to just bring the edges of adjoining boards together while maintaining a straight line.

Allowance for expansion in floors

Fitted floors require a minimum 10 mm expansion gap between the floor boards and any internal or external wall structures. However, where board ends abut doorways the gap may be reduced to a neat fit but with a small gap (approximately 1 mm) to prevent rubbing. Floors up to 6 m (measured at right angles to the run of boards) should not require intermediate expansion joints provided that normal atmospheric conditions exist. For floor widths over 6 m or where extra allowance for expansion is required (e.g. moist locations) cramping pressure needs to be considered along with providing an intermediate expansion joint, or a series of smaller expansion gaps every 800 mm to 1000 mm to provide equivalent spacing. If cork expansion joints are used, the cork should be 2 mm or so proud of the floor surface when installed. This will be removed during the sanding process. However, cork to the perimeter should be installed level with the timber surface. Refer to Figure 2 for details of expansion gaps.

Species Group	Grade	Thickness (mm)	Acceptable Species, Grade and Joist Spacing			Maximum Span	
			450 mm End matched	450 mm Butt joined	600 mm Butt joined	End matched	Butt joined
Hardwood	AS 2796						
All hardwood species listed in Datasheet 1	Select Grade	19	✓	✓	✓	500 mm	630 mm
	Medium Feature (Standard) & High Feature Grade	19	✓	✓	✗	450 mm	570 mm
Cypress	AS 1810						
	No. 1	19	✓	✓	✗	410 mm	510 mm
	No. 2	20	✓	✓	✗	410 mm	510 mm
Softwood	AS 4785						
Slash Pine	Select & Standard Grades	19	✓	✓	✗	410 mm	510 mm
Other pinus species	Select & Standard Grades	19	✗	✓	✗	350 mm	470 mm
Araucaria (Hoop Pine)	Manufacturers Grades	20	✓	✓	✗	410 mm	510 mm

Table 1 - Allowable Joist Spacing and Maximum Span of Floorboards

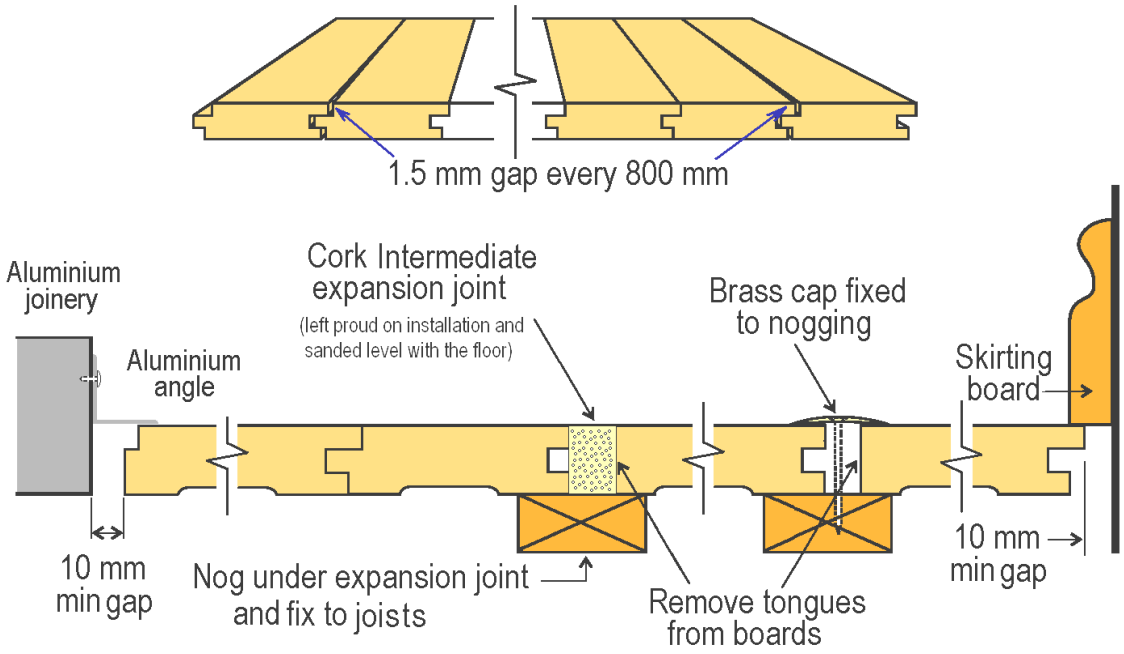

Figure 2 - Expansion Gap details

Fixing of floors

Boards with cover widths of 65 mm or less should be top (face) nailed with one or two nails at each joist. Boards with cover widths over 65 mm should be top (face) nailed with two nails at each joist. Secret fixing with a single nail or staple per joist is suitable with secret nail profile end-matched boards having nominal cover widths not greater than 85 mm. The recommended minimum fixing sizes are shown in Table 2. The recommended minimum edge distance for nailing at butt joints or board ends is 12 mm. All nails, including machine nails, should be punched a minimum of 3 mm below the top surface.

During fixing, the joint between floor boards and the top surface of floor joists should be checked to ensure that gaps are not present. If gaps are present, nails should be punched to draw boards tightly onto joists.

Installation of Strip Flooring Over Existing Timber and Sheet Floors on Joists

Assessing the Existing Floor

Timber T & G flooring may be laid over existing T & G or sheet floors (plywood or particleboard). Where the existing floor is structurally sound, either overlay flooring (generally 11 mm to 14 mm thick) or structural flooring (generally 19 mm to 21 mm thick) can be laid. Floors may be fixed into the joists or with shorter fixings at reduced centres into the existing floor only. In instances where there is doubt over the structural adequacy of the existing floor, defective boards or sheets should be replaced to make the existing floor structurally sound, or structural flooring fixed through to the joists can be used. To provide a level surface, top (face) nails in existing flooring should be re-punched and the existing floor rough sanded. Adhesives require a clean, structurally sound floor that is free from moisture, loose particles and contaminants. It is also particularly important that if a new floor is laid at 90° to an existing floor, the existing floor must be structurally sound and level. In some instances sheet

TYPE OF FIXING	FLOOR JOIST TIMBER	
Top (Face) Fixing	SOFTWOOD, LVL and I - BEAMS	HARDWOOD & CYPRESS
Without Adhesive		
Hand driven	65 x 2.8 mm bullet head	50 x 2.8 mm bullet head
Machine driven	65 x 2.5 mm T-head	50 x 2.5 mm T - head
With Adhesive #		
Hand driven	50 x 2.8 mm bullet head	
Machine driven	50 x 2.5 mm T - head	
Secret Fixing		
With Adhesive #		
Machine driven	50 x 15 gauge staple	45 x 15 gauge staple

A continuous bead (6 mm approx.) of polyurethane flooring adhesive to be applied to the joist

Table 2 - Minimum Fixing of T&G Flooring to Joists

sub-floors (substrates) can sag between joists and if not leveled the sagging will show through to the new floor.

It is also necessary to check that the existing floor moisture content is appropriate to accept the new floor. The cause of any excess moisture (wetting during construction, leaks, inadequate sub-floor ventilation, etc) needs to be addressed prior to installation. Moisture meters are unpredictable in sheet flooring and this may necessitate oven dry testing. Prior to laying, the existing floor should be of similar moisture content (within a few per cent) to the new floor.

Squeaking present in an existing T & G floor may be reduced by providing a bead of polyurethane flooring adhesive to fill any gaps between the underside of flooring and tops of joists (caused by cupping, shrinkage etc). Further reductions may be achieved by fixing a seasoned batten (approximate dimensions 35 x 45 mm), to the underside of flooring (mid-span between joists) fixed with a full length bead of polyurethane flooring adhesive and screwed at approximately 300 mm centres.

Installation

Installation of flooring should not be done until other construction activities (particularly wet trades) are complete and after the building is roofed and enclosed, with the temperature and humidity as close as possible to the expected in-service conditions. Expansion gaps of 10 mm should be provided at all walls and other fixed obstructions, which are parallel to the run of floor boards. Intermediate expansion joints should also be provided in larger floors (width at right angles to boards exceeding 6 metres), to give an equivalent gap of 10 mm every 6 metres (approx. 1.5 mm every 800 mm).

Fixing flooring through sheet floors and into the floor joists will provide a more robust fixing and is particularly appropriate where greater expansion in the floor is expected after installation. Alternatively, if expansion after installation is expected to be small then mechanical and adhesive fixing into the sub-floor (substrate) may be used.

For secret fixing of structural flooring boards, secret nail profile boards should be used (maximum cover width of 85 mm) with one fixing per board at the appropriate spacing. For (top) face nailing, standard profile or secret nail profile boards may be used. Boards exceeding 65 mm cover width, which are top (face) nailed, require two nails per board at each fixing.

Secret Fixing into Sub-floor (Substrate) Only

When relying on the sub-floor or substrate for fixing, boards should be secretly fixed with the first and last few boards that do not allow secret fixing, top (face) nailed and adhesively fixed with polyurethane flooring adhesive. When laying over an existing T&G sub-floor the new flooring may be laid either parallel to it (with boards offset half a board width) or with boards at 90° to the existing floor, providing the sub-floor (substrate) is level. If edge bonding is present in an existing T&G floor over which the new floor is being laid, it is recommended that the bonding is relieved by a series of saw cuts down the length of the existing boards and that the new floor is laid at 90°. Fixings should be the maximum possible length as indicated in Table 3.

When staple fixing at close centres is being used, provide a cushion of polyurethane flooring adhesive between the two floors to minimise possible squeaks. This is achieved by using a continuous bead of adhesive at 90° to board length, midway between fixing points. Where polyurethane flooring adhesive is used to provide much of the fixing, staples may be spaced up to 450 mm apart. Note that flooring cleats (as used with Powernailer) of a similar length may be used in lieu of staples.

Top (Face) Nailing into Joists through the Sub-floor (Substrate)

If the sub-floor is an existing T&G floor, boards should be run in the same direction as the sub-floor with boards offset by half a board width from those in the existing floor. This assists in offsetting the nails in the new and old floors. When structural 19 mm flooring is used, the floor should be top (face) nailed with 65 x 2.5 mm machine nails or 65 mm x 2.8 mm hand nails through the existing floor and into the joists. For thinner overlay flooring, 50 mm x 2.5 mm machine nails or 50 mm x 2.8 hand nails should be used. In all cases, continuous beads of polyurethane flooring adhesive should be provided at the joists and midway between them to provide a cushioning effect between the two floors. Board ends adjacent to walls should be fixed with polyurethane flooring adhesive and nailed to the sub-floor.

Installation of Strip Flooring Over Concrete

Assessing the Concrete Slab

Timber floors may be laid on battens or plywood over a concrete slab, or by direct fix. Direct fix to the slab is a specialist field and appropriate professionals in this field should be consulted if considering this method. This data sheet covers installation of T & G flooring on plywood over concrete or battens over concrete. Prior to installation it is necessary to ensure that the concrete is sufficiently level to accept the system. Where the slab is greater than ± 3 mm out of level over any 1500 mm length, a concrete topping (leveling compound), grinding or packing should be used. Slabs on ground should be constructed with a continuous under slab vapour barrier (e.g. 0.2 mm thick polyethylene). Timber floors should not be installed until the concrete slab has a moisture content less than 5½% (generally achieved after slabs have cured for approximately 4-6 months). In old slabs, moisture contents should be below this level and if not, care should be exercised. Various methods are available to test the moisture content of concrete, including resistance meters, capacitance meters and hygrometers.

FIXING METHOD	SECRET FIXING TO SUB-FLOOR (SUBSTRATE) ONLY
Staple fixing up to 250 mm spacing	Staples - 32 x 15 gauge to plywood or 38 x 15 gauge to particleboard for flooring 19 to 21 mm thick. Zigzag pattern of polyurethane flooring adhesive between fixing points. (For overlay flooring maximum length to suit sub-floor (substrate)).
Adhesive fixing with staples up to 450 mm spacing	Polyurethane flooring adhesive - zigzag pattern to achieve approx. 25% glue contact area after laying. Staples - 32 x 15 gauge to plywood or 38 x 15 gauge to particleboard for flooring 19 to 21 mm thick. (For overlay flooring maximum length to suit sub-floor (substrate)).

Table 3 - Minimum Secret Fixings of T&G Flooring to Plywood Sub-floor (Substrate) over a Slab

Installation

When floors are to be fixed over a plywood sub-floor, overlay or structural flooring may be used. For fixing to battens, structural flooring (19 mm or thicker) should be used. The plywood sub-floor or battens need to be at a moisture content within a few per cent of the flooring at the time of installation.

Installation of flooring should not occur until other construction activities, particularly wet trades, are complete. The building should be roofed and enclosed with the temperature and humidity as close as possible to the expected in-service conditions including the use of air-conditioning if applicable. For secret fixing, secret nail profile boards should be used (maximum cover width of 85 mm) with one nail per board at each fixing. For top (face) nailing, standard profile or secret nail profile boards may be used. Boards exceeding 65 mm cover width require two nails per board at each fixing. Expansion gaps of 10 mm should be provided at all walls and other fixed obstructions, which are parallel to the run of floor boards. Intermediate expansion joints should also be provided in larger floors (width at right angles to boards exceeding 6 metres), to give an equivalent gap of 10 mm every 6 metres (approx. 1.5 mm every metre 800 mm) or the use of loose cramping.

As an added protection against moisture from the slab (from slab edge effects, beam thickening etc) or minor building leaks, a 0.2 mm thick polyethylene or poured chemical membrane over the slab is recommended. The polyethylene should be lapped by 200 mm, taped at the joints and brought up the walls (or fixed columns etc) above the top of the flooring. The polyethylene is then covered by the skirting. Note that fixings of plywood sub-floors or battens through the polyethylene is not considered to reduce the overall effectiveness of the membrane.

Fixing recommendations - plywood sub-floors to concrete slabs and flooring to plywood

Plywood sub-floors should be structural grade, a minimum 15 mm thick and with a type A bond. Sheets may be installed in a 'brick' pattern or 45° to the direction of the strip flooring with a 6 mm gap between sheets and a 10 mm gap to internal and external walls. Various methods of fixing are used including adhesives and mechanical fixing. The option detailed below is for hand-driven spikes which provides solid fixing to the slab:-

- Slabs should be level to ± 3 mm in 1.5 m. If not, the effect needs to be assessed and as appropriate the use of a topping compound prescribed for the purpose or other measures to provide a satisfactory floor installation should be undertaken.
- Install 0.2 mm polyethylene vapour barrier
- Fix plywood sheets to the slab with hand driven 50 mm long by 6.5 mm spikes ('Powers SPIKE' or equivalent). A minimum of 20 spikes to be used per 2400 mm x 1200 mm sheet, equally spaced and with the outer spikes 75 mm to 100 mm from the sheet edge. If a brick pattern is used, it is preferable that sheets be staggered by 900 mm so that fixings do not line up from sheet to sheet.

Fixing recommendations are provided in Table 4 and Figure 3. When staple fixing at close centres is being used, provide a cushion of polyurethane flooring adhesive between the two floors to minimise possible squeaks. This is achieved by using continuous bead of adhesive at 90° to board length, midway between fixing points. Where polyurethane flooring adhesive is used to provide much of the fixing, staples may be spaced up to 450 mm apart. Note that flooring cleats (as used with *Powernailer*) of a similar length may be used in lieu of staples.

FIXING METHOD	SECRET FIXING TO SUB-FLOOR (SUBSTRATE) ONLY
Staple fixing up to 250 mm spacing	Staples - 32 x 15 gauge to plywood for flooring 19 to 21 mm thick. Zigzag pattern of polyurethane flooring adhesive between fixing points. (For overlay flooring maximum length to suit sub-floor (substrate)).
Adhesive fixing with staples up to 450 mm spacing	Polyurethane flooring adhesive - zigzag pattern to achieve approx. 25% glue contact area after laying. Staples - 32 x 15 gauge to plywood sub-floor (substrate) for flooring 19 to 21 mm thick. (For overlay flooring maximum length to suit sub-floor (substrate)).

Table 4 - Minimum Secret Fixings of T&G Flooring to Plywood Sub-floor (Substrate) over a Slab

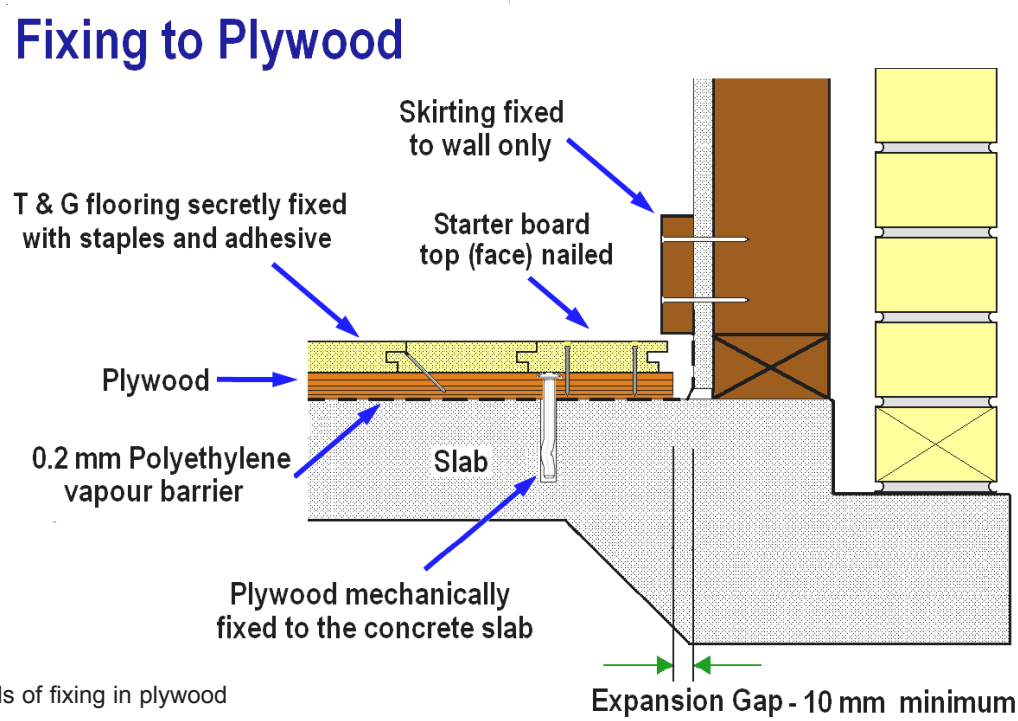

Figure 3 - Details of fixing in plywood

Fixing recommendations - battens to concrete slabs and flooring to battens

Battens are to be seasoned and may be either hardwood or softwood. Battens may be fixed to the slab using 75 mm gun nails at 600 mm maximum spacing, 6.5 mm dia. 'Powers Spike Fasteners' with a minimum embedment of 32 mm or equivalent at 900 maximum spacing or M6 masonry anchors at 900 mm maximum spacing. Table 5 outlines the minimum batten size and fixing requirements for structural flooring to battens. Batten spacing is dependent on the species and grade of flooring used. It shall be the same as for flooring over joists as provided above in Table 1. Figure 4 outlines details of fixings into battens. When 19 mm thick hardwood battens are used, additional adhesive is necessary to compensate for the reduction in staple length.

TYPE OF FIXING	BATTEN TIMBER & SIZE		
Top (Face) Fixing	HARDWOOD & CYPRESS 35 X 70 mm	HARDWOOD 19 x 80 mm	SOFTWOOD 35 X 70 mm
Without Adhesive			
Hand driven	50 x 2.8 mm bullet head	–	50 x 2.8 mm bullet head
Machine driven	50 x 2.5 mm T - head		50 x 2.5 mm T - head
Secret Fixing			
With Adhesive #			
Machine driven	50 x 15 gauge staple	32 x 15 gauge staple	50 x 15 gauge staple

A continuous bead (6 mm approx.) of polyurethane flooring adhesive to be applied to 35 x 70 mm battens and the equivalent of 2 beads to 19 x 80 mm hardwood battens

Table 5 - Minimum Fixing T&G Flooring to Battens over a Slab

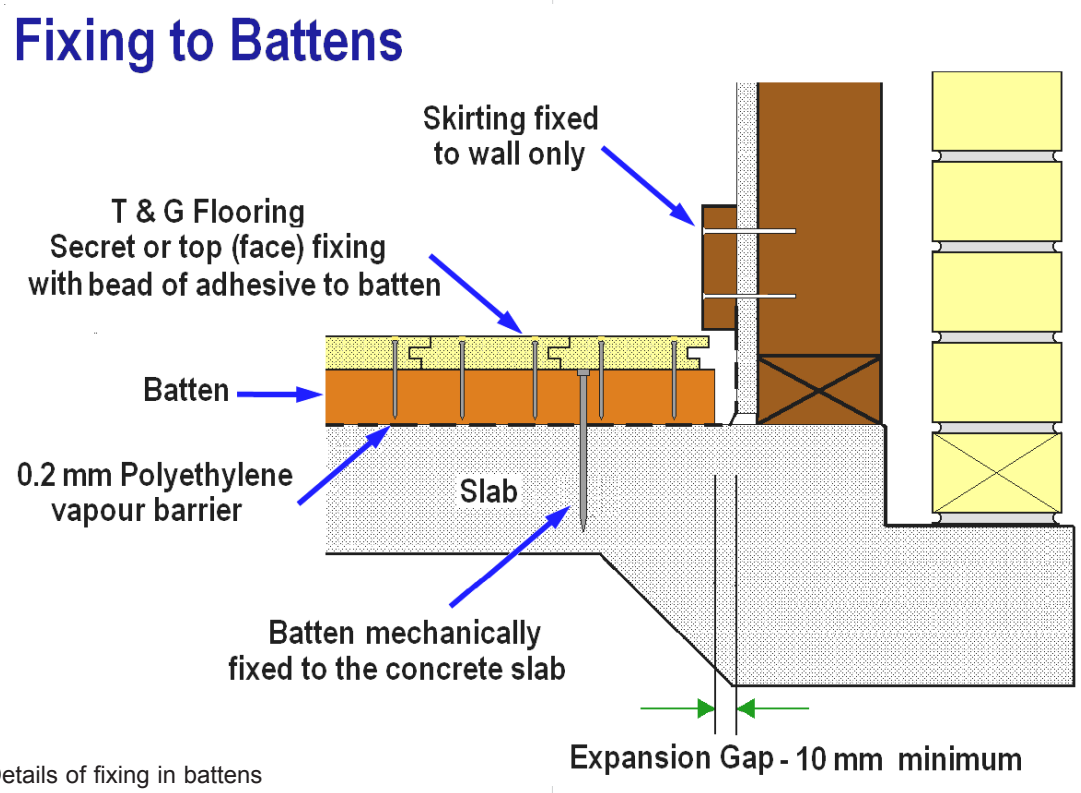

Figure 4 - Details of fixing in battens

Safe Working

Working with timber produces dust particles. Protection of the eyes, nose and mouth when sanding, sawing and planing is highly recommended. Refer to tool manufacturers for safe working recommendations for particular items of equipment.

Disposal of Offcuts and Waste

For any treated timber, do not burn offcuts or sawdust. Preservative treated offcuts and sawdust should be disposed of by approved local authority methods.

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Technical Data Sheet
Sanding and Finishing Timber Floors 21

Recommended Practice / March 2006

Issued by: Timber Queensland Limited

Introduction

Outlined in this data sheet are aspects that should be considered when sanding and finishing timber floors. The sanding and finishing process is particularly important to the overall performance and appearance of the timber floor and is an area that offers a wide array of methodologies and coating systems. The practices outlined are those employed broadly throughout the industry, however, variations of sandpaper grades and procedures are common. The aim in all cases is to provide a smooth surface with the desired surface coating suitably applied to give an even level of sheen across the body of the floor.

Assessing the floor prior to sanding

Prior to sanding the condition of the floor should be assessed to ensure that it is in a condition suitable for sanding. This may include assessing vertical movement at board or end-matched joints, an appraisal of the overall condition of the floor (e.g. degree of cupping in boards, gapping at board edges, signs of moisture). If there are signs of abnormal moisture content, it should also include taking and recording moisture contents of the installed floor. This ensures a complete history of the floor, should issues arise in the future. Any issues should be provided in writing to the applicable person (e.g. principal contractor, owner) and an appropriate course of action taken. It is good practice to let the floor "settle" for a period, which may be three to 14 days before the sanding process takes place. This period is also beneficial for curing of adhesives where utilised.

Preparation for sanding

Punching nails and filling nail holes

Before the sanding process can begin, ensure that all nails are punched a minimum of 3 mm below the surface of the boards. Any nail that is not suitably punched will potentially damage the sanding equipment and affect the sanding process. It is important to note that secret nailed floors may have been top nailed adjacent to a wall or other areas where access is limited.

The punched nail holes can then be filled with either oil or non-oil based filler. Oil-based fillers may bleed oil into the timber and affect the colour of the wood surrounding the nail hole, or may not be compatible with various coating products. The colour of the filler should be carefully selected to minimise any visual impact of the filler. Many of these products are sold in colours pre-matched to specific species. In mixed species floors or where significant colour variations are present, it is usual to mix or select a neutral colour that is slightly darker than mid range between the extremes of colour. Generally all fillers are slightly darker and this allows for the boards to deepen in colour following finishing and UV exposure.

To any imperfections and/or grain, apply grainfiller prior to the first coat. Grainfiller needs to be water based, not acrylic or latex. Filling should be done at this stage or after the first coat of finish is applied. By filling after the first coat any potential for the filler to impact on the surrounding timber through bleed or moisture is minimised. In all cases the filler must completely fill the hole so as not to impact on the finish quality.

Cleaning

The floor requires thorough cleaning to make it free from dirt, grit and debris. These particles, if not removed, can cause deep uneven scratching in the timber surface, requiring substantial additional sanding to remove. The floor should initially be swept followed by vacuuming, paying particular attention to areas which are not effectively cleaned by sweeping, such as gaps underneath the skirting, corners, window sills and the like. The vacuum should have sufficient capacity in terms of both suction and filtration to satisfactorily clean the floor.

It is important to remove any materials that may potentially impact on either the sanding or coating process. Additional care should be taken with silicone-based sealants that may have been dropped onto the floor. These products can potentially be widely spread through the sanding process, impacting on the bond between the coating and the timber.

Protection

During the sanding and finishing process it is imperative that access to the area of the work be restricted. Any tradesmen working in or around the area can potentially generate dust, wet the floor, introduce silicone based mastics and sealants, walk over the area or generally contaminate it. Clear instructions should also be given to the owner or occupants regarding access, not opening windows which may blow dust over the area, and time required for coating systems to adequately cure.

Sanding

The sanding operation will vary based on the condition of the floor and the hardness of the flooring species. Where the floor is being sanded for the first time, the sanding process is made up of a number of separate sanding stages, which generally start with a coarse paper and progress to a relatively fine grade of paper. It should be noted that the sanding process is effectively scratching off the surface of the boards, and the reduction in grades of paper means that you start with a severe scratching action and finish with a more subtle scratching action.

Level / Basic Sanding

The level/basic sand, as the name suggests, is to cut the boards level, taking out any ridges or high points in the floor. It typically comprises of three passes with the sanding machine. The level or basic sanding is to provide a level, completely sanded floor - each of the sanding procedures that follows this step is designed to remove the sanding scratches generated by this initial step.

Pass 1 is done from a small angle or up to a 45 degree angle to the direction of the grain (diagonally). This angle is dependent upon the layout and size of the area to be sanded. A coarser grade of paper is used, depending upon the species and the condition of the boards. A lower grade of paper may be used to enhance the effectiveness of the sanding process in a floor that is very uneven or with hard timbers such as Turpentine or Ironbark.

Each room is sanded starting at a point, which will allow the longest path of travel at approximately 45 degrees (or as is deemed appropriate given the room parameters) to the grain

direction (run of boards). The machine is started, ensuring that the drum is not touching the boards and walking slowly forward, the drum is eased onto the boards. A slow walking pace and consistent pressure is maintained. At the end of the pass the drum is raised smoothly off the floor and then by walking backwards, pulling the machine, it is eased back onto the floor for the return pass. The power lead, controlled by the operator, must be kept well clear of the drum.

When the original starting point is reached the drum is again gradually raised off the floor. The machine is then moved to the right or left hand side of the first path, ensuring an overlap to the first cut path. Sanding continues in that direction, sanding strips and maintaining a similar overlap in each forward and backward pass. When the limit of accessibility has been reached in the corner of the room, the machine is brought back to the starting point and the remainder of the floor is sanded in the same direction and manner but to the opposing side of the first cut. That is, if sanded to the left of the first cut, sanding then takes place to the right of that first cut, ensuring that there is an overlap of around 200 mm between the two sides of the floor.

The second pass is carried out on the opposite diagonal to Pass 1, using a similar grade paper. The third pass continues in the direction of the boards, using a similar grade paper to remove the sanding lines from the action of pass 1 & 2. Typically the operator should start at a point that is a few metres off the side wall. The process of walking speed and easing the drum onto the floor is as previously described.

Once a forward and reverse path is sanded, the machine is moved, ensuring an overlap to the previous cut and sanding recommences in the same manner. This process is carried out across the room. When the full width of the room is sanded, the operator should turn 180 degrees and sand the unsanded band of floor. At the completion of the level or basic sanding the boards should be generally smooth and free from cupping, and mismatching of surface levels between adjacent boards. If this has not been achieved the floor will require additional passes to achieve this state.

The sanding drum should never contact the floor unless moving forward or backward. Doing so will cut a groove into the floor (drum mark), which may not be recoverable. Specialist equipment and manufacturers' recommendations, and user instructions should be followed.

Edging

The sanding machine will not be able to sand the boards along the edges of the room, in corners or areas of reduced access such as wardrobes etc. In these areas the boards need to be sanded level and generally blended into the body of the floor. For these areas an edge sander is used. In all cases, care is necessary to ensure that the operation does not dig grooves into the boards and the finished edge is level with the body of the boards.

The most commonly used machine for the edging process is the disc sander. When using this machine, the operator should move the machine in a smooth even pattern at board ends and across the grain. The pattern of sanding should overlap and blend into the body of the sanded floor. It is important that the machine is held level as the boards are easily grooved with any uneven pressure. On each movement, the machine should sand approximately 50 mm section of unsanded floor. Along walls, the edge sanding machine should be smoothly moved, back and forth, overlapping some 100 mm into the body of the sanded floor.

For the purpose of edging on new and old floors, in good clean condition, finer grit papers are usually sufficient to achieve a colour match to the center of the floor.

It may be necessary in areas of very limited access or at the corners of the room, to hand scrape the floor. The scraping action should always be in the direction of the grain with the surface being hand-sanded or machine-sanded with a smaller machine i.e. orbital sander. With orbital sanders too much pressure or use of an overly aggressive grade of paper can result in deep swirl marks, which will show up in the finish. Once again, care needs to be taken to blend in these hand scraped areas with the body of the floor. This process is repeated following the second sanding process of the body of the floor.

Finish Sanding

The finish sanding operation involves two separate stages of operation.

Stage 1 - Initial Cuts

The initial cuts utilise a finer grade of paper than that used in the level or basic sanding operation. Typically an F60 - 100 grade paper is used and the floor is sanded in the direction of the grain (board run). The purpose of the initial cuts is to smooth off the coarse sanding marks left by the level or basic sanding. Once a suitable level of smoothness is achieved, the final stage of sanding may be carried out.

Stage 2 - Final Sand

The final sand utilises an even finer grade of paper - once again reducing the depth of scratching and preparing the floor for the coating system. The floor must once again be fully cleaned of dust, grit and debris. Any matter left on the floor will invariably impact upon the quality of the finish.

Typically, the final sand is carried out using a rotary sander, plate orbital sander or similar machine with a 100 - 150 grade paper or screenback. The sanding should be carried out in the direction of the grain, ensuring a smooth action and applying a balanced control of the machine. If a water-based coating system is specified the final sand may need to be carried out using a new or worn 150 mesh screenback dependant on the system being used (See manufacturers recommendations). The floor is then vacuumed thoroughly and if required tack rag cleaned. Special attention should be paid to any potential dust traps in the floor (dig out any dirt or dust and vacuum away). These can contaminate the floor coating system if not cleaned adequately, as the applicator will most certainly pull the dirt onto the body of the floor. It should also be noted that heavy sanding equipment may have the potential to create wheel marks on low density floor boards. Additional care should be taken in these applications.

Coating System Application

The following information is a typical application methodology, which might be utilised for the various finish types with minor product specific variations.

Cleaning

The floor finish will be easily contaminated with any dirt, dust or other extraneous matter left on the floor. It is essential that the area be thoroughly cleaned / vacuumed, paying particular attention to any areas which may have caught dust during the sanding process, such as window sills, picture rails, skirtings, power and light switches, light fittings, handrails, etc. The floor needs to be well lit with adequate ventilation. It is important not to have draughts blowing across the floor during the process as they may well introduce contaminates from outside of the actual working area.

Mixing the Coating

The coating material should be well and thoroughly mixed so that all the solids are blended through the body of the liquid. Care should be taken not to stir too quickly or roughly as this may introduce air bubbles to the material, impacting on the coating quality. If there are any additives to be used, ensure that they are mixed thoroughly into the coating liquid. In all cases follow the manufacturers' instructions.

Cutting In

Using a clean, good quality brush, cut in the finish around the perimeter walls and any other obstructions or areas which may not be accessible to the main applicator. The cutting in should extend out approximately 150 mm into the body of the floor so that the applicator is not required to venture too close to the skirtings and other limited access areas. If any bristles fall out of the brush into the finish, remove immediately.

Applying Coating

The initial coat applied to the raw sanded timber may be either a recognised sealer coat as prescribed by the coating manufacturer or the same material to be used as a finish, except when outside the manufacturers' recommendations. Sealers are available in both water-based and solvent-based products. The use of a sealer can enhance the development of colour in the timber floor and can reduce the risk of "edgebonding". Penetrating and low rupture sealers are available. In all cases it is imperative to closely follow manufacturers' instructions.

There are many approaches and methods used in the application of floor finishes and coating systems. The following approach is one such application method, which has generally been accepted by the industry.

The applicator as specified by the coating system manufacturer (often a 6 mm Mohair roller or equivalent) is immersed in the coating contained in a large painter's tray or applicator bucket. These allow the applicator to be lightly squeezed on the shallow portion of the tray to avoid drips. Applying the product to the boards should be carried out in a smooth action, starting at one end of the boards and working the product in-line with the grain of the timber boards. The finish should be feathered off at the outer edge to minimise any buildup of coating at that point. This process should leave a "wet edge" so that each successive section of application blends into the previous section without any ridging, which can occur if the material skins or dries off before the next application strip.

The application process should continue in the same manner working from one end of the area to completion. An even, wet look should result without any dry patches.

Filling/Stopping

It is recommended when coating parquetry floors, that filler be applied first to fill any open grain or imperfections. Once dry sand and apply the first coat. This aids in reducing the phenomena known as "quilting" where the finish does not flow across joints at board or parquetry edges. Filling of parquet floors may be carried out prior to or following the application of the initial sealer or first coat, and is at the discretion of the floor sander. It is generally not a recommended practice to fill tongue and groove timber floors.

Any nail holes not previously filled and any cracks or other open faults should now be filled with a suitable filling compound that is compatible with the finish type. (Note: ensure that the coating system is dry) Generally, a non-oil based filler is best which is suitably colour matched to the timber. The filler should be installed with a clean bladed applicator. Ensure that the filler slightly overfills the hole and has been fully pushed into the void. If the material is not completely filling the void, it may potentially come loose in service. Clean off any filler that is spread over the floor surrounding the hole. Any excess will be sanded away in the light sanding between coats.

Sanding Between Coats

The floor will typically have a slightly rough feel to it after the first coat of finish, depending on the system used and the degree of grain raise of the timber created. It is normal for more open grain timbers to exhibit a higher degree of initial grain raise than denser close grain species. The floor requires a light sand after the first coat to remove this roughness and to also key the surface for the next coat of finish. A 150 or finer grit paper or screenback is used at this stage with a rotary sander or similar. It is imperative that the sanding does not expose the timber as this will create further raised grain. The sanding process is required to smooth off the roughness in the coating, not the timber. Edges must be hand or orbital sanded to a similar smoothness.

Cleaning between coats

All dust should again be thoroughly removed from the floor along with any potential dust traps as previously described. Ensure that there are no draughts blowing through the area that could contaminate the final coat(s). In addition it may be prudent to use a tack rag over the floor to remove any dust missed by the vacuum. This will ensure that the floor is as clean as possible for the final coat(s).

Second Coat

The floor should again be edged with a clean brush coming out some 150 mm or more into the body of the floor. The application process is as per the first coat with the applicator being worked along the full lengths of the boards and lightly feathered at the outer edge of each strip of application.

Additional Coats

Any additional coats shall follow the same process of light sand of the previous coat, thorough cleaning and application of the coating. Typically a three-coat system is utilised, however, all manufacturers' recommendations should be followed in regards to number of coats, time between re-coats and sand paper grades, in addition to any requirements of the specifier. Various water-based and oil-based coating systems require a finer grit of paper between coats compared to the solvent-based products.

Safe Working

Working with timber produces dust particles. Protection of the eyes, nose and mouth when sanding, sawing and planing is highly recommended. Refer to tool manufacturers for safe working recommendations for particular items of equipment.

For specific recommendations on handling, use and disposal of floor finishes, refer to manufacturers recommendations.

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Technical Data Sheet
Acceptable Appearance from Timber Floors 31

Recommended Practice / March 2006

Issued by: Timber Queensland Limited

Introduction

There are no standards that outline what an acceptable appearance of timber floor should be. There are standards that relate to the manufacture of timber flooring and when recommended sanded and finishes practices are undertaken, there is a general level of acceptance of the finished product in the marketplace. Floors of the same species can differ markedly in their appearance, depending on timber source, age of the tree, board cover width, the finish system used and the lighting in which the floor is viewed. Timber is a natural product that will shrink and swell in response to changes in atmospheric humidity, no building environment is the same as another, the sanding and finishing is not undertaken in a dust free factory environment and finishes may darken with time. Even with these variables a high standard in the finished floor is achievable. This data sheet outlines what is considered an acceptable appearance for a timber floor.

Acceptable Appearance

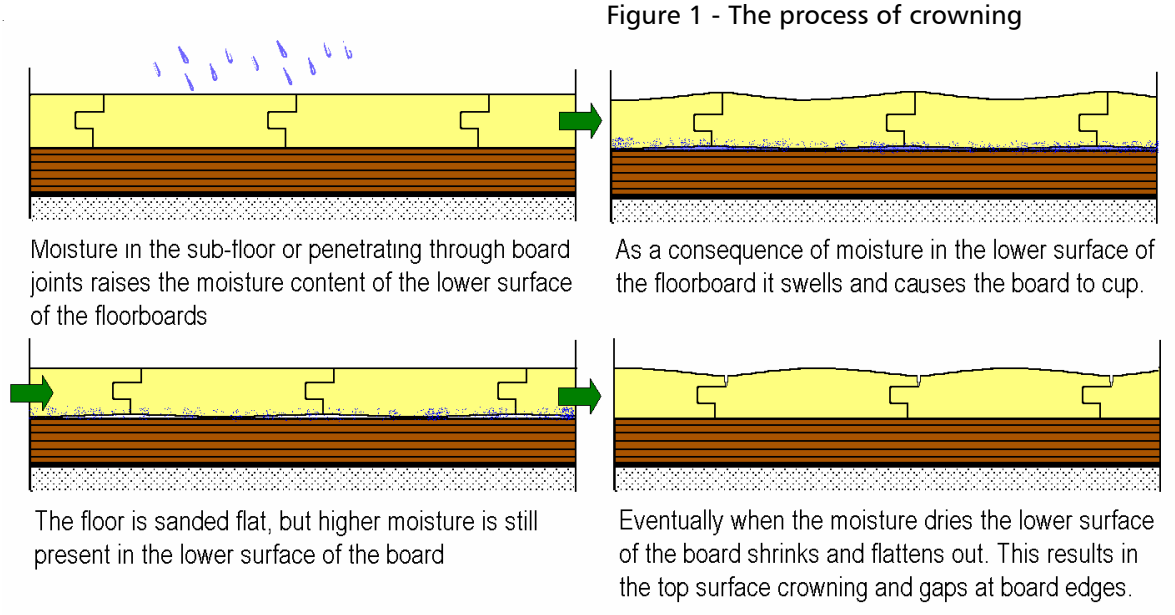
Even timber surface

The following outlines some problems that affect the surface of the boards and these should not generally occur in timber floors. However, specific heat sources from appliances or sun exposure through large uncovered windows may induce some cupping of boards in the affected area. Similarly, wide boards or thinner overlay boards may also show some slight cupping in certain house environments. It should also be recognised that the actions or inaction of owners can contribute or even cause these to occur.

- Cupping - boards with their edges either higher or lower that the centre of the board. Heat in a specific location or a very dry environment above the floor may result in cupping. Moist sub-floor spaces can also cause boards to cup. Cupping is more likely to occur in overlay flooring and standard thickness boards that are wider than 100 mm. To some degree a small amount of cupping may occur in some locations within a dwelling (e.g. sun exposed floor) where these types of flooring are used.
- Tenting - two adjacent boards, where the adjoining edge has lifted above the level of the adjacent flooring. This is often associated with high moisture beneath the floor and can be from many causes.
- Buckling - a section of flooring containing a number of boards raised above an adjacent section of flooring.
- Crowning - floor boards that are flat on their lower surfaces but where the upper surface has its edges lower than the centre of the board. This may occur if a floor is cupped (board edges up) at the time of sanding. Crowning does not become apparent until some months after finishing.

Note: Floors exposed to heat sources after occupancy (e.g. no curtains, fireplaces, vents from appliances, houses closed up for extended periods) may cause boards to cup. Cupping and shrinkage from such sources may be the owner's responsibility.)

Figure 1 - The process of crowning



Relatively even gapping between boards in areas not exposed to specific heat sources

During drier times of the year, gapping between boards may average 0.75 mm. Some gaps may be larger than this and others smaller, however, the appearance generally indicates gapping between most boards.

An appearance can be expected that is free from split boards and wide gaps between boards that may be irregularly-spaced across the floor. Irregularly-spaced wide gapping may occur from either the edges of boards being bonded together or from a proportion of boards being high in moisture content at the time of laying.

Limited vertical movement at T & G joints

Flooring is manufactured with the board tongue narrower than the groove. This is necessary so that boards will fit together during installation. When floor boards are laid over joists in particular, some differential vertical movement may occur between adjacent boards, when a load is applied to an individual board. This is due to the clearance between the tongue and the groove. The clearance should not exceed 0.6 mm.

Minimal Squeaking

A small amount of noise can be expected from most timber floors when walked on. Noises can occur from movement of one board edge against another or from boards moving on nails. A floor is often more noisy during drier weather due to loosening at the joints.

Indentations

Timber strip floors can be expected to show some indentations depending on the hardness of the species used, volume of traffic and footware worn.

A Finish with Minimal Contamination and Sanding Marks

A finish similar to that of fine furniture should not be expected. Timber strip floors are not finished in a factory environment and different pieces of flooring will sand differently. The home environment is also not dust free. However, the finished floor can be expected to have an even appearance free from heavy sanding marks, blooming or frequent air bubbles in the surface. A minimal level of contaminants, minor sanding marks and small depressions of the finish at board edges and in nail holes etc. may be visible. The perimeter and other hard to get at places are more likely to contain these irregularities. Due to this a mirror finish is an unachievable expectation. Some finishes will also yellow with time, and if rugs are moved a contrast in the depth of colour can be expected.

When floors are inspected for imperfections, the floor is to be inspected during daylight hours with lighting on. The overall assessment of the floor is from a standing position with the floor viewed from positions that are usually occupied by people. Internal and external reflections in areas not usually covered by furniture should be assessed. Acceptability relies on judgement that takes into consideration the effect of lighting on noticeable surface imperfections as well as initial wear of the floor, which can cause some imperfections to significantly lessen or disappear. A floor is subject to much heavier wear than furniture and although a good quality finish can be expected, the same finish quality as furniture should not be expected.

Some imperfections that could be expected to some degree in a floor but which should also be assessed include:- sanding quality; gloss variation; dust, insects and debris; bubbles and gel particles; coat leveling.

Safe Working

Working with timber produces dust particles. Protection of the eyes, nose and mouth when sanding, sawing and planing is highly recommended. Refer to tool manufacturers for safe working recommendations for particular items of equipment.

Disposal of Offcuts and Waste

For any treated timber, do not burn offcuts or sawdust. Preservative treated offcuts and sawdust should be disposed of by approved local authority methods.

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