CUPPING

Cupping is the direct manifestation of a board with a high moisture content on the underside and a low moisture content on the top side. It is produced by board contact with "wet" (over 5.5%) concrete slabs (new slabs, or slabs without moisture vapour barrier fitted), by temporary flooding of a room with water trapped underneath boards set on particle board, by installing boards over joists with a flooded or damp subfloor area so that the undersides absorb more water (likely to occur if the storm water system has not been installed before the floor), and by drying of the top surface of the boards as can occur with the sudden but prolonged use of a refrigerated or reverse cycle air conditioner.

Cupping can occur with any timber and any boards, but the risk can be reduced easily.

Use quarter-sawn boards. Quarter sawn boards are resistant and back sawn boards are prone. Back sawn boards will cup away from the centre of the tree (and try to flatten out the end grain growth rings).

Use narrow boards. Narrow boards are resistant and wide boards with an aspect ratio greater than 4.5 (ratio of the width to the thickness) are more prone. Top nail the boards. Conventional tongue and groove boards wider than 80mm should be top-nailed, not secret nailed. Secret nailing is not as strong in resisting board movement as top nailing.

Use the correct nails. For top-nailing into hardwood joists (F17), use two 50mm by 2.8mm bullet head nails at each joist, the nails driven in slightly skew at an angle of 80 degrees opposing, 12mm in from each edge. For top-nailing into softwood joists (F7), use two 65mm by 2.8mm bullet head nails at each joist, the nails driven in slightly skew at an angle of 80 degrees opposing, 12mm in from each edge. For secret nailing, use a 50mm long coated staple recommended by the fastener manufacturer for the purpose.

Use the correct adhesive. Bostik Ultraset and Selley's Liquid Nails Direct Stick are polyurethane formulations that remain resilient after curing.

Resilience allows the timber to move slightly without breaking the bond. Harder adhesives, such as standard Liquid Nails, are not suitable. For standard 19mm T and G flooring, run a 5mm squiggly bead down each joist before nailing

Anecdotal reports of the susceptibility of certain species of timber to cupping are without scientific foundation. It is not the species that matters.

Unfortunately, cupping does not recede completely but usually becomes a permanent set in the boards. If cupping occurs, find and stop the source of the water (if that is the problem), be patient, allow the boards to dry out to 12% nominal moisture content (use a moisture meter to check this), and only then sand out the distortion. Sanding before the boards have dried out will cause more timber than necessary to be removed from the edges of each board, thinning the boards out towards the edges, quite possibly preventing a tight edge to edge longitudinal join ever being restored to your floor, and producing a convex (rounded top) board if the board dries further and flattens out more after sanding.

TENTING

Tenting occurs when boards absorb moisture after installation, expand fairly uniformly across their width, and, being unable to go down, go up at the edges. The boards tend to remain flat and not cupped. A severely tented floor will look rippled, like small waves on a large sea. Since this is essentially a moisture absorption problem, the rectification advice is similar to that given above for cupped floors. Fortunately, tenting tends to subside as the boards dry back down to a more typical 12% moisture content. After drying has been completed, the boards can be flattened back into place, renailed if necessary, lightly sanded and recoated. It is rare to have to remove and replace a tented floor.

GAPPING

Gapping between floor boards is not covered by any of the Australian Standards.

Gapping is covered by an accepted and unwritten rule within the flooring industry. Boards of up to 100mm over four continuous boards are not to contain more than 3mm of accumulative gaps. This may be 3mm between 2 boards when affected by Polyurethane solvent coatings. This is called edge bonding (boards glued together at the tongue & groove joints due to penetration of coating) Boards which are split and gaps which are wider 3mm should be replaced. In most cases gaps up to 1mm between boards can be filled with a coloured and flexible filler and sanded back and recoated.

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HOW TO PREVENT THEM; WHAT TO DO ABOUT THEM

Floor contractors only have to follow well-established principles in installing and coating a floor in order to avoid problems entirely. Problems, whilst rare, can usually be traced to shortcuts or to lack of knowledge. Here is a short technical note on problems, causes and rectification. Note that timber is hygroscopic, and will relentlessly absorb moisture and lose moisture as it tries to bring its own moisture content into harmony with the surrounding air. Most of this movement is invisible, but if the surrounding air oscillates from very dry to very moist with a large amplitude, the timber will try to follow, and visible expansion and contraction will occur.

Correct MC ex the mill: the starting point

Non-air conditioned buildings

Australia is divided into three zones of relative humidity. Victoria is in Zone 3.Testing has shown that 12% MC is the average Winter/ Summer moisture content, for non-air conditioned houses, in most locations in Victoria. This 12% moisture content is therefore a starting point for most locations in the state. Timber processors dry flooring to 12% and then wrap the flooring in plastic sheeting to ensure that the timber remains at 12% during transport, storage and final delivery to the site.

Buildings with refrigerated or reverse cycle air conditioning

The winter / summer average moisture content is 9%; timber destined for such buildings should be dried to 9%, not 12%. This form of air conditioning dehumidifies the air.

Buildings with evaporative air coolers

Evaporative air coolers saturate the air with moisture. As a general statement, evaporative air coolers should not be used in buildings with solid timber floors; the sudden onslaught of saturated air may cause the timber to expand visibly, producing "tenting". Small evaporative coolers operating intermittently in the upstairs part of the building generally do not cause a problem, but whole of house coolers used continuously probably will.

There is no official manufacturer moisture content figure set for this circumstance, as the incidence of use (occasionally to continuously in Summer) and coverage of house volume (partial to complete) vary too much from house to house.

Acclimatization: the next step

The ideal is to install timber flooring in mid-Spring or mid-Autumn, with the boards at a moisture content that is the average of the summer and winter readings at that location in that house. In this way, the boards will be in the middle of the moisture content range they will have to cope with over a typical year's seasonal cycle, and expansion will be slight and invisible, and contraction will be slight and invisible.

This is often impractical. The alternative approach is to install the boards at any time of the year, but use only 12% mill moisture content boards (for non-air-conditioned buildings), acclimatize the boards on site in the room or rooms in which they will be installed, for four weeks, and then cramp them during installation with the time of year in mind. In high summer, cramp lightly to allow for winter expansion. In the depth of winter, clamp tightly to allow for summer contraction.
Timber flooring should not be delivered to site until the building is lock-up and the storm water system is fully operational. Once delivered to site, the flooring should be taken inside the house and placed in the rooms in which it is to be installed. The plastic wrapping is then removed, and the boards are left in the house in the area where they will be installed, for two to four weeks. The atmospheric conditions to which the timber is exposed during this period must as closely as possible mimic the real conditions that will apply when the building is in full use.
Acclimatization is sometimes difficult to achieve; the floor may be installed before the air conditioning or heating has been installed, so no proper acclimatization can take place. Acclimatization can backfire; if the exposed sub-floor area is saturated with surface water, the boards will harmonize their moisture content with this circumstance, absorb water and expand, and shrink later on, as they dry, after installation.

As a final check to see if anything has gone off the rails, it is standard practice to check the moisture content of a sample number of boards before installation commences. All competent flooring contractors and carpenters carry a moisture meter.

Coating selection: what to expect

Solid timber floorboards must be able to expand and contract without restriction. Each board is domiciled in its specific location and will expand outwards and contract inwards about its epicentre. If boards are glued edge to edge, they cannot behave normally. The results for your floor will be deleterious, without doubt. All film-build coatings except Tung Oil are capable of "edge bonding. However, only the two-pack polyurethanes are capable of forming a bond that is stronger than the wood. Two pack polyurethanes, such as Wattyl's 7008, should not therefore be used on solid timber flooring. In itself, edge bonding is innocuous. It's when the boards commence to shrink again, ever so slightly and invisible to the eye, that the problems start. The benign result is a loud crack as the boards break the film of coating; a white fracture line may sometimes appear. Clumping occurs when (say) six boards stay glued together, but produce a large and very visible gap between them and the next clump, at a join where not much of the coating penetrated. Any board with a longitudinal structural weakness, such as quarter-sawn board with a significant gum vein, may be pulled apart by its neighbouring boards, splitting the weaker board.

All in all, two pack coatings are not considered worth the extra cost and trouble they bring, although they are generally more abrasion resistant than single pack coatings and the gloss level is the highest possible.
Let's look at some typical problems. Some of these are sole problems with one proximate cause; others are compound problems with several factors contributing to the result. Rectification advice follows.