
“TIMBER FAILURE” (EDGE BONDING)

Timber failure and edge bonding are the common terms generally applied to strip timber flooring where the floor demonstrates unevenness of lateral movement and structural variation to a significant extent. The phrase “edge bonding” is normally applied when a floor experiences this type of “failure”, which may include splitting within the boards, at board edges, or the opening of large periodic gaps between boards. Currently “edge bonding” is usually only referred to where timber is coated with polyurethane (or another high strength coating), even though there needs to be several other influences present for this phenomenon to occur.

Ultimately this phenomenon is the result of high-rate, short-term shrinkage of the timber substrate under restraint, and the “effect” as described is one which requires the influenced of many factors, *only one of which may be the coating*.

When discussing coatings in relation to “edge bonding” driven “Timber failure” we must recognise that coatings themselves are required to be adhesive by design, or they would not fulfil their specification as a “coating”. By nature certain types of coatings have a greater propensity to adhere to surfaces than others, yet it would be an uneducated and simplistic approach to attribute the blame for the effect referred to as “the phenomenon of edge bonding” wholly upon the surface coating.

In this instance “**Timber Failure**” or (edge bonding) will refer to the uneven or random gapping, and structural failure of strip timber flooring where evident to a significant extent, and driven by factors outlined within the accompanying flow chart.

Fundamental Cause

High rate short term timber movement and/or shrinkage of boards where resistance to free movement of adjacent boards, or groups of boards, cause apparent random and uneven gapping in the overall floor surface. If there are pre-existing, or subsequently affected weak points in the floor at the time of this high rate movement or shrinkage, boards or edges of boards containing this structural weakness may split or crack, as the most fragile points are where naturally driven stresses will be initially released.

In rare cases if the properties of the coating or the *source adherent* (which may also be glue etc) are such that they cannot accommodate the extent and rapidity of shrinkage, intermittent gapping between boards may occur in conjunction with the loss of moisture content. This initial occurrence can even out with further moisture loss, as the contact points will fail (open) in order of the strength of resistance affected.

If this weakest point is the timber itself, then the timber splits due to movement stress exerted upon this point (pre-existing weakness) then the failure is called a TIMBER FAILURE (edge bonding). However this failure is basically a “structural failure” and would be unlikely to have occurred had the integrity of the timber been, or remained intact.

Alternatively, the timber may not fail, but large periodic gaps may occur between clusters of boards at the weakest fixing points.

Three Factors That Must Be Present For A Coating Influenced Timber Failure To Occur

- 1. Timber That Demonstrates A Very High Rate Of Shrinkage.**
A large dimensional change over a short period of time i.e. usually where moisture levels are ignored, timber is poorly handled, aged flooring has undergone structural variance, laid in wet conditions prior to dry season.
- 2. Gaps Between Boards**
i.e. to glue an edge, coating must come into contact with that edge (opened) or possibly poorly machined or loose T & G joints (causing "pooling" of coating).
- 3. A Coating With Low Stretch, And High Strength Properties**
The coating may be high in tensile strength with not enough 'give' to bridge the widening gap between the shrinking boards. Alternatively a whitish or opaque "dag" may occur where stretched coating forms where gapping closes.

“ Give Me The Complete Story ?“

This question is being asked more and more by Sanders and Finishers, particularly as we become more concerned with the **why** and not just the **what** of job failures in our increasing litigious environment.

Polycure has considered the total process of Timber Failure (edge bonding) and through extensive research the appended chart has been prepared and should be considered and understood.

Process Flow – Timber Failure

This follows the **complete process** from the tree and the coating formulation, right through to a timber failure.

All process steps that can contribute in any way to a resultant timber failure are asterisked (#).

As can be seen, many of the steps in the chain of events can have an influence on the occurrence of a timber failure.

As can be seen many factors can potentially contribute although some are much higher in **probability** than others to apply to individual cases.

“ What Can I Do As A Floor Sander / Finisher To Avoid Timber Failure On Jobs That I Do ? “

- 1. Ensure the timber you coat is conditioned or equilibrated to e.m.c. (equilibrium moisture content) of the premises interior. Allow the prescribed time prior to nailing and especially before coating, even in old floors time is required for adjustment after floor coverings (carpet, tiles,etc) are removed. Ask your builder or installer to ensure this and to provide moisture readings if suspect.**
It is sometimes in the interest of the timber side of the equation to produce timber at the upper end of the moisture specification - be aware that **the higher the moisture level, the greater the timber shrinkage will be in the reaching of the building interior EMC. Outdoor, or site, Equilibrium Moisture Content**, is basically the moisture level the timber will level out at when stored outdoors under cover with adequate air flow in a particular location at a particular time of the year.

Site EMC for example in Adelaide for Jarrah is mean 17% (15 to 19 %) for the month of August and a mean of 9% (7 to 11%) for the month of January. Exposure to these differing conditions will effect timber accordingly.

Building Equilibrium Moisture Content is the moisture level that the timber will average out to within the building normal environment (this may mean with air conditioner or heating running as it will synthetically dehydrate timber).

As a 'rule of thumb', the timber should be at a building emc of 9 - 14 % prior to coating to minimise potential for timber failure to occur, however the closer to the 9-11% reading the less likely shrinkage/movement is to occur.

So as well as the possibility that the timber may have been delivered on site with a higher than average moisture level, in many instances today the time pressures on the floor layer, or their non-understanding of "best practices", may be such that the timber is:

- Not laid out in the building for 10-14 days to reach EMC before fixing.
- Not laid in compression via cramping to an adequate degree.
- Stapled or fixed to an inadequate degree etc. etc.

So what do you do ?

1. Ask of the person who laid the floor to **put it in writing that the floor was laid per best practice for the attainment of EMC** and to produce a moisture reading that would confirm the moisture level prior to nailing; Alternatively (especially for existing floors) - include a disclaimer in your quote to the effect that " this floor is coated on the understanding that it is stable (as floors may vary during exposure to building/renovation conditions), and was laid in accordance with deemed good practice for Tongue and Groove floor installation.
2. Ask the company that supplies you the **timber or parquetry to verify that it is within the 10 to 15% moisture** level expected. Get this in writing. Condition the timber or parquetry on site prior to gluing and especially before coating.
3. **Do not coat moist timber !!!** It is impossible to predict moisture content and even less possible to ensure those before you have acted correctly and cautiously, so where possible we suggest that you or your installer **CHECK ON THE MOISTURE LEVELS!! IF YOU HAVE ANY DOUBTS SOURCE A MOISTURE METRE AND CHECK THE MOISTURE CONTENT YOURSELF.**

Your state Timber advisory body can indicate what the EMC should be for your location at that time of the year.

As a guide, in prolonged dry weather, EMC = 7 to 11%
..... in prolonged moist weather, EMC = 11 to 17%

Applying coatings above these moisture levels will significantly increase the risk of later edge bonding failure via the increased timber movement levels they generate.

Again, only apply Polyurethanes to timber in the range of 9 - 14%.

Use Only Recognised Brands Of Coatings With 'Track Records' Of Good Performance Or Flooring Industry

KNOWLEDGE RE: TIMBER FAILURE RESISTANCE

There is no question, some finishes are more likely to contribute to the incidence of timber failure than others purely based on adhesive properties (as a coating “*must*” have), but it will not/can not occur without the presence of other more influential factors.

As a guide:

- Use 1 packs rather than 2 packs for strip timbers
- Just like ‘oils aint oils’, one packs can vary massively in their toughness, adhesiveness, and stretch properties.

With Polycure single packs you know you will have the optimum quality product for edge bonding resistance consistent with other performance properties.

- Waterborne Polyurethane systems tend to have good edge bonding resistance than solvent based Polyurethanes due to their increased stretch potential. Although there are significant durability and film build concessions.
- Oil based finishes will rarely contribute to timber failure due to their weak tensile strength and high elongation, those same properties that cause them to wear rapidly. *A floor coated in oil based can however fail, as other factors may be present that “still” cause failure regardless of coating type.*

Take Care In Using Low Viscosity Or Highly Catalysed Sealer Coats

If you dilute the sealer coat with thinners, or use a commercial very low viscosity sealer coat, the sealer will percolate or drain easier into the tongue and groove and be in contact with more timber area. It will also soak into the timber more.

Both actions promote adhesion and increase possibility of timber failure.

The more catalyst in the sealer, the lower the elongation qualities of the Urethane. This reduces the coatings ability to slowly stretch and bridge the increasing board gap as the timber shrinks.

Keep away from low viscosity fast curing urethane sealers on new strip timber floors. Lay secret nailed flooring over “structafloor”, as its weaker fixing may exaggerate the impact of other contributing factors.

NON-URETHANE SEALERS

Products such as Polycure Fast Sealer 3018 and Fastaseal 3030 possess properties that have the potential to significantly reduce edge bonding from high shrinkage and fragile timbers and are recommended over Polyurethane sealers in such situations.

A statistical study taken over 2 years showed that not one timber failure case occurred out of the various reported cases, where a non-urethane sealer had been used to seal the T & G floors.

Presumably the mechanism for this effect is that these sealers have low tensile strength and will tend to ‘let go’ preferentially at the board interface in high abnormal shrinkage situations.

Although impossible to guarantee due to other contributing factors, but these products provide a statistically significantly reduced chance of edge bonding occurring and therefore lowering the incidence of timber failure.

Be Extra Careful With Brittle And Weak Timbers

Although any timber can experience failure from the correct combination of above EMC timber, adherents present, and the type of coating, it is much more prevalent on the brittle and weak across-grain tensile strength timbers such as:

- Pines of all types, especially lower grades with high knot content
 - Timber that may have been over heat exposed
 - Existing timber may have absorbed years of abuse or structural variance.

Determine If Any Increased Building Temperatures Or Reduction In Humidity Will Occur Within The Few Weeks After Coating.

eg will a room air conditioner or a space heater be used ?

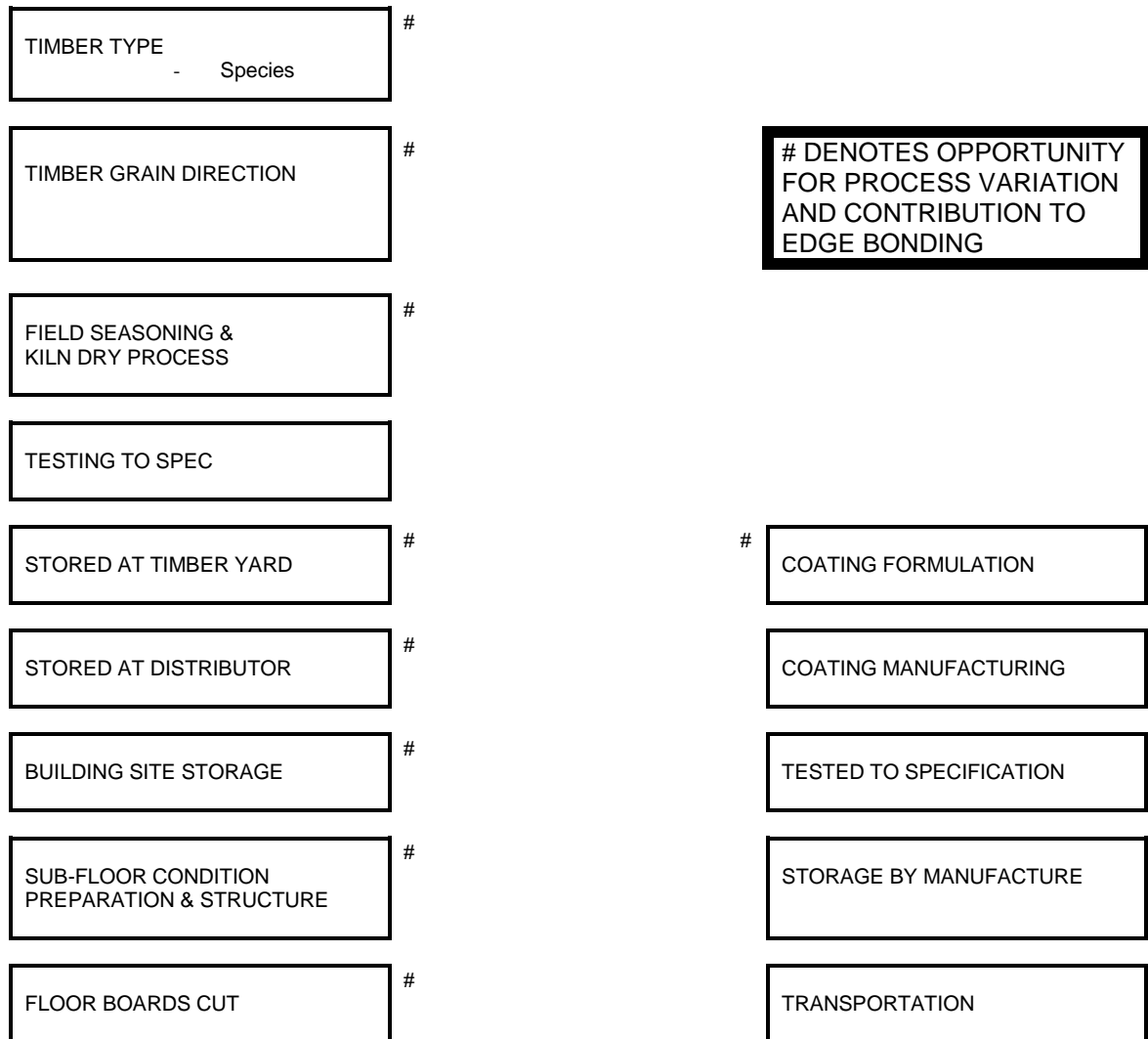
A rapid change in building humidity or temperature **WILL** cause a high **RATE** of shrinkage of the timber, and if this rate is greater than that which structure can accommodate movement, or the finish can slowly stretch to, then edge bonding can occur.

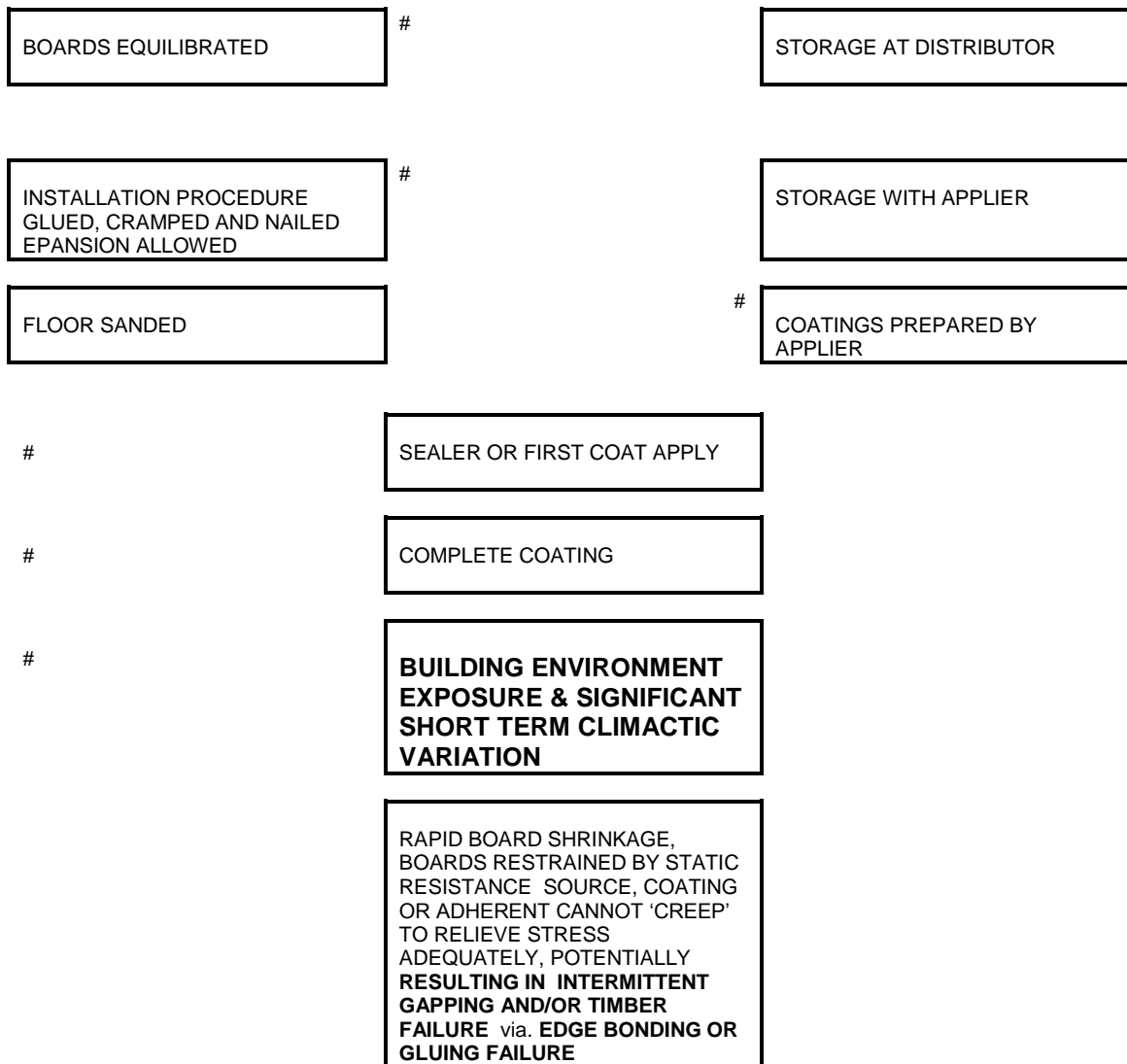
FINAL ADVICE

This technical bulletin on TIMBER FAILURE is a complex piece of information, but through our sharing of knowledge and the following of the enclosed advice, the exclusive use of Polycure products as specified, AND YOUR COMMUNICATING WITH YOUR POLYCURE SPECIALIST WHEN IN DOUBT, you should be prepared enough to avoid experiencing a timber floor failure (edge bonding).

PLEASE CONTACT POLYCURE'S TECHNICAL SERVICE DEPARTMENT OR YOUR LOCAL POLYCURE BRANCH FOR FURTHER FREE ADVICE.

PROCESS FLOW - TIMBER FAILURE





EDGE BONDING FAILURE - INFLUENCES IN SHORT

Some of the more obvious contributors to an edge-bonding situation are listed here and may ultimately help identify where a problem has stemmed from, help alleviate it, or assist in avoiding reoccurrence in future projects/installations.

- Excessive/high moisture content. Timber by nature is hygroscopic (varies in moisture relative entirely to environment) and the younger less “dense” timber used today is more susceptible to a greater range of variation. This is why handling and storage at “all” levels of distribution is far more crucial than ever before. It only takes a slightly higher than specified moisture content to generate quite significant movement with the onset of habitation, or unusually warm weather conditions.
- Often forgotten even a timber sub-floor can be influenced by moisture variation and also influence erratic timber movement. As can the type of timber and fixing methods ie an under specification nail or staple may not fix suitably to some timber substrates especially under the duress of movement. Also in older installations or new installations over old sub-floors it is crucial that the sub-floor is structurally sound as degeneration may result in yet another source of timber movement.

The information in this Technical Bulletin represents typical values. Application variables affect product performance therefore this information should be used as a guide. The user must satisfy themselves as to the suitability of this product for their requirements. Mirotone assumes no liability for use of this information.

A concrete sub-floor must obviously be checked for moisture, or be isolated via moisture vapor barrier prior to any timber installation. In both sub-floor types it pays to look for any "new" moisture sources, and ensure significant sub floor ventilation is present and free from obstruction prior to beginning or finalising works.

Also be wary of processes during a renovation, as the environmental change can/will effect existing timber installations. For example a major extension will expose flooring to environmental variations not present during its previous situation. Old timber is still hygroscopic and will absorb moisture when present ie during building works, and will shrink/move when environmental considerations vary "again". Seal or isolate the original living area as best as is possible during these works to minimise the impact of variation.

- Fixing of timber is more complex than it appears and a professional "experienced" installer (carpenter/builder/flooring contractor) should be utilised as installation "must be to specification", and all aspects of such considered (especially with "secret nailed" profiles).

For example many carpenters, builders, installers may run a "bead" of glue across joists and/or along T&G joint when laying flooring, this will in fact "glue" the boards and create the same visual effect as that increasingly blamed on the coating. Adhesives such as "liquid nails" provide an excellent almost impervious bond, however when the floor wants to move, a break in the "bead" or a split groove joint will become the weak point where the stress will be released = Edge bonding failure.

Similarly it is impossible to provide an utterly uniform fix between nail, timber, and timber, across a floor therefore some will be better fixed than others (especially apparent where nail or staple *fixing* guns are used) and will move unevenly when stress becomes apparent. This movement will be directly relative to the amount of moisture present at fixing and its variation in the short to medium term future.

Even minor aspects like a tightly fixed or even glued skirting board or doorjamb can provide enough stress to promote unevenness or restriction in free timber movement. Ultimately this can lead to unsightly gapping or even "edge-bonding". Timber maybe laid hard up against the side of a wall stud or plate, its invisible in a finished building, its an adherent, it can be responsible!

- Also check that installations where ceiling to floor or large exposed windows are apparent that the recipient of the floor understands the potential consequences of this situation, and that the precautions are in place ie curtains, shutters.
- Floods and flooring do not go together. After a washing machine, dishwasher, or drainage mishap, expect movement to some degree – depending on exposure.
- Ensure that your timber is handled carefully as each potentially damaging impact will result in a weak point that may be come a point of edge bonding failure. A) Don't use excessive force to join boards ie T&G joint may fracture = weak point. B) Hand unload timber. "Bailing" or rolling a pack of timber of the back of a truck 4 feet to a concrete footpath or driveway will cause "multiple" weak points. C) Ensure timber was wrapped, dry, undamaged, and if possible within moisture content specification at delivery.

NOW WHAT?

- At the advent of a complaint always check for any circumstance that may suggest a starting point for change in an environment ie massive/significant climactic change. One example may be where a floor installed in "July" (winter) and is exposed to a high equilibrium moisture situation, and an adherent or unevenness of stress in some form is present at points within in the flooring structure. In warmer months (summer) via excessive weather conditions or via closure of the dwelling, the environment under goes severe variation and the moisture content of the timber varies accordingly. This can lead to high-rate short-term shrinkage and ultimately result in a "timber failure".
- Also look for any obvious weak points in the timber, shrinkage or cupping, poor installation or handling procedure, current moisture content (a guide for previous moisture content ie at installation), additional fixing (skirting), and check sub-floor ventilation and moisture content.
- It is at the suggestion of members within the timber industry that a "new" or "modified" timber installation can take between 1 and 2 seasonal cycles (2 years) to settle to a point of minimal seasonal movement.

Therefore it is suggested that where possible a “failed” floor be allowed at least the one cycle before any “remedial works” be undertaken. At this point repairs, filling and coating, or just recoating are more likely to provide a long-term solution than short-term patch ups that will potentially create other problems if instigated too quickly. For example it is expected that a shrinking floor will “rehydrate” or “grow” to some extent with the onset of winter or moister months, this may completely fix gapping problems. Therefore premature remedial works may become undone in a very short period of time and become an expensive waste of time and money.

- Refer to a flooring professional to provide “individual” appraisal of a sites particular rectification procedures and timings required. Get more than one opinion where possible as it can be a complex matter.
- At all times remember the beauty of timber comes with the fact that it is a natural product, and with any natural product it is worth remembering that there is only so much that can be done to control its behavior. Unless we respect this fact at all points in the supply, installation, and ownership it is likely that at some stage it will gently remind us of any ignorance either intended or otherwise.

CONCLUSION

To add perspective to the coating side of this phenomenon, in 1999/2000 Polycure Pty Ltd produced enough of a single coating product to coat several million square metres of Australian flooring with three coats. That’s 10,000 average 100m² projects for every million square metres coated. Each batch of this coating passed stringent quality control to a) ensure the absolute premium quality of Polycure products and b) ensure that they were “**all the same**”.

Only a handful of timber failure (through edge bonding) situations were reported to us in this time. Should the coating be the major contributing factor to this phenomenon as some timber related industry segments imply, then common sense tells us that the instance of coating driven timber failure (edge bonding) would be closer to the 100% mark than the “fraction” of a percent that it is.

We suggest that due to the relatively low instance of this phenomenon and the fact that we (and our coating industry competitors) have been unable to replicate this problem in a controlled environment, a lot more research into best installation practices is required. Remember we have been using the same coating formulations for 20 years and only experienced concerns such as timber failure recently, usually due to inadequately processed or incorrectly installed timber.

If any further information is required please contact Polycure or your Polycure stockist.

This document supercedes any previous Polycure bulletins on this or any related subject, as they may not be representative of the current level of information currently available regarding this phenomenon. This document will replace all previous issues in technical data manuals.

www.polycure.com.au