



# DRIVE Marine Services

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## WHY CLEAR COATINGS FAIL

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Have you ever wondered why varnished surfaces need constant attention or it breaks down readily, and whether there is a better way to achieve a long lasting clear finish for timber which is constantly exposed to the environment in exterior applications. The following information is provided based on well founded research after years of listening to people that think they have the best finish, and some who have published misinformation as they do not have the ideal product range to achieve a long term durable finish.

This information is directed at the DIY and professional boat builder, but is equally applicable to the woodworker or home owner undertaking exterior clear finishes to a house or furniture. The reference material used in developing this information was sourced from "Why Exterior Coatings Fail" by the US Forest Products Research Laboratory (available at [www.BoatCraftNSW.com.au](http://www.BoatCraftNSW.com.au)) and testing by BoatCraft Pacific. BoatCraft Pacific had samples of timber coated with three (3) coats of Bote-Cote Non-Yellowing Marine Epoxy resin and then three (3) coats of clear AQUACOTE Topcoat placed on test panels at Townsville for the equivalent of seven (7) years with no maintenance and with minimal loss of gloss evident at the end of the test.

The failure of coatings is dependent on a few things, most commonly:

- Exposure to moisture. and
- Exposure to Ultra Violet (UV) rays as the primary causes.
- Type of coating applied.
- Inadequate / Incorrect preparation.
- Sharp corners / inadequate radius.
- Coating damage and joint cracks.

**Note:** *Although the information in this document is directed towards clear finishing timber, it is equally applicable to painted surfaces.*

### **Exposure to Moisture**

Water molecules are extremely small and moisture will permeate through most things given enough time. Have you ever had an annoying leak onboard or in a bathroom that was the bane of your life trying to eliminate it. Well, Bote-Cote Marine Epoxy (not all epoxies are waterproof) is the closest thing to waterproof available. Having timber sealed in Bote-Cote Epoxy is the first step in creating a waterproof barrier, and stabilising timber, all but stopping expansion and contraction due

to moisture content variation. This can be substantially greater than thermal effects, witness how a wooden clinker boat left out to dry can have 2 or 3mm gaps between the planks which take up when it is returned to the water.

Not all coatings are waterproof and moisture migrates through the layers of many types of paint causing expansion and contraction. Upperdeck brightwork on a boat is the worst case scenario. The moisture can also migrate through from underneath if the underside or interior of a hull is not preserved or the surface is damaged.

### **Ultra Violet Rays**

Ultraviolet light is the enemy of all finishes, especially clear timber finishes. UV light attacks the coating or varnish itself, as well as the underlying timber. The surface cells of the timber break down, and the coating attached to them then flakes off. UV filters in the coating help retard this process, as does the Bote-Cote soak coat, which helps to bond the timber surface together. However, standard Bote-Cote itself, in common with all other epoxies, yellows and chalks under UV light and weathering, and is not suitable as an exposed exterior surface, so it must be covered by further protective layers such as Aquacote. Even Aquacote, which has excellent UV resistance, will allow the timber substrate to start to deteriorate after two to three years as the UV stabilisers are depleted and the surface gloss will start to dull after four to five years. Therefore, recoating should be undertaken before the gloss levels fade significantly.

### **Type of Coating**

The main types of clear coatings used in marine and outdoor applications are;

1. **Oil Based Varnishes** – Most are only 60 to 65% waterproof and unless there are 6 to 8 coats applied, they start to fail by cracking in six (6) to twelve (12) months, if not sanded and recoated. The reason they fail in a relatively short time is that the moisture finds its way through to the timber which causes increased expansion & contraction due to the daily temperature and humidity changes. The other limitation of varnish is that the oil leaches out as it ages and it becomes more brittle; the result is cracking as it becomes too brittle to handle the expansion of the timber as the moisture level increases. By sanding and applying fresh coats of

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varnish regularly it rejuvenates the surface to keep it supple. The other limitation of cheaper varnishes is that they yellow off or darken as they age. With modern coatings available, they should be relegated to interior use only unless you have a love of sanding and the smell of freshly applied varnish.



**Figure 1-** Varnish Breakdown on Teak

**Note:** *The timberwork in Figure 1 is normally covered with specially made Sunbrella covers when not in use which shows how moisture was the significant influence of deterioration, not UV on varnished surfaces.*

**Oils** – Oiling timber is probably the easiest way to maintain a good durable long term natural finish on timber as long as you are happy to re-oil the surface every three to six months and do not want a high gloss finish. It is also the easiest finish to recover if it is allowed to degrade and fails.

**Note:** *Unfortunately many oil finishes develop black mildew stains, which become very unsightly and are difficult to remove.*

2. **Two Pack Polyurethanes & Estapols** - Most are about 80 to 85% waterproof and depending on the number of coats (at least three are recommended) moisture will permeate through over eighteen months to three years, depending on the thickness of the coating, unless the surface is sanded and additional coats applied every twelve to eighteen months. Even Aquacote Topcoat will fail in two to three years in full exposure without recoating. The advantage Polyurethanes have over varnish is that they have very good UV resistance and set extremely tough and are very hard wearing. They remain supple, but they fail by the coating lifting off the surface as the moisture that penetrates through degrades the timber at the bond interface.

We do not recommend applying polyurethanes direct to timber for exterior applications due to the difficulty of removing it once the coating fails.



**Figure 2 -** Teak Drink Holders with Polyurethane breakdown

3. **Marine Grade Epoxy Resins with Non Yellowing Hardener** <sup>(1)</sup> – These Epoxies have excellent preservation qualities and are the closest thing to waterproof available as a coating. Bote-Cote Marine Epoxy Resin is over 99% waterproof <sup>(2)</sup> and with three (3) coats applied to all surfaces ensures a waterproof surface for many years.

The problem with Clear Epoxies in an exterior application is that they have inadequate UV resistance. They will dull quickly, go chalky, and break down over several months if left in full sun. The result will be similar to varnish if they are not protected with a UV stable coating such as Aquacote Topcoat which has excellent UV and wear resistance.

**Note: 1.** *Not all Epoxy manufacturers have a Non Yellowing (NY) hardener. Most epoxy hardeners have more economical ingredients which will yellow in full sun even with a UV stabilised coating sealing it.*

**2.** *Other brands have not been tested to determine their degree of waterproof. Check manufacturers Technical Data.*

**3.** *Be mindful some varnishes and polyurethanes do not adhere well to epoxy and some can be easily peeled off.*

**4.** *Yes, there are Epoxy Paints, but they are loaded with pigment and UV stabilisers to make them last a few years. They are mainly used for interior waterproof coatings e.g. inside steel tanks. As soon as the surface dulls and becomes chalky, it is no longer waterproof.*

4. **Clear System** – The ultimate exterior finish consists of three (3) coats of Bote-Cote Non-Yellowing Marine Epoxy resin and then three (3) coats of clear AQUACOTE Topcoat which ensures several years of protection with minimal maintenance. To maintain the

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surface in good condition we recommend lightly sanding the surface every two to three years and applying another two coats of Aquacote Clear Topcoat to ensure continued good UV resistance and the surface remains in pristine condition. If you are like me and get sidetracked, at least keep an eye on the finish and if it starts to lose its gloss, get a couple more coats of AQUACOTE on as it is telling you the UV stabilisers are depleting. If not recoated at this stage, there is a good chance the surface will break down.



**Figure 3** – Runabout brightwork finished with the Clear System

### **Inadequate & Incorrect Preparation**

Applying coatings to weathered timber can lead to premature failure as the coating cannot form an adequate bond. Even prepared surfaces left from a few days to a couple of weeks, is too long. This is even more critical with oily timbers and some Australian eucalypts such as Red Gum and Jarrah as their longevity when harvested or in the wild is due to an oxidising film which develops on the sawn surface in a short period of time. These timbers need to be sanded with the grain immediately before coating to remove the oil or oxidation and we recommend this technique for all timbers. Also, inadequate sanding and cleaning of previously coated surfaces can cause peeling due to inadequate adhesion.

**Note:** *Be mindful that oily timbers such as Teak & Huon Pine and many Australian eucalypts (where the surface oxidises to protect it) should be coated as soon as the surface is sanded to ensure good adhesion. Even 1 hour can be too long.*

Another cause of poor adhesion can be from steared sandpapers. The following hint comes from Courtaulds Paints Ltd as published in their in-house magazine *Waterline*, and is headed 'Steared Sand Papers'. "When using steared sand papers, or so called non-clogging papers (they are visible by their colour which is usually a light grey) beware! They can leave a residue on the surface that can be a very effective

*release agent for your next coat of paint. If using them, ensure that you solvent wipe well to remove any possible contamination". We suggest you simply avoid steared sand papers altogether, and do not solvent wipe a clean sanded surface. Use Red, green or yellow coloured sanding materials and keep a good quality wire brush handy to clean the disc if it starts to clog. I know sanding is a pain in the neck, but remember all of the effort is in the preparation. Ask us for an information sheet on Peelply if you want to save effort on sanding and improve your epoxied finish.*

Timber (and epoxy/fiberglass) should be dry sanded with 120 grit paper before applying epoxy seal coats. Sand down to at least 180 grit before applying Aquacote, and at least 240 grit when sanding between coats of Aquacote. We also recommend finish sanding with a green scourer pad as it lifts residual dust and provides a good fine finish. Try using it with your random orbital sander.

### **Sharp Corners / Inadequate Radii**

Sharp Corners or small radii are a recipe for coating failure as the surface tension of the coating tends to pull away from corners leaving a thin layer. Also you will tend to sand edges more due to the reduced area. Large radii are good with 10 to 12mm, being ideal with 3 to 4mm being the minimum. Also, when applying sealing coats; apply two or three extra coats to corners and edges to build up adequate thickness for sanding prior to the topcoat.

### **Coating Damage / Joint cracking**

The final reason for coating failure is cracking at joints which is an indication of a design or construction problem. This needs rectifying or the coating will continue to fail. Epoxy is the ultimate adhesive and loves gaps, but at highly stressed joints it may crack, or more frequently the timber or fiberglass cracks alongside the (stronger) glue line. Coating damage can occur even when owners take the greatest of care. You need to resolve the stress issue before the coating failure can be resolved. This may require the services of a qualified shipwright or naval architect to provide the solution.

Using Bote-Cote with AQUACOTE Clear top coat is easy to repair as they are totally compatible and adhere to each other extremely well.

- Damage back to the timber – Dry sand the area back to good timber and apply three coats of Bote-Cote

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with non yellowing hardener and sand level to the surrounding surface then apply three coats of Aquacote over the sanded area.

- Damage back to the Epoxy – Dry sand the surface to fair into the Bote-Cote and remove the scar. Overcoat with a minimum of three coats of Clear AQUACOTE Topcoat.
- Scratching / scuffing of the Aquacote – Sand the surface with warm to hot soapy water with Wet N Dry 320 / 400 grit and recoat with at least two coats of Clear AQUACOTE Topcoat.

**Note:** *If the topcoat has not been recoated for a couple of years, it may be worth applying Clear AQUACOTE Topcoat over the entire surface.*

### **Proof is in the Finish**

Figures 4 & 5 are two interesting photographs of brightwork in the cockpit of the 70 foot yacht, El Karim. Additional photographs of the brightwork can be seen at <http://elkarim.com/photo-gallery.php>. The surfaces were prepared with three (3) coats of Bote-Cote with NY Hardener, followed by three (3) coats of Aquacote Clear approximately six (6) years ago. Since then the boat has been across the Tasman 4 times, Fiji, Vanuatu, New Caledonia several times and now back in Australia. No maintenance has been carried out to this brightwork.

Figure 4 showing the winch is very telling as it shows where the sheet has rubbed over the brightwork and damaged it, which allowed moisture and UV rays to penetrate. You can see how the water is moving further under the coating, causing oxidation and damage to the timber and the de-lamination of the coating is spreading. The damage is absolutely confined to the locality of the failure of the protective film, which allowed moisture to enter. It is also pretty apparent that the degree of sun access to the area under the film which is failing is not a factor.



*Figure 4 – El Karim Clear system localised damage*

The other photograph is a spare winch pad which clearly demonstrates just how well the system holds up after 6 years. It is perfect, showing no signs of failure where the timber has remained sealed and therefore dry.



*Figure 5 – Spare Winch Pad in good condition after six years exposure using Clear System*

In summary, if you enjoy sanding and painting use varnish or oil for exterior timber protection. If you want to spend less time sanding or are time shy use the clear system for a long lasting Clear finish.

One last piece of advice, do a section you can complete in two or three days. Do not try and do the entire boat in one go. Also there are some good techniques for removing old varnish and sealing around stainless steel uprights etc. Give us a call.

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