

## Replacing the Floorboards in a Beneteau 445

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My wife, Susan, and I purchased our Beneteau 445 in June 1995 and placed her in the Moorings charter fleet in St. Lucia, in the Windward Islands of the Eastern Caribbean. In March, 2000. Three friends sailed Windward Passage with me via Bermuda to the Chesapeake Bay where we secured a slip at North Point Marina in Rock Hall, MD which has been our home port for 20 years now. We chose this location for its direct access to the Bay where we have enjoyed unforgettable cruises of all kinds including several August trips to Penobscot Bay in Maine.

Randy and crew of four friends sailed Windward Passage offshore to Tortola, BVI in 2007, 2009, and 2011. Each time Susan then flew to Tortola to join me we and we lived aboard for 7 months while exploring Eastern Caribbean Islands from St Thomas to Grenada with many friends who joined us for a week or two. Following every exciting Caribbean journey, Randy and a crew of friends sailed back to the Chesapeake Bay.

Windward Passage has more than 35,000 nautical miles under her keel. After 25 years of active sailing, several of the laminated plywood floorboards suffered water intrusion with accompanying rot. Replacement boards were not available from Beneteau, so I decided to make them myself.

The original floor had a laminate with a teak and holly stripe pattern shown in Figure 1. I was unable to find



Figure 1 Original Floor

laminated with the original pattern but found a beautiful teak and holly vinyl material made for use on boats and is sold by PlasTEAK, Inc. in Copely, OH. Their pattern is slightly wider than the original so replacement of only a few of the damaged boards would not look good. I wanted to replace the entire floor, so this was not a problem. The most severely damaged boards were in the area around the mast step and the bilge sump. I decided to start with four boards from this area to see how difficult the job would be and to develop a technique for duplicating the existing boards. I purchased four feet of the vinyl flooring (six feet wide) and a quart of glue from PlasTEAK and one 4x8 sheet of marine plywood from our local lumber yard.

The technique for duplicating the boards was to trace each board onto the plywood using a marker that gave a tracing about  $\frac{1}{4}$ " larger on each side than the original board. Using a hand-held saber saw I cut out each board along the traced line. The original board was then clamped with at least two clamps to the slightly larger new board. A router was used with a laminate trimming bit (with a bearing at the end of the bit that is the same diameter as the cutter) to route the excess material from the new board by having the bearing pressed against the old board. On the larger boards I used several clamps and moved the clamps as I routed around the perimeter. This resulted in the new piece being an exact duplicate of the old piece. I quickly learned that, if there is a chip or groove in the old piece, it will be duplicated in the new piece! I had to either repair the chip with wood putty before routing or carefully control the router in the area of the defect to make a smooth edge. It pays to mark each board with an identification number and to designate which surface is to be the top to which the vinyl will be glued. To ensure the stripes in the vinyl laminate are oriented correctly, I also marked each board to indicate the forward edge.

The new board was then placed on the vinyl, paying attention to the location and orientation of the stripes, and the perimeter was traced about  $\frac{1}{4}$ " larger on all sides and the vinyl was cut and glued to the new piece.

After the glue dried for 24 hours the router with the laminate trim bit was used to trim the excess vinyl – this time the bearing on the bit was against the new board. Since I wanted the stripes to align the length of the floor, including in the transition between cabins, care was required when cutting and gluing the vinyl to subsequent pieces once the first piece was done.

I was quite pleased with the four test boards and decided that the project was doable. Since there are 25 separate pieces in the floor. I needed a plan that I could refer to for estimating material requirements and documenting the status of each piece during production. Using the Microsoft Powerpoint program on my computer and a scanned image of the interior of a Beneteau 445 from the sales brochure in my files I drew the approximate shape of each piece and coded each one as shown in Figure 2. The pieces labeled D1, D2, D3, and D4 are the test pieces. The remaining pieces in the forward cabin were labeled with the prefix “F”. Those in the main cabin had a prefix “M” and the two aft cabins had a prefix of “P” or “S” for port or starboard.

When calculating the required amount of wood, it is important to that the rough-cut piece must be slightly larger than the original. Likewise, the stripe alignment must be considered when the amount of vinyl sheeting.

To minimize the waste of expensive plywood I used Powerpoint to piece to scale and then copied each drawing onto similarly scaled four 4x8 sheets of plywood. Using this technique, I was able to draw drawings of pieces around to minimize the waste of plywood and cut all 25 pieces from four sheets of plywood.

Estimating the amount of vinyl needed was complicated by the pattern. Again, I used a scale drawing but used rectangles to each piece and added 2.5” to the width of each piece. I then oriented each piece in the fore and aft direction and copied the images to a scaled sheet of vinyl that was set at a scaled width of six ft. The resulting length of vinyl required was 24 ft. The glue coverage is touted as 45 - 50 square feet per quart. I found it to be accurate and ended up using four quarts.

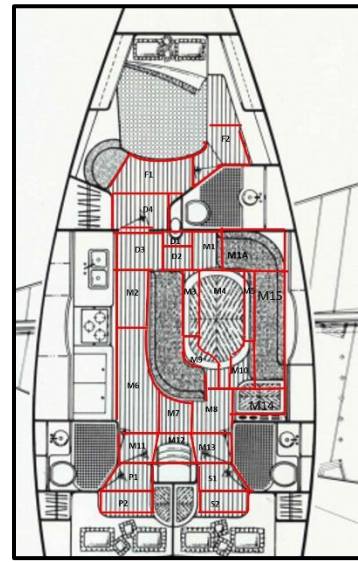


Figure 2 Layout of Flooring Pieces

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Figure 3 Trial Fit of New Boards

Once I acquired the materials, I removed all the floorboards and took them home to be duplicated. It took two long days to cut the 25 pieces. The new pieces were then installed in the boat for a trial fit. As shown in Figure 3.

Several of the boards had a 1” diameter hole to allow them to be easily lifted when installed. I drilled these holes with a brad point bit before I glued the vinyl to the board. Epoxy sealer was applied to the interior wall of the hole. Then, when the vinyl was glued on, I drilled through it. These holes can be drilled with a hand-held portable drill, but it is difficult to manage with this large a bit. I used my drill press and obtained a smooth, neat edge for the hole in the vinyl.

To access two of the boards I would need to remove the navigation desk and one of the large storage lockers and I decided to hold off

on fitting these boards until the end of the sailing season. Both boards were cut as oversized rectangular shapes that were wide enough to be able to match the stripe pattern when cut to their final dimension.

Once satisfied with the fit I labeled each board on the bottom to correspond with the Layout Plan. I then applied two coats of West Epoxy sealer to the bottom and edges of each board using blue painter's tape to minimize the amount of epoxy on the top of the board. Bill Gribble, the technical advisor at PlasTEAK had advised me that the glue would adhere much better to bare wood than to epoxy so I sanded away any epoxy that seeped under the tape on to the top surface of the boards.

Once all the boards were sealed, I laid them out with the boards I had developed in my initial test so that I



Figure 4 Layout of New Boards for Alignment

could start the difficult orientation of the lines in the vinyl covering (Figure 4). Using the board from the forward port side of the main cabin from the test group (part D4 in Figure 2) as a starting point I aligned the edges of the new adjoining board and carefully marked the location of the vinyl's narrow lines on the test



Figure 5 Alignment of New Vinyl Pattern Stripes

board with the adjoining edge of the new board (Figure 5). The marked board was then laid out on the vinyl sheet and the markings were aligned with the lines on the vinyl sheet, being careful to keep the lines parallel to the edge of the board. Then the perimeter of the board was traced onto the vinyl sheet with a marking pen held so that the line drawn was about  $\frac{1}{4}$  inch away from the board (Figure 6). I used a permanent marker pen that had a wide felt tip. When I made a mistake, I thought I had ruined a large piece of vinyl, but I discovered that methyl ethyl ketone solvent removed the bad marking without doing any apparent damage to the vinyl.



Figure 6 Cutting the Vinyl

The board was then removed from the marked sheet to cut the vinyl. My first cuts were done with a pair of industrial scissors, but I quickly learned that a box cutter razor knife worked better for me. I developed the technique of lifting the sheet about an inch off the linoleum floor and starting the cut. Once started, the knife easily cut the vinyl as the cutter is pulled down the perimeter line while keeping the vinyl lifted off the floor so that the knife did not cut into the linoleum floor below. I found this technique to be easier than trying to cut the vinyl while it was flat against a sacrificial cutting board. Since the lines on the vinyl were  $\frac{1}{4}$ " away each of the board's edge, small deviations from the line did not matter so precision in cutting is not necessary.

To ensure alignment of the lines in the vinyl I laid all of the boards out as shown in Figure 4 and then worked with one board at a time, starting with the board aft of board D4 and working in a counter-clockwise direction around the area where the center console is located. With each new board I would align the stripes with the prior board then carefully mark on both the forward and aft edges the location of the stripes.

I found it helpful to not just mark the top of the board but to line markings down the edge of the board so they would be after the glue was applied to the top of the board. The glue says that the glue can be applied with a notched trowel but after with PlasTEAK, I decided to use a disposable short bristle brush to apply the glue (Figure 7). Once the glue is on the board you season for about seven to ten minutes before applying the the brush with water after each gluing application and found it reused. This was a significant savings since I was doing one time and could have gone through 25 brushes. I actually used brushes for the entire project.



Figure 7 Brushing on the Glue

extend the clearly visible instructions consulting (chip brush) need to let it vinyl. I rinsed could be board at a only two

When applying the vinyl, it is important to align the lines on the markings on the edge of the board before the vinyl sheet makes significant contact as it is difficult to move the vinyl once it has made contact with the glue. Unlike with contact cement, it can be moved slightly, but it pays to get the sheet aligned as accurately as possible before a major part of the vinyl surface is in contact with the glue. Having the location of the lines marked on both the forward and aft edges ensured that the alignment is correct. This is especially important for the odd shaped boards and those that do not have an edge that is parallel with the stripes. I found that it was helpful to have a second person assist with the positioning when working with the larger pieces. If all the positioning has been done correctly, there should be about ¼ inch of extra vinyl around all the edges that will be trimmed later, and the stripes should align with the adjoining board.

vinyl with the



Figure 8 Pressing the Vinyl with Laminate Roller

Once the vinyl is in place, it is important before the glue sets up to apply as much pressure as possible across the entire surface area to ensure a good adhesion. I used a laminate roller to apply the pressure as shown in Figure 8. It was helpful to be able to clamp the piece to the workbench during this operation as the smaller pieces would tend to move when the roller applied the pressure.

The glued pieces must stand overnight before attempting to trim the excess vinyl. I used the router with the trim bit (Figure 9) used earlier to match the new pieces to the old, but I raised the bit so that the guide bearing was in contact with the edge of the new board (Figure 10). This produced an excellent vinyl edge that was smooth and flush with the board edges. This trim operation could probably be done with a box cutter, but the router was much easier for me.

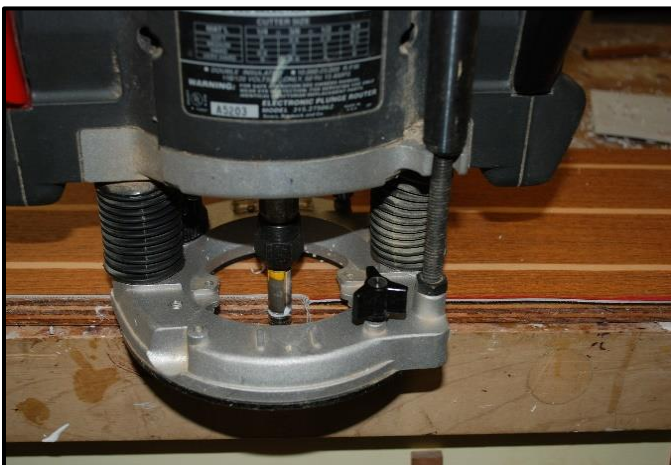


Figure 10 Trimming the Vinyl with the Router



Figure 9 Router Laminate Trim Bit

The seat and lockers on the starboard side of the main cabin and the navigation station desk had to be removed to replace the boards underneath them. They were screwed to wooden cleats that were screwed to the floor and walls. However, the center console contains the water heater and all of the fresh water plumbing and pumps. I elected to not remove all of this equipment. Likewise, the refrigeration system and galley that runs the portside length of the main cabin were not removed. This resulted in a narrow exposure of the old flooring along the edge of these pieces that I thought would be acceptable.

The 23 completed pieces were then installed and they all fit! However, the alignment of the stripes on one board was off by ¼ inch. I made a replacement for this board. I removed the navigation desk and locker and trimmed and fitted the two boards that had been rough cut. They were installed and the navigation desk and locker were reinstalled.

Once the entire floor was in place, I was dismayed with how the narrow trim of old flooring that had been left under the galley and center console stuck out like a sore thumb (Figure 11). I considered gluing a strip of the vinyl to these edges



Figure 11 Problem with Old Floor Showing



Figure 12 Painted Old Floor

but that would leave a raised trim. However, I was able to mitigate this considerably by sanding the exposed old floor and then painting it with a semigloss black paint (Figure 12). Another option would be to use flexible polyurethane quarter round, but this would require nailing or gluing it to the flooring or cabinetry and I did not want to do this.

Figure 13 shows the new flooring in the main cabin. My wife and I are pleased with the final result and feel it considerably upgrades the appearance of our boat. However, we now see that we need to refinish the old wood for the cabinetry to bring the rest of the interior up to the standards of the new floor. Every boating project seems to lead to “one more project”!

The total cost for the project was \$1648 as detailed in Table 1.

Table 1 Summary of Project Costs		
Item	Cost	Source
Four 4x8 sheets of ¾" marine plywood	\$400	Local building supply company
24 ft. of 6 foot wide PlasTEAK vinyl flooring	960	PlasTEAK, Inc. Copely, OH
4 quarts PlasTEAK vinyl flooring glue	80	PlasTEAK, Inc. Copely, OH
126.6 oz. West System epoxy 105 resin	100	Ace Hardware
27.5 oz. West System 206 slow hardener	55	Ace Hardware
West System Dispensing Pump set	23	Ace Hardware
Miscellaneous brushes, sandpaper, gloves	30	Lowes
<b>Total</b>	<b>\$1648</b>	



*Figure 13 Finished Floor in the Main Cabin*

Reflecting on the time for this project, I estimate that about 56 hours were required. About 30% (16 hours) of this time was spent planning the project, 35% (20 hours) cutting and fitting the boards and 35% (20 hours) applying and trimming the vinyl.

The tools used included a router with a trim bit, a saber saw, a random orbit sander, several wooden handscrew clamps, a drill (or, preferably, a drill press) with a 1" brad point bit, and a laminate roller. The epoxy and hardener were dispensed using the West System dispensing pumps and they gave accurate amounts of each component.