Finding the Breaking Point

After selecting seven popular caulking products representative of the four major sealant/adhesive types, we set up a six-step test procedure to compare adhesion, elongation, and the effects of immersion and cure time.

In the first round of tests, we used identical coupons (pieces) cut from a fiberglass (FRP) laminate, and placed identical size dabs of sealant on each test coupon in order to cement them to a base made of the same FRP laminate, mimicking a fiberglass-to-fiberglass seal, one of the best uses of such adhesive/sealants. Prior to the application of caulk, both contact surfaces were sanded with 100-grit paper and wiped clean with Interlux 202 solvent wipe. The coupons were placed sequentially on the FRP base and uniformly pressed until the sealant reached the edge of the coupon. A covering board and weight was placed over the entire seven coupons and left in place for 24 hours. Temperature ranged from 61 to 84 degrees during the curing period. Three weeks after the bonds were made, they were tested to failure.

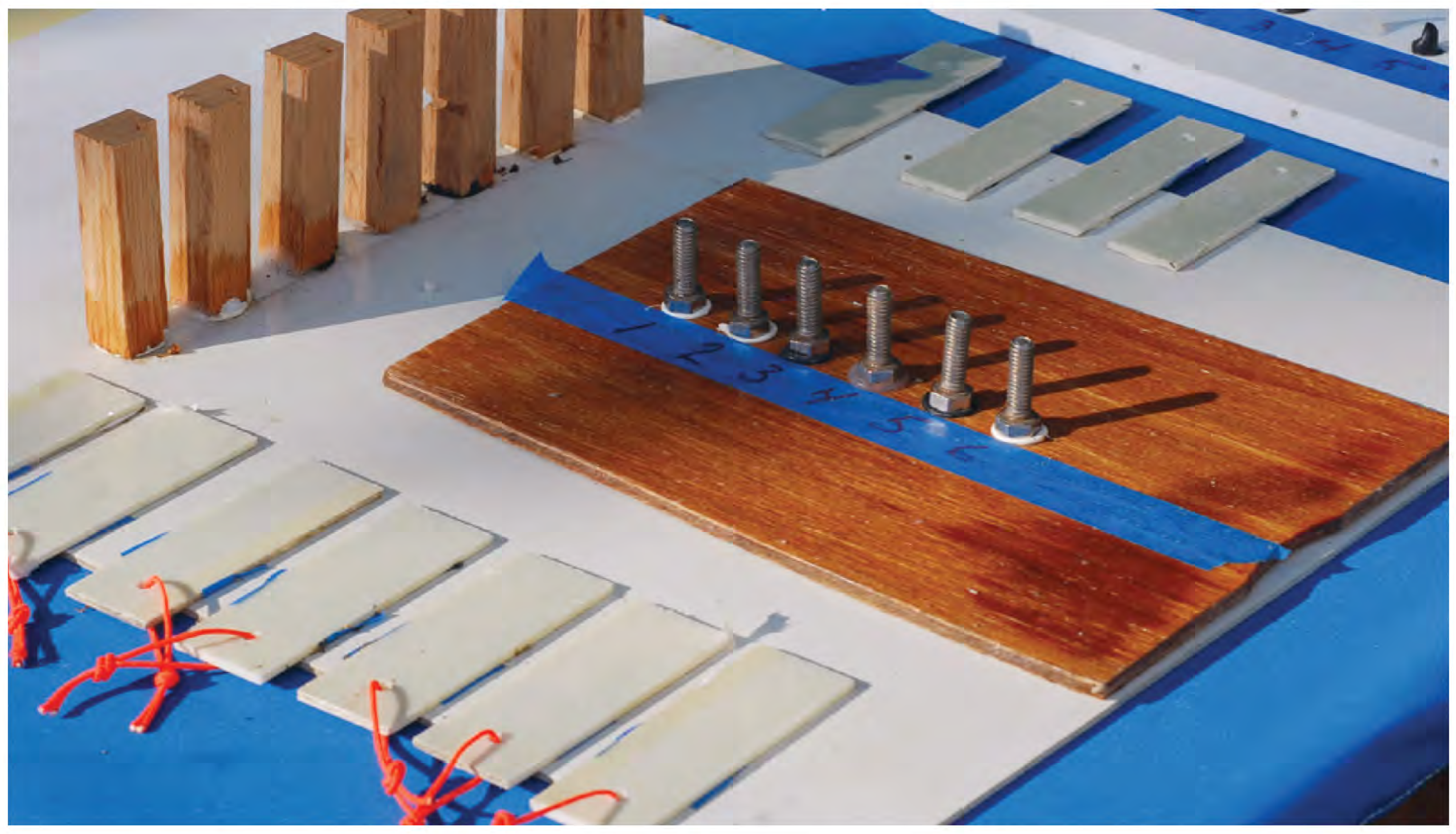
Each fiberglass coupon had a thin line inserted in a hole at the end opposite to the adhesive bond. The length of each coupon, and the position of the line attachment point was consistent on each sample. Tension was applied at this point causing the coupon to create a lever-like shearing effect across the bond. Tension was gradually increased until bond failure occurred. The load at the time of the bond failure was measured with an accurate spring scale; the numbers on the Value Guide reflect the maximum load (in pounds) each held.

In addition to shear stressing the adhesive bonds, we conducted a similar test with wood-to-fiberglass bonds. Three-inch-long oak segments were end-grain bonded to a fiberglass base, and using the same spring-scale pull to destruction process, each of the seven adhesive/sealant products were tested.

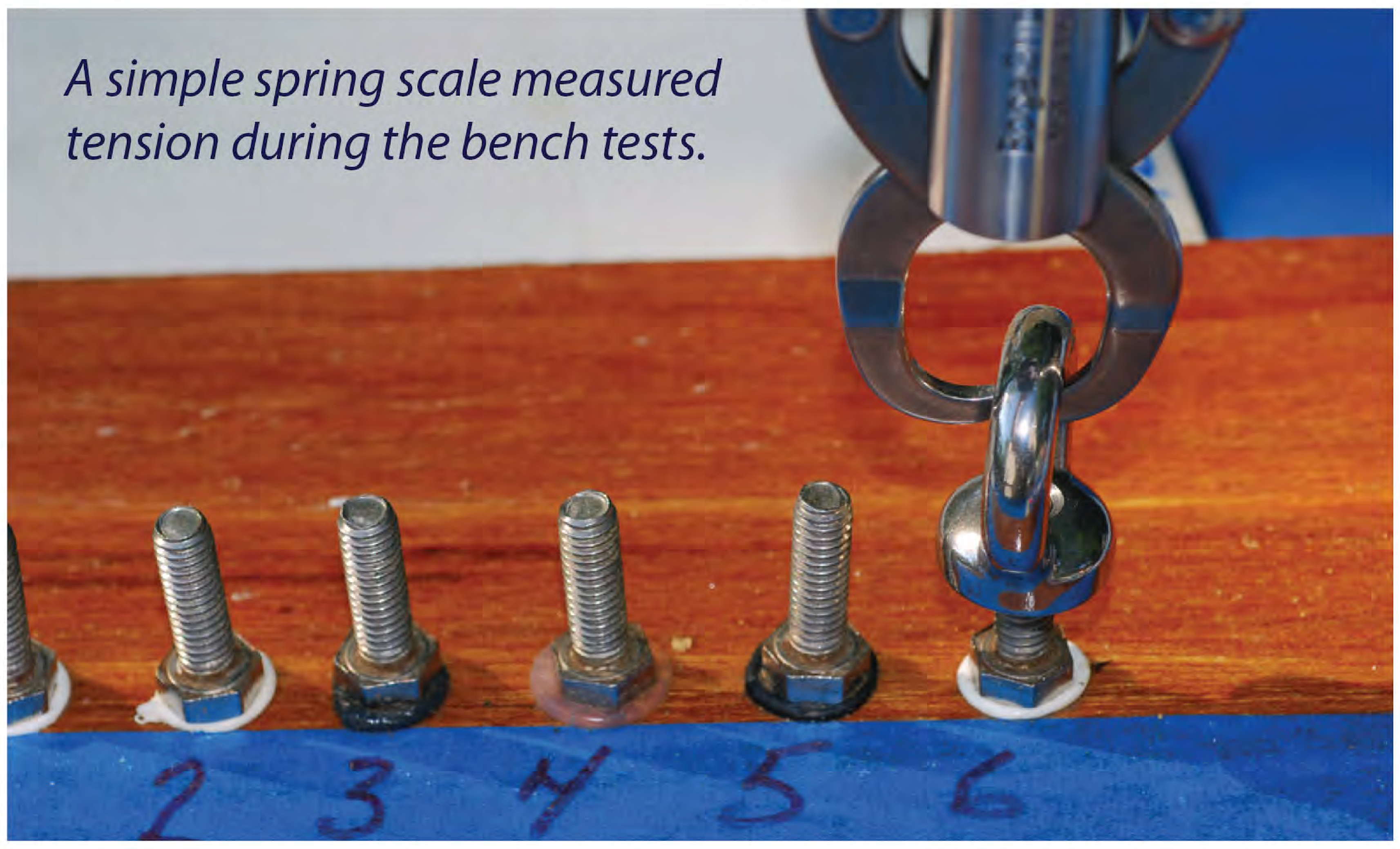
We followed this dissimilar material adhesion evaluation with a tension test of how well stainless and wood could be attached via an adhesive bond. Prior to placing a hex-head cap screw in a dollop of adhesive, we cleaned and degreased each with acetone and provided a rough wooden surface to act as the substrate.

The wood-to-fiberglass, metal-to-wood, and immersion testing followed a similar surface prep and material application process. We also included a Dacron-to-Dacron adhesion test to determine the value of these sealant/adhesives for emergency sail repair. None of the product manufacturers highlighted their adhesive as a sail repair product, but because Dacron-to-Dacron bonding is inhibited by fillers and cloth coatings, it made a good test of an adhesive's tenacity. We did not weight the result of this testing as highly as the others; it was more of an extra-credit assignment.

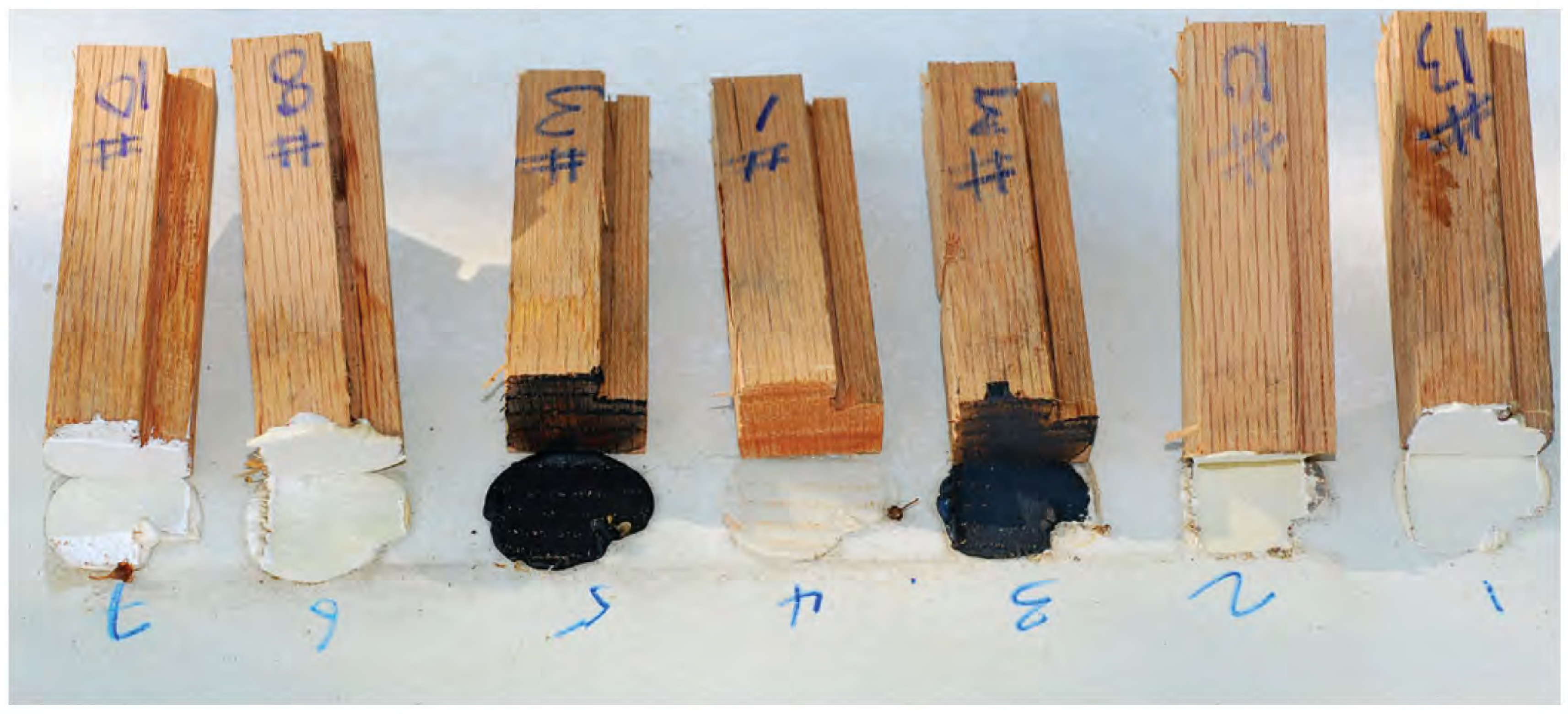
In order to enhance the validity and reliability of the testing, we repeated each battery of tests five times, dropping the high and low readings and averaging the mid-scores. Comparing these results with the mean, median, and mode of the full trial provided numerical correlation that did not alter the standing of winners and losers—a good indication of test repeatability.



Most adhesives are designed to bond to multiple substrates. To test the variety of possibilities, PS tested each product's adhesion on FRP-to-FRP, wood-to-FRP, and metal-to-wood joints.



A simple spring scale measured tension during the bench tests.



The wood-to-fiberglass (above) and Dacron-to-Dacron (below) tests put a zipper-like shear load on the adhesive joint.