

REPORT

2006 / 1

News about

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Surfboards and PRO-SET® Epoxy

Several months ago, Clark Foam, the largest supplier of shaped foam blanks for the surfboard industry, closed its doors. This closing has had a profound impact on the professional and amateur surfboard, kite board, snow board, and sail board builders. While some suppliers are stepping up to fill the foam blank orders, there are still concerns with the global supply of these blanks.

Expanded polystyrene (EPS) foam is an alternative to the foam produced by Clark. EPS foam is made in very low densities, but is a little more difficult to shape because it does not sand as easily. Another issue is that the styrene monomer in polyester and vinylester resins will melt EPS foam. So trying to apply reinforcing fabric to the EPS foam blank with polyester or vinylester resins will cause it to dissolve.

However, PRO-SET epoxy formulations do not contain chemicals that dissolve EPS foam. Some board builders have used PRO-SET 125 Resin for a long time. A number of hardeners in the PRO-SET line can be used with the 125 Resin. You can choose the hardener that provides the proper working time and cure rate for your working conditions. Currently the most common resin/hardener combination for applying reinforcing fiber to a foam blank is 125/226.

A recently developed custom resin/hardener combination also has potential to be useful to board builders. The M1006/M2006 combination provides good mechanical and physical properties with room temperature cure. M1006/M2006 has very low color, so using it for clear-finished boards is possible. The viscosity is about 800 cPs, so even though it is a little more viscous than the 125 combinations, it will still wet out the fabric very nicely.

Structural epoxy systems are generally not used as a final finish. They have very good chemical resistance, high mechanical properties, and provide very good tough-

ness, but structural epoxies are not UV stable. So a board that will spend much time outside should be painted, gel coated, or coated with an UV-resistant clear coat. If the board will be kept inside and taken outside only while being used, it will last a long time with no significant UV degradation. UV damage will generally begin as a yellowing or chalking of the surface. This surface damage has to continue for a long time before it will have a structural effect on the epoxy.

If you would like information about the PRO-SET products that can be used for board building, contact our Technical Support staff or ask for our PRO-SET literature on CD at 888-377-6738.



Doug Vickery of San Diego, CA, shows off two of the boards that he made with PRO-SET 126/226. A yellow dye was added to provide this distinctive color. Doug has been building boards for 37 years.

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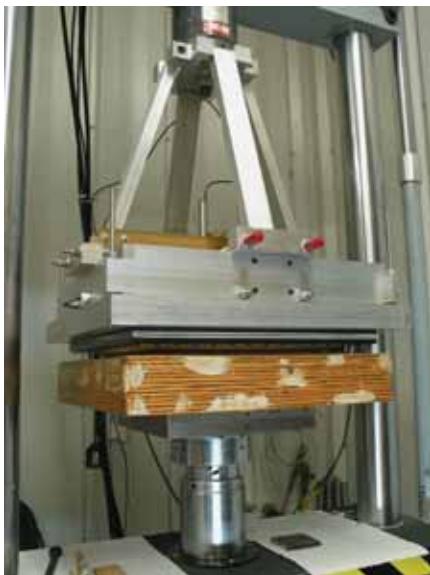
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Hydromat Testing Update

Significant effort is applied in our test lab to characterize the mechanical, physical and thermal properties of all PRO-SET® epoxy combinations. This information is then compared to laminate properties. This comparison can show how a particular epoxy's characteristics can impact the properties of the composite structure, which is important for both solid and cored laminates.

One of the tools used for this analysis is the Hydromat. This test method was developed and refined by our Chief Test Engineer, Bill Bertelsen, in the mid 1990s. The test method was approved as ASTM standard D6416 in 1999. This ASTM designation allows any competent lab to have the information necessary to perform the test and get repeatable results. One measure of the test's value is that the results can be duplicated and validated by another lab.

The test is a 2-Dimensional plate-flexure test for composite sandwich panels. At the heart of the test is a



ASTM D6416, Hydromat.

water-filled pressure bladder which transforms concentrated force from a load frame into a uniformly distributed (pressure) load, causing test panels to bulge without inflicting dents or dimples in their faces. The load is reacted by the panel support framework. Measurements of pressure

in the bladder, deflection of the panel, and total force applied provide data necessary to plot a load vs. deflection curve.

The test method has applicability in a number of industries. A very large Hydromat was built to test a composite bridge deck at the Georgia Institute of Technology. *(Photo below.)*



Georgia Tech Bridge Deck Test Facility.

This hydromat had to withstand internal bladder pressures of 120 psi and a total force of 60,000 pounds. At the other end of the spectrum, NASA's Glenn Research Lab needed a specialized design, with similar strength, to characterize the stiffness and pressure capacity of an extremely exotic sandwich laminate for construction of the combustion chamber of a new-generation, reusable rocket motor. The method has been used to provide valuable information for the boat building industry, aircraft and aerospace design, and infrastructure fabrication and repair.

Currently, Bill Bertelsen is leading a task group under ASTM Committee D30 on Composite Materials to make the Hydromat more user-friendly. The team includes Michigan Technological University (Houghton, MI), the University of Maine (Orono, ME), DIAB Divinycell (Desoto, TX), and Convergent Mechanical Solutions (Seattle, WA). The goals of the task group are twofold: (1) to use the Hydromat force, pressure, deflection, and surface strain data to calculate the 2-dimensional stiffness matrix of orthotropic sandwich panels, and (2),

to create a computer program to automate the calculations.

"Orthotropic" refers to panels with cores and face-sheets having higher physical properties in certain directions and lower physical properties in other directions, due to asymmetric fiber orientation. A good example would be a honeycomb-core panel with unidirectional, carbon fiber faces.

As refinement of the Hydromat method continues, it is done with one goal in mind: to create a better understanding of composite structures and the effect of PRO-SET epoxy on them.

M1002 Toughened Laminating Systems

Standard PRO-SET® epoxies exhibit significant toughness when properly cured. However, a number of epoxy combinations in the PRO-SET product line have been formulated with extra toughness for specific situations like high-peel and impact resistance, and for working with honeycomb core or where there is a minimal bond line.

The most commonly used toughened laminating resin in the PRO-SET Custom Product group is the M1002 Resin. It is compatible with all of the standard hardeners. Working times range from approximately 25 minutes with the M1002/224 combination to approximately 8 hours with the M1002/239 combination. The one hundred-gram pot life test ranges from 17 minutes with the 224 Hardener to 137 minutes with the 239 Hardener.

This resin is generally used when wet bagging carbon fiber laminates to honeycomb core. Significant increase in core bond strength can be realized

when M1002 is used. This resin is compatible with the rest of the PRO-SET resins, so switching back and forth between resins is fine. A common situation would be to use 145 Resin to build the bulk of the outer carbon skin of a hull. Then switch to M1002 for the last ply of that skin, and wet the core with M1002 as well. Bag the laminate and allow to cure. Then apply the inner skin using M1002 for at least the first ply of that skin. This method takes advantage of the high thermal properties of the 145 Resin while getting the benefit of the additional toughness where it is necessary, at the honeycomb core to skin interface.

If you are building bulkheads or structural members, where print-through is less of an issue, M1002 can be used for the entire laminate. Parts like these generally do not require the same high thermal properties that the outside of a hull does.

This resin was initially developed for a customer building very large Nomex-cored carbon bulkheads and structural members for a high-speed mega yacht. To determine the benefit of using this resin, a test program was designed that would allow us to identify the proper process timing and also compare several resin/hardener combinations at the same time. Flat panels were fabricated that were identical to the laminate that would be used in the parts. The first group of panels was made varying the time between completion of the skin and installation of the core and subsequent installation of the vacuum bag. All of the panels were cured with the same post cure and prepped for testing. Then the same test regime was duplicated with the M1002 Resin. The process timing that provided best results was the same for both resins.

The test used to identify the core bond strength is ASTM E2004-99, also known as the Facing Cleavage for Sandwich Panels Test. This test requires a trapezoidal specimen. Once the shape is cut out of the panel, the core is saw cut for 2 inches to ensure the failure begins at the core/skin bond line. (Figure 1.)



Figure 1. Detail of saw cut and steel tab.

Steel tabs are glued to the surfaces of the laminate so the grips of the servo-hydraulic test machine can grip and pull on the laminate. (Figure 2.)



Figure 2. Steel tab assembly.

As the skin is pulled from the core, the load is measured and described as pounds force per inch of specimen width. The best of the first group of samples had a pull force of approximately 25 lb/in. This is a reasonable result. However, the best of the specimens made with M1002 Resin generated more than 80 lb/in. (Figures 3 & 4.)



Figure 3. Samples after testing.

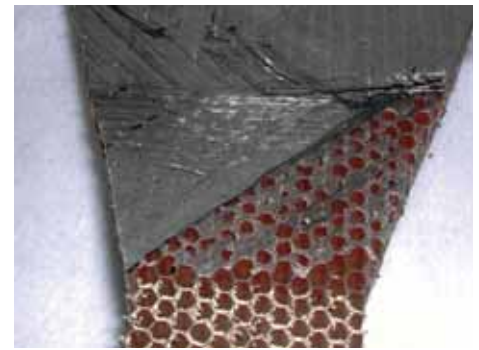


Figure 4. Detail of delamination.

As these samples failed, the break jumped from the core interface into the skin, causing the carbon skin to delaminate.

The table below shows the load carried by the various panels when subjected to the Cleavage test. Panels A and B were made with a thixotropic resin and panels C and D were made with M1002 Resin.

M1003 Thixotropic Resin		M1002 Toughened Resin	
A	B	C	D
18 lb/in	25 lb/in	60 lb/in	80 lb/in

Test results of ASTM E2004-99 Facing Cleavage for Sandwich Panel Test.

*All 4 panels were made using PRO-SET 237 Hardener.

The standard battery of mechanical, physical, and thermal property tests were also done to characterize the M1002 Resin with all of the standard PRO-SET hardeners. This testing along with the E2004-99 method validate the performance of this resin system. M1002 provides a very good combination of high toughness and physical properties.

For additional information on this resin, or any of the PRO-SET products, contact us to request the latest product data.

PRO-SET® Product Information Now Available on CD

The complete PRO-SET literature packet is now available on CD. The CD contains information on all of the PRO-SET products, including the newest standard products. A section also includes data sheets for all of the current Custom Product combinations. All of the Product Data Sheets are in PDF format, so they can be opened and viewed on virtually any computer with a web browser or a PDF reader.

The CD also contains a selection of photos of our customers' products. There are planes, sail and power boats, and even a spaceship included in the photos.

The files are arranged in a directory tree that is easy to follow, so the product descriptions and Product Data Sheets are easy to find. The PDF files are compatible with both PC and Macintosh computers.

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New PRO-SET® Mini Pumps

The 300-P Mini Pumps are designed for convenient and accurate metering of Group Size-00 and Group Size-0 PRO-SET 125 Resin and 226, 229 and 237 Hardeners. A conversion kit, available upon request, allows the use of these pumps on Group Size-1 packages as well.

The pumps mount directly on the containers and act as the seal for the containers when they are not in use. Made of polyethylene, the pumps will give years of dependable service.

One full pump stroke of resin and one full pump stroke of hardener deliver the correct volume of each component. The pumps meter about 0.9 fluid ounces per stroke.

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