PRO-SET®

REPORT

2003 / 1

NEWS ABOUT

EPOXY CHEMISTRY,

COMPOSITE PROCESSES &

FABRICATORS

Product Update

# Custom Product Formulation

*Gougeon Brothers, Inc.*

The standard **PRO-SET®** product line includes a wide array of resin and hardener combinations suitable for most typical manufacturing processes. However, as the composites industry has matured, fabricators have developed new, improved processes. In some cases, the standard PRO-SET Epoxy products do not exactly meet the requirements of a particular manufacturing process, especially if that process is proprietary. Over the last several years, we have developed an efficient system and made a commitment to formulating custom products for these situations. We have a number of custom resins and hardeners that are currently being used by customers in projects ranging from large yachts to inner-space aircraft.

This line of products is described differently than the standard product range. The format is M1000 for resins and M2000 for hardeners. The M at the beginning of the product number indicates a custom product. The numbering sequence indicates the chronological order in which the resin or hardener was developed. M1001 Untinted Adhesive Resin and M2001 Untinted Adhesive Hardener were the first to use this format. This group of new products widen the range of available resin / hardener combinations, and provide additional handling and cured physical properties to choose from.

The commitment to our customers is to provide the best product solution for their manufacturing needs. We call this a "properties approach" to finding the correct product combination. Depending on the customer's needs, the most important properties may be mechanical, handling, or thermal. There will be a priority for these properties in every project. We can help determine that priority and assure that you use the most appropriate solution. Call us to discuss your requirements. ■

# Fire Retardant Resin

*Brian Knight*
*Technical Services*

Gougeon Brothers, Inc. is pleased to announce that we have developed two fire retardant epoxy laminating systems that have the approval of Lloyd's Register of North America for the construction of life boats. The fiberglass/epoxy laminate samples were tested at Underwriters Laboratories to the specifications of IMO (International Maritime Organization) Circular 1006.

These certified epoxy resin systems are "type" certified, meaning they can be used with any reinforcing fabric the designer chooses. The fire retardant laminating systems wet out fabric easily and adhere to all commonly used reinforcing fabrics, much like PRO-SET 125 Resin. To qualify for the Lloyd's certification, the fire retardant resin must be post cured at 140°F for 8 hours.

If you are interested in using a fire retardant laminating epoxy in your next project, please contact our technical service department for details. ■

**PRO-SET laminate sample during 2900° F flame testing at Underwriter's Laboratories**

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PRO-SET REPORT is published by Gougeon Brothers, Inc., Bay City, MI USA



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# Big Batch Metering Methods

*Tom Pawlak*
*Technical Services*

Using epoxy requires metering the resin and hardener at accurate ratios. There are a variety of methods for achieving fast and accurate dispensing of large epoxy batches. Some cost almost nothing, while others involve costly pumps that deliver the epoxy at an exact ratio.

## Volume Measure

Many people prefer volume measure for delivering accurate ratios. To set up for mixing in volume measure, you will need the following:

**A straight sided container** with no taper, that has approximately double the capacity of the batch you will be mixing.

**A mixing paddle** that will also serve as a measuring stick for volume measure of the resin and hardener. This paddle can be made from nearly any material and should be tall enough to obtain a good grip for mixing.

Refer to the product literature for the correct resin to hardener volume ratio for the combination that you will be using. For the example below we will be using a 3:1 ratio.

**Creating a Volume Measure Chart**

**1.** Use a ruler to draw two lines from a single point on a base line through the 3" and 4" marks on the ruler. At any point along the baseline, the resin and hardener lines will be at the same porportion from the base line and each other.
**2.** Place the measuring stick vertically along the base line, depending on the quantity of epoxy you need.

**3.** Transfer the Resin Line (a) and Hardener Line (b) to the stick.

**Metering by volume:**

**1.** Place the measuring stick in the bottom of the container. Be sure the stick is standing straight up in the bucket.
**2.** Pour the resin into the bucket until it reaches the resin fill line (a). Be sure to stop on the mark to maintain the proper ratio.
**3.** Pour the hardener into the bucket until it reaches the hardener fill line (b).
**4.** Mix thoroughly with the measuring/mixing stick (smaller batches) or power mixer.

## Weight Measure

Weight measure is one of the most accurate metering methods available. It works especially well if you use a scale with a tare button. Use the following method to achieve accurate ratios using weight measure: we'll assume again that the required ratio is 3:1.

**1.** Tare the scale with the container on it.
**2.** Add three pounds of resin to the container.
**3.** Without removing the container of resin, tare the scale again.
**4.** Add one pound of hardener.

This method is more accurate than the volume method, especially if you are reusing the mixing buckets. The tare allows you to zero out the bucket's weight, including any epoxy that might be left in the bottom from the previous batch.

If the project requires many batches of epoxy, pre-measuring, either by weight or volume, into separate resin and hardener containers may expedite the process.

## High-Capacity Pumps

Several manufacturers offer high volume pumps that deliver epoxy at upwards of several gallons per minute. Their pumps are specially designed to meter resin and hardener simultaneously. Some can pump resin and hardener through a static mixer, so no additional mixing is required. They can cost five to fifteen thousand dollars.

## Mixing Methods

Thorough mixing is critical for success, and mixing quickly is important when working with large batches. Using a powered mixer greatly reduces the time necessary to mix thoroughly.

**Static Mixers**

Companies that require high volumes of epoxy often pump their epoxy through static mixers. Static mixers deliver mixed epoxy that can be applied immediately to your project. These mixing devices are located inside high-pressure tubing. Resin and hardener are forced through a series of baffles that tumble the epoxy hundreds of times so that it comes out completely mixed. This type of mixer requires a delivery system that is unaffected by the back pressure created by the in-line mixing device.

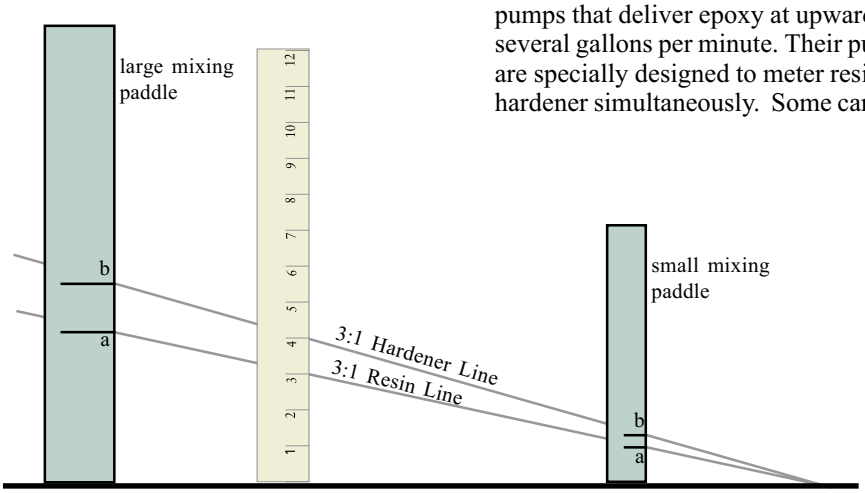
**Drill Motor Mixers**

A variety of motor-driven mixers can be used to thoroughly mix epoxy. They are essentially paint mixers or variations of paint mixers chucked into a variable speed drill. When mixing with a motorized mixer, we recommend the following three-step approach:

**1.** Mix for 30 seconds with a drill motor mixer.
**2.** Stir by hand with the measuring stick, thoroughly scraping the corners, sides and bottom.
**3.** Mix for 15 to 30 seconds more with a drill motor to blend completely.

Accurately controlling the ratio of the epoxy mixture and ensuring complete and thorough blending are important. Large projects certainly require good attention to detail, as a small mistake can be a very expensive one. ■

### Volume Measure Chart




**Some high-volume pump manufacturers:**
ITW Industrial Finishing / Binks Manufacturing 630-237-5000
Liquid Control Corp. 330-494-1313
Graco Inc. 800-367-4023
GS Manufacturing 949-642-1500
Sheepscot Machine Works 207-633-2461
Michael Engineering 989-772-4073
Accumetric, LLC / Meter-Mix® 800-928-2677
Gougeon Brothers, Inc. 989-684-7286

# Gelcoat Assessment

*Bruce Niederer*
*Technical Services*

An important aspect of PRO-SET® products for both custom and production builders is the technical support provided by Gougeon Brothers, Inc. We understand that building a boat incorporates many materials that must work well together to meet the expectations of everyone involved. Building a composite boat has changed dramatically from only a decade ago when the majority of hulls were built with polyester resin and fiberglass. A growing number of builders are choosing epoxy resins to laminate hulls due, in part, to regulatory changes in emission standards, but also because of the evolution of laminate design. Gel coats, fibers, cores, and resins must work synergistically to create predictably strong and reliable boats.

One problemn that builders faced early on involved the bond between polyester gel coats and epoxy laminates. In response, many gel coat suppliers have developed a tie coat or bond coat material that is intended to provide primary bonding to both the polyester gel coat and epoxy resin. We began assessing tie coats manufactured by Neste, CCP, Ferro, Duratec, Interplastic, Scott Bader, and others from the time they began to appear on the market. Over the years, our testing methods have changed to give a better picture of the long term performance for a specific combination of materials that a builder can expect as opposed to simply relying on climbing drum peel or tensile adhesion alone.

The first thing we do in our process is to build what we call a matrix panel (*see photo A, right*). The matrix involves time (of epoxy applied after the gel or tie coat) in the X direction and mil thickness of the gel or tie coat in the Y direction. The gel / tie coat is applied very accurately with a draw-down bar generally at 10, 15, 20, 25, & 30 mils in 4" wide strips. An X1508 fiberglass strip, also 4" wide, is then laminated perpendicular over the gel / tie strips at various time intervals, generally 1 hr, 2 hrs, 3 hrs, 24 hrs, 48 hrs, and 72 hrs. Most of the PRO-SET resin and hardener combinations have been included in this type of testing, but if a customer needs to assess a specific combination of materials, we will tailor the test to their needs. A complete balsa cored panel is built on top of this matrix. Once post cured, two PATTI studs are mounted in each of the resulting (36) 4" x 4" test areas. When the studs are pulled, we note the value on the meter and make a close inspection of the pull sites and assess the failure mode (*see photo B, right*). The failure mode is actually more important than an absolute tensile adhesion value. We look for failure at each interface, cohesive failure of the gel / tie, and laminate failure and subjectively assign a percentage of each type of failure. The best case is when there is 100% laminate failure - the worst case is 100% failure at the interface of the epoxy and the gel / tie. We also note if the gel fails beyond the diameter of the stud's face which is not characteristic of all gel coats.

By building this initial matrix, we accomplish two things: First, we see how rigidly the manufacturer's recommended application guidelines must be followed. Because we know that in a production setting something often happens to force schedules to change, this type of knowledge is invaluable. Secondly, we use results to design the next phase of testing. This next phase involves building laminated, cored panels that approximate a hull laminate complete with gel coat, tie coat, and epoxy laminate for long term environmental testing in our 100°F / 90% RH environmental chamber.

We invariably build one 17" x 34" panel to represent the manufacturer's recommended mil thickness and time window, unless the initial matrix strongly contradicts this choice. Additionally, we will build 1 or 2 more panels based on the results from the initial matrix or due to a specific request from a builder to push the application window. Each 17" x 34" rectangular panel can accommodate 10 rows of 5 PATTI studs each for a total of 50 studs. Each bond site is sanded with 80 grit paper before the studs are mounted. One row of studs are pulled to serve as a control and the pull sites evaluated and filled with epoxy so the moisture can not affect the results on subsequent rows unnecessarily. The panels then spend the next 9 weeks in the humid hut while another row of 5 studs are pulled each week. We are convinced that this treatment and analysis yields a much more complete and useful performance profile for builders to base their choice of materials on. We often also pass on subjective handling characteristics, as well as the performance results, to the manufacturer which is helpful for their formulators to tweak properties important to the end user. We have also built panels like this, but have not mounted any studs, to assess the print through characteristics of a specific laminate schedule.

Finally, we build 'flex strips' using the same gel coat/tie coat/epoxy combinations but without a core. Flex strips are stiff laminates cut 2" x 12" using X1508 bi-axial glass with the fibers oriented at ± 45° to the length of the strip. The strip is then slowly bent over a steel cylinder while we listen for the first snap/crack sound and the amount of bend measured in inches. The bending continues until several snaps are heard and then we check the cracked areas for loose or easily removed gel coat. While this data is not absolute, it does provide a relative comparison of the flex characteristics of the combination of materials being used.

We have developed this procedure for assessing gel coat / tie coat products because builders want to have as good an idea as possible of how the materials they are using or recommending will perform in the long run after experiencing the conditions they will endure in a marine environment. Heat and moisture, bumps and bruises are a fact of life for a boat. Providing the best customer support in the industry is a fact of life at Gougeon Brothers, Inc. ■

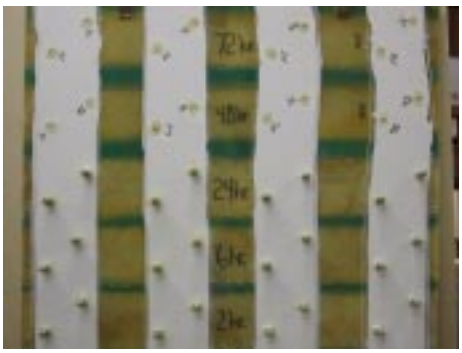



**Photo A: matrix panel**


**Photo B: close up of pull site**

# *Alchemy* out of the Shop

The latest creation from the good folks at Dencho Marine is the Andrews 77, *Alchemy*. This is the latest boat built by Dennis Choate and the crew at Dencho for Mary and Dick Compton. Dencho Marine has been building boats for the Comptons since the 1970s. Alchemy was designed and built to be a first to finish contender. In the interest of weight reduction, the interior is sparse.

Several innovative features of the Alan Andrews designed carbon / epoxy boat are worth mentioning. There are integral water ballast tanks and a unique lifting keel. The keel configuration allows for a sailing draft of approximately fourteen feet. However, lifting the keel to the upper position will allow entry into harbors with approximately ten feet of depth.

The hull shell and deck are carbon fiber and balsa core, wet out with PRO-SET® Epoxy. Internal structural members are carbon, with balsa cored / carbon bulkheads. All structural members as well as the hull and deck were vacuum bagged to save weight.

Dick Compton, a Bay City native now living in California, says the new *Alchemy* is the most powerful boat he has ever sailed on. The boat consistently exceeds wind speed in winds under 20 knots. The first day out, the boat was sailing at 16 knots in 12 knots of wind. This boat is much faster than an IACC boat (America's Cup class) when reaching or running, and has similar upwind speed. The boat weighs approximately 27,000 pounds and can carry an additional 6,000 pounds of water ballast if necessary.

**Alchemy deck construction - this isn't the photo we will be using - this is just for layout purposes.**

## Notice

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PRO-SET®

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- adhesives
- process equipment

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