An Affordable Lobster Yacht Floats to the Top
By Dave Gerr

The October, 2008 issue of PassageMaker and the December 2008 issue of The Masthead, announced the Westlawn/PassageMaker design competition. Sponsored by Imtra Marine Lighting, the competition builds on Westlawn’s tradition of not only training boat designers but encouraging new and innovative designs to meet real-world needs. It also offers readers a fresh way to consider different types of boats and gain a better understanding of which might be best for their own use.

The primary goals for this competition were to create an economical and affordable cruiser for Jane and Bob, and their 65-pound black lab, Bart, to live aboard for two or three months while cruising such routes as the Great Circle or the Inside Passage to Southeast Alaska, as well as tropical cruising in the Caribbean and Mexico. These inland waters include bridges and will have areas with some limits on draft. (CLICK HERE for the complete competition rules and conditions.)

Twenty-four designers submitted a remarkable assortment of innovative boat concepts. Entries ranged from basic sketches to bound books of design calculations and drawings from a PhD naval architect. Boat sizes ranged from 31 feet to 78 feet,

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Design Competition Winners
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monohull and multihull. Construction materials ran the gamut from fiberglass to aluminum to wood/epoxy and steel.

The Judging Process
PassageMaker and Westlawn Institute employed a panel of six judges to evaluate the challenging and imaginative array of concepts submitted. Meeting at Westlawn Institute’s Mystic Seaport office, each judge brought decades of experience in the boating industry to the table. The judges were: Bob Johnson, president of Island Packet Yachts; Bob MacNeill, an industry consultant and former president of a major boat manufacturer; Bill Parlatore, PassageMaker’s founder; and Chris Wentz, a boat designer and president of Z-Sails. From Westlawn Institute, there was myself (Westlawn director) and Norm Nudelman (former Westlawn president and current provost).

Task one was to divide the designs submitted into two categories: Those that met all the design criteria and had no serious technical problems, and those that failed to meet the criteria or that had serious (as opposed to minor) technical problems.

Considering the current state of the economy and the design criteria which specifically included the consideration that the winning boat should be economical in these days of potentially $6.00-per-gallon fuel, the judges were strongly driven to favor the smaller entries. In addition, large boats would have problems on the inland waterways, both with bridges and with draft. The 78-foot and 63-foot yachts were thus quickly eliminated. They were simply too large and much too costly. Similarly, a superbly designed but complex 44-foot power cat was eliminated. Not only did it have far more accommodations than required for our two owners and their dog but it would be far too costly. Other designs either did not meet the competition criteria or had intractable technical defects.

Three Finalists
After the initial weeding-out process (all judges looked at every boat design submitted), there were eight potential finalists vying for top honors. Each of these was put on the drawing table as all the judges reviewed every sheet for each of these designs. One by one, the remaining entries were winnowed down until three finalists were left. Though the judges had now eliminated twenty-one of the submitted designs, there was universal agreement on the designs eliminated as well as on which should be in the top three. From here, the process was more challenging.

It would be hard to imagine three more completely different designs than those that were sitting on the finalist’s table: a 49-foot, slender-hull power tri; a 44-foot monohull with traditional styling; and a 32-foot lobster yacht with a hard-chine hull. Each of had supporters among the judges, and intense debate ranged about their merits and drawbacks.

Ultimately, the judges agreed that all three designs met the overall requirements for the competition, and a tabular evaluation sheet was created in which each judge rated the finalists on seven criteria: appearance, innovation, livability, fuel efficiency, dinghy handling and storage, maintenance (ease of and cost of), and the initial cost of the boat. Tabulating the results resulted in a clear winner.

The Winner – An Economical Lobster Yacht
Ives-Marie de Tanton’s LST.32 hard-chine hull lobster yacht took the honors. The judges were impressed that the design met all the criteria in one of the smallest and thus least expensive packages. Not only does the boat have good deck access (with stairs gentle enough to even be used by a large dog) and a large outside fly-bridge deck with helm station, but the interior arrangement has a generous forward master stateroom with enclosed head and a completely separate shower. The pilothouse saloon has a usable though compact galley with a comfortable dinette/settee berth that will really seat four for a meal. Further, the boat has an aft cabin with a washer drier—a real boon for the live-aboard cruiser. The single aft berth extends to form a double, so another couple can join Jane, Bob and Bart for weekend cruises with their own private cabin.

The LST.32 gets quite a lot out of a small volume, and the smaller size not only reduces initial cost, but makes maneuvering in tight spots on inland waterways easier. The judges
reservations about the LST.32 were minor—dinghy handling was acceptable, but interfered with the use of the swim platform, and—though a good-looking boat—it struck most of the judges as somewhat high in appearance relative to its length. This, however, is almost an inevitable result of working so much into 32-foot LOA. In fact, Tanton notes that the high profile requires a bow thruster (included in the design) to insure good handling in a stiff breeze during docking. The bridge clearance of 19-feet 5-inches will pose some issues on inland waters.

A Traditional 40- Footer With Hybrid Drive
Karl Stambaugh’s Redwing Hybrid struck almost all of the judges as the most attractive of the designs submitted. Though 8 feet longer than the Tanton LST.32, the Redwing 40 is actually nine inches narrower and has just 4 inches more draft. Bridge clearance, is considerably lower than the 32FT. In fact, with 12-foot, 6-inch bridge clearance the Redwing 40 will go under many bridges without waiting for them to open. Lowering the mast would reduce bridge clearance to just 8 feet, 9 inches. Initially, several of the judges felt quite strongly that the Redwing 40 Hybrid should be the winner. Being larger, though, this boat will cost more and so everything would have to really be spot on throughout this design to justify the extra expense.

The dinghy handling was singled out as particularly well conceived, with storage for not only standard dinghy on the aft cabin deck, but with arrangements made for kayaks as well. The cabin layout made good use of the extra length for spread-out and spacious accommodations. As the judges examined the arrangement in more detail, however, some problem areas appeared. Most important, is that the size and space allowed for the heads (toilets) on the drawings was much too small. The toilets as drawn were just 11-1/2 inches wide, where 14 to 15 inches width is normal, and the sinks in the heads were just 7 inches in diameter. There isn’t even comfortable width for the shoulders of an average man to sit on these tiny toilets as drawn. None of this is realistic or workable. The double berth in that aft stateroom was only 42 inches wide—too narrow for a true double. Some judges didn’t like the fact that you had to pass through the aft stateroom to get to the cockpit, but others argued that this is not only acceptable, but that some owner’s prefer it. The galley, on this 40 footer was small, slightly smaller even than that on the LST.32, and the aft cockpit—while otherwise workable—had seats only 5 feet long, which is too short to lie down on.

All of these problems are fairly easily corrected. In fact—since several of the judges are professional designers—the concepts to correct these issues were quickly sketched out. The judges had to base their assessment on the design as submitted, not as how they might slightly rework it, however. In addition, all six judges concurred that hybrid propulsion (a Steyr 75-hp “pancake” system in this case)—though it has cachet at present—is not the answer for efficient operation. There was nothing fundamentally wrong with the concept or execution, but all the judges concluded it added cost without much real benefit (if any at all) in overall fuel economy.

Though the Redwing 40 Hybrid, was the personal favorite of several judges—after accounting for the above issues—this design’s score on the final-criteria judging sheet came in behind the LST.32.
Radical and Innovative – A Power Tri

Triple Threat—a 49-foot modern power trimaran with slender hulls—impressed all the judges with its bold innovation and handsome styling. It’s rare to see a truly fresh and different boat design that six completely independent judges all agree is handsome and inarguably unique. Triple Threat accomplished just that, no mean feat! Further all the judges were impressed with how carefully and sensibly thought out this unusual concept was. It is quite a difficult design challenge to work in usable accommodations in the odd form and tight spaces of a trimaran of this size with its very slender hulls. Designer Jon Ames accomplished just that.

Long, slender hulls can be driven very economically with much less power for a given speed than any conventional monohull. Such hull forms are fundamentally more fuel efficient. These long slender hulls also slice through the waves and have small waterplane areas, factors that combine to make for lower heave and roll motions, and the multihull form will roll to much smaller angles than a monohull. Taken together, this creates a boat with particularly comfortable motion. (Note multihulls with fat, beamy hulls—and there are many such out there—don’t gain many of these advantages.)

The arrangement has a private stateroom forward and a private guest stateroom aft. The main cabin, on deck contains not only a well-equipped, enclosed helm station, but a generous galley, a large dining table/settee, and a full head with separate shower, all with full standing headroom. There’s no doubt that Triple Threat would draw a crowd at any marina it pulled into, and there’s no doubt that it would be efficient.

Closer examination, raised several issues ultimately knocked this design out of the top spot. One is that the engine indicated is rather large. The single 330-hp diesel would drive Triple Threat to 23 knots with a cruise around 18. This seemed like too much power and speed for the goals of this design competition. A 125-hp diesel would drive the same boat at 14 knots max, with a 12-knot cruise; much more economical. Again, the judges felt that they could only go with the design as presented. Triple Threat also has a hybrid drive system. This is an add-on system (unlike the integral Steyr system on the Redwing 40), but—though the hybrid electric drive could be omitted it was part of the design, which—as before—the judges concluded wasn’t ultimately cost effective.

All the judges concurred that this design would be the most expensive of the three finalist designs. Indeed, none of the judges believed Triple Threat...
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could be built for under a million dollars. This is not a design fault. It’s a necessary result of the complexity of the multiple hulls, as well as the intricate superstructure and the lightweight, composite construction required.

Finally, aspects of both the arrangement and of access to the machinery were affected by the limitations of the slender hulls. The aft cabin can only be accessed by a vertical ladder on deck. Similarly, the flybridge is accessed by a vertical ladder. The double berths in both the forward and after cabins are fitted into the hull. Jon Ames did a nice job here in working in such sensible accommodations, but making up these berths and getting in and out of them will take some gymnastics. As Jane and Bob get older (not mention their older friends), the difficult access will be a drawback. More important, their 65-pound dog will never be able to get down into the aft cabin or up onto the flybridge.

By the same token, the engine and generator are deep in the main hull (the vaka). Though the general machinery is well considered, access to around the sides of the engine is tight. Maintenance will be difficult. Though, all the judges were quite impressed with Triple Threat, these considerations kept it from taking top honors.

The Winning Designers
Competition winner Yves-Marie de Tanton, is a professional designer with decades of experience. Born in Belgium, he started sailing when he was eight. He went to work as a designer for the John Illingworth office in Great Britain. From there, he moved on to work with the French naval architect Andre Mauric and with Briton Chance on the 12-meter, France. Moving to the U.S. to work at Sparkman & Stephens, Yves-Marie ended up as design director at the Dick Carter office. In 1974, Tanton started his own design firm, Tanton Yachts, in Newport, and has been creating all kinds of boat ever since. He has been awarded the $1,000 prize for the winning entry, from funds generously donated by Imtra Marine Lighting. www.tantonyachts.com

Karl Stambaugh got his degree in naval architecture from the University of Michigan, and has his own design office, Chesapeake Marine Design, in Severna Park, MD. He currently works for the US Coast Guard naval architecture branch. www.cmdboats.com

Jon Ames is a current Westlawn student and a winner of the prestigious Owens Scholarship to Westlawn. He holds a 50-ton masters license with sail endorsement and has spent a number of years as crew on commercial boats, including as captain on boats in Florida waters. email: jonames15@gmail.com.

CLICK HERE to go to the PassageMaker website and read additional comments from other competition judges.

Design Particulars

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<thead>
<tr>
<th>LST.32</th>
<th>LOA: 32’ – 1’</th>
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<tbody>
<tr>
<td>DWL: 31’ – 9’</td>
<td>Beam: 12’ – 11’</td>
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<tr>
<td>Draft: 3’ – 2’</td>
<td>Bridge Clearance: 19’ – 5” (top of antenna on mast)</td>
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<tr>
<td></td>
<td>Bridge Clearance: 12’ – 1” (top of flybridge – mast lowered)</td>
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<tr>
<td></td>
<td>Disp: 14,380 lb.</td>
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<tr>
<td></td>
<td>Power: 60- to 100-hp Diesel (owner’s option)</td>
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<tr>
<td></td>
<td>Speed w 80-hp: 9.8 knots max.</td>
</tr>
<tr>
<td></td>
<td>Speed w 80-hp: 8 knots cruise</td>
</tr>
<tr>
<td></td>
<td>Construction: fiberglass or aluminum Strongal with minimum internal framing</td>
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<th>Redwing 30 Hybrid</th>
<th>LOA: 40’ – 0’</th>
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<td>DWL: 40’ – 0’</td>
<td>Beam: 12’ – 0”</td>
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<tr>
<td>Draft: 3’ – 6”</td>
<td>Bridge Clearance: 12’ – 6” (top of mast)</td>
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<td></td>
<td>Bridge Clearance: 8’ – 9” (top of searchlight on cabin – mast lowered)</td>
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<tr>
<td></td>
<td>Disp.: 24,000 lb.</td>
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<tr>
<td></td>
<td>Power: 75-hp Styer hybrid diesel with 7 kW pancake motor generator</td>
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<tr>
<td></td>
<td>Speed: 9.1 knots max</td>
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<tr>
<td></td>
<td>Speed: 8 knots cruise</td>
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<tr>
<td></td>
<td>Construction: fiberglass, wood/epoxy, aluminum, or steel</td>
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<tr>
<th>Triple Threat</th>
<th>LOA: 48’ – 11”</th>
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<tr>
<td>DWL: 48’ – 9”</td>
<td>Beam: 18’ – 5”</td>
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<tr>
<td>Draft: 2’ – 9”</td>
<td>Bridge Clearance: 13’ – 8”</td>
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<tr>
<td></td>
<td>Disp: 19,600 lb.</td>
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<tr>
<td></td>
<td>Power: 330-hp diesel</td>
</tr>
<tr>
<td></td>
<td>Speed: 23 knot max.</td>
</tr>
<tr>
<td></td>
<td>Speed: 18 knot cruise</td>
</tr>
<tr>
<td></td>
<td>Construction: fiberglass/composite</td>
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The Ultra Scale Master Pro Replaces the Planimeter for Westlawn Coursework

By Dave Gerr, © 2009 Dave Gerr,
Photos by Dave Gerr

For well over 100 years, planimeters have been used by draftsmen to measure complex irregular areas. Over the past decade, computer drawing (CAD) has replaced much manual drafting. Since the areas of irregular shapes are quickly measured inside CAD programs, planimeters are used less and less today. As a result, the only company making low-cost planimeters (Lasico) is going out of business.

This posed a problem: Westlawn students must learn manual drafting before moving on to CAD (as do students in almost all architecture programs). Further—for naval architecture—you need to be able to measure the areas of irregular shapes on drawings (largely the body plan sections). What can you use for this if you can’t find a planimeter?

The answer is the Ultra Scale Master Pro. This device is a “sonic digitizer.” It uses sound waves (miniature SONAR really) to take precise measurements from drawings—bouncing sound off nearby reflector bars. Not only does the Ultra Scale Master Pro measure areas, but it also measures lengths. It can be used without a computer to give direct digital readings, or you can plug it into a computer’s USB port to send measurements directly to a spreadsheet or other program. The Ultra Scale Master Pro can also be used to digitize a drawing to convert a manual drawing to CAD. (This is not generally recommended as the best approach for converting your manual drawings to CAD, but the Ultra Scale Master Pro has this functionality.)

Even better, the Ultra Scale Master Pro is less expensive than a planimeter. Planimeters run around $250 to $300. The price of the complete Ultra Scale Master Pro is $179.75 (Dec. 2009), at Westlawn student-discount price. Go to the post on the Westlawn student forum for ordering information. Others interested in purchasing the Ultra Scale Master Pro should go to: www.tigersupplies.com and then type “Scale Master Pro” into the search box.

From now on, Westlawn recommends the Ultra Scale Master Pro instead of a planimeter. The planimeter has been the device used for so many decades that planimeters and their use are built into the Westlawn course. Where you see reference to a planimeter in the Westlawn course material, you should use the Ultra Scale Master Pro.

NOTE: There is nothing wrong with a planimeter. If you have a planimeter or can get one inexpensively, you are welcome to use it. Just follow the guidance for using planimeters in the Westlawn course material. You do not have to purchase an Ultra Scale Master Pro if you already have a planimeter, or if you prefer to use a planimeter for personal reasons and you can locate one.
Plevier P7  Designed by Westlawn alumnus Reis Plevier

As promised in the Sept.09 issue of The Masthead, here are more photos of the Plevier P7, a 22 ft. (6.73 m.) traditional tug yacht of fiberglass, finished to look like riveted steel.  For more information go to http://www.slepertje.nl/
"New hull forms has been my passion, and will continue to be. One of my most recent efforts is this entry-level utility skiff. The running plug proved quite successful, achieving 46.5 mph with a test weight of 2,000 lbs. using a 90 HP Mercury engine."

Contact Information:
John Winter Yacht
P.O. Box 722
Lenoir City, TN 37771
865-986-5808
kwin824@yahoo.com

U.S. Coast Guard Issues Marine Safety Alert on Sailboat Rigging Dangers

On November 16, 2009, the U.S. Coast Guard issued Marine Safety Alert 07-09 - Sailboat Rigging Dangers. The alert notes that there have been 28 failures of mast, spars and rigging components over a six year review of inspected sailing passenger vessels. Nine involved dismastings, 6 on catamarans, with two separate dismastings resulting in fatalities. The common cause was failure of the mast’s standing rigging. Initial forensic metallurgical analysis of the failed wire rigging showed visual corrosion and evidence of fatigue failure.

Coast Guard Sector Honolulu has developed Inspection Note #13, outlining an enhanced inspection regime for sailboat rigging, masts and associated components. The Coast Guard alert also recommends manufacturer-published guidelines on mast and rigging-system

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Graphite, 9.8 meter semi-custom cruiser
Designed By Westlawn Alumnus Will Allison

GRAPHITE, a was launched at the 2009 Tasmanian Boating & Leisure Show, on October 17, 2009. The boat was released to wide acclaim and received a great deal of interest at the show.

Hobart (Australia) based Imaginocean Yacht Design’s proprietor and principal designer, Will Allison, describes the boat as a significant departure from anything else currently available. Initially, it is Graphite’s contemporary styling that catches one’s attention, - but the thinking behind this design is far more than skin deep. Mr. Allison says that, “Whilst there are a multitude of aspects of the boat that are worthy of note, there are three that really set her apart — performance, trailerable and customizable.”

The SC hullform is defined by rounded forward sections, reducing annoying chine slap at anchor and improving ride quality underway by reducing slamming loads. These give way to more typical hard chines aft to maximize efficiency and stability. A spray knuckle in the lower topsides helps to keep the boat dry.

Epoxy composite construction has resulted in a monocoque structure that is light, strong and durable. This, combined with the long waterline length and relatively flat planing surfaces, result in bottom loadings that are half that of many production boats. The end result is a boat that slips onto the plane at under 10 knots, remains level and is economical to operate at any speed – attaining better than 4 nmpg right up to her maximum 32 knots.

PRINCIPAL DIMENSIONS
LOA 9.8 m 32’ 1”
LWL 8.8 m 28’ 9”
Beam 2.8m 9’ 3”
Displacement approx. 3000 kg 6,600 lb.
(full cruising condition, 50% fuel & water)
Fuel 525 l
Water 400 l
Power Yanmar 6BY2 260 Z
Mercruiser Bravo 3

Imaginocean Yacht Design
4 Warwick Street
Hobart, Tasmania, Australia 7000
Phone: 0419 366 885
E-Mail: office@imaginocean.net
Web: http://imaginocean.net
On November 10th Robert Mazza wrote:
Dave and Norm,

Thanks for lunch yesterday, and thank you for visiting our facilities. On an unrelated subject, during lunch I brought up the Onrust, the replica of Adrian Block's vessel, which was the first European vessel built in the New York area. The replica was built in or around Albany, but I'm not sure by whom. There was an extensive article in Boating on the Hudson at the beginning of the year. Attached are some photos taken during the 400th anniversary cruise in June celebrating Hudson's 1609 voyage, with Half Moon, Clearwater, NYC Fireboat, and Onrust, not to mention, our little Trillium. It was quite an event.

Rob

Editor's Notes:
Robert Mazza is Manager - New Market Development Alcan Baltek Corporation. Rob is also the author of the three-part technical article “All About Cores—What Lies Beneath the Skin.” Read Part 2 in this issue of The Masthead.

On June 6, 2009 the Onrust (pronounced AHN-roost), a reproduction of the 52-foot, 29-ton 17th-century Dutch ship joined fifteen other historic vessels and many private and commercial boats to sail 140 miles up the Hudson River from Manhattan to Albany to commemorate the 400th anniversary of Henry Hudson's 1609 journey up the river. The weeklong voyage also included the 85-foot, three-masted replica of Hudson's ship Half Moon, the 130-foot, 268-ton NYC fireboat John J. Harvey built in 1931, the 106-foot tall ship Clearwater, a replica of the Hudson River stone sloops of the 18th and 19th century. The vessels received a West Point 16-gun salute. Towns along the Hudson rang church bells, sounded whistles, and celebrated with waterside public events. Photos by Rob Mazza
**We Get Mail** Continued from Pg. 10

_in the September 09 issue of the Masthead, we published a short piece with a photo of Dry Dock 1 in the Charlestown Navy Yard in Boston Massachusetts._

On August 31, Westlawn student Jay K. Jeffries e-mailed this interesting note about Dry Dock 1

Norm,

Received the link to the latest edition of the *Westlawn Journal* and currently reading it from front to back with great pleasure.

Remembering our discussions during the tour of the *Charles W. Morgan*, I was pleased to see a short piece concerning Dry Dock 1 at the old Charlestown, MA., the dry dock in Norfolk (actually Norfolk Naval Shipyard [NNSY] in Portsmouth, VA.), and careening. After the closing of Charlestown Naval Shipyard some years ago, Dry Dock 1 which is adjacent to the *USS Constitution* was transferred to the US Park Service and is dedicated solely to the maintenance of that historic warship.

Having reported aboard my first submarine docked next to Dry Dock #1 at NNSY, I had the opportunity to appreciate the workmanship that went into building from granite this graving dock which is still operational. In fact, it is the oldest dry dock in the western hemisphere (it beat Boston out by 1 week). This was the same dock where during the Civil War, the *USS Merrimac* was burnt to the waterline and abandoned by the retreating Union forces in hopes of making the dry dock unusable by the advancing Confederates. Due to a lack of resources, the South had to make ingenious use of what they found so they turned the *Merrimac* hulk into the ironclad *CSS Virginia*. As most people know, *Virginia* went on to destroy several Union ships off of Hampton Roads before battling the North’s ironclad *USS Monitor* to a draw.

Respectfully,
Jay K. Jeffries
Andros Is., Bahamas

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E-mail from Westlawn Student Jonathan Brewster
August 31, 2009

Subject: Masthead

Norm,

I look forward to receiving *The Masthead*. I especially appreciate the more technical articles. I also want to thank you for the more technical and professional direction you are taking the journal. SNAME journals are very good, but not solely focused on design. You seem to be able to straddle the divide between the technically competent practitioner and the researcher in the small-boat design area. Please continue to publish articles that stress the engineering and design aesthetics without overwhelming the practitioner.

Thank you,
Jon Brewster

Your comments and questions are welcome. Space permitting, we will print them in a future issue of *The Masthead*. Address your comments and questions to Letters to the Editor and email them to: nnudelman@westlawn.edu

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**U.S. Coast Guard Issues Marine Safety Alert on Sailboat Rigging Dangers** (continued from pg. 8)

maintenance, and specifically recommends:


Click Here to read U.S. Coast Guard Alert 07-09.
Click Here to read U.S. Coast Guard Inspection Note #13

Click Here to read Navtec Rigging Service Guidelines
Click Here to read Sailboat Rig Problems

Though this information on inspecting sailboat rigging is directed at commercial passenger vessels, designers, builders, and surveyors of both recreational vessels and commercial vessels will find these guidelines invaluable.
Westlawn Student Alan Gluyas, from Western Australia designed and built Skylark, a 29ft. alloy cruiser. He has been building boats for over twenty years.

**Principle Dimensions**

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<thead>
<tr>
<th>LOA</th>
<th>Disp</th>
<th>Towing weight</th>
<th>Cp</th>
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<tbody>
<tr>
<td>8.8 mtrs</td>
<td>2470 kgs</td>
<td>3200 kgs</td>
<td>0.61</td>
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<tr>
<td>7.35 mtrs</td>
<td>7,440 lb.</td>
<td>7,050 lb.</td>
<td></td>
</tr>
<tr>
<td>BOA</td>
<td>2.5 mtrs</td>
<td>2.1 mtrs</td>
<td>26° amidships</td>
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<tr>
<td>2.5 mtrs</td>
<td>6.7 ft.</td>
<td>5° transom</td>
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**Designers Notes:**

*Skylark* is fitted with a 70-hp Nissan diesel, 2.91 Borg Warner transmission, and a 4-bladed, 18-in. prop. Fuel tankage is 2 x 250 litre (66 gal.) integral tanks either side of the engine space amidships.

Performance on sea trials was 17 knots with clean hull, lightship, at 3,600 rpm. Normal cruise is 13 to 14 knots at 3,200 rpm, burning approx 10 ltrs /hr.

She is fitted with a Vetus 12-volt bow thruster and hydraulic trim tabs, and basic living accommodations.

*Skylark* was an experiment in slender hull forms and her calm-water performance was excellent. The sharp entry and fine lines made her very comfortable punching into a chop but sensitive to big quarter waves running downhill. She did suffer from beam seas with 4 people on board and empty fuel tanks and I eventually had to add 350 kgs of lead shot/epoxy ballast into the box keel. I designed a MkII version with more waterline and overall beam which in hindsight would have been a better boat. She also would have benefited from 100 shp which would have given her a top speed of 20 to 21 knots and a cruise of 17 or 18.

I developed the lines on paper, developed the concept in AutoCAD, drew the lines in ProSurf and then used AutoCAD for the engineering. The bottom was conically developed and I built a 1/8th scale model to verify that she would plate up. All the plates were cut by the local alloy supplier to .dxf cutting files (see cutting plan on right) and I built her from the bottom up, skin first. I used similar system 20 years ago to build a 40 foot steel schooner that I did not design. Although I did the reverse engineering later for the plate development, this boat was designed by the well known NZ designer Bruce Askew and was the second steel Askew yacht I have built.

I did all the engineering on all boats, including the engine marinization and fitting, rigging, electrics, trailer, welding etc. With *Skylark*, I farmed out the final topcoat painting and fairing, and I bought in the alloy marine windows.

*Skylark* took me just over twelve months of part-time work to build (from first weld to launching) once the design was finished.

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**Alan Gluyas**
The question from the September 2009 issue was:
It’s early spring on a cool, clear day. The weather has been dry for a couple of weeks, and you are surveying Dancing Daisy, a 1992, 38-foot, cruising sailboat, with a moderate fin keel. The hull, deck, and cabin are all cored fiberglass, except for the solid-glass region at the centerline (in the keel and stem area). Dancing Daisy has been hauled out all winter, and is well ventilated under an open shed.

You have taken moisture meter readings high on Dancing Daisy’s topsides as a baseline, and find that—in comparison—most of the deck and cabin top, as well as the hull bottom are reading wet (though not the cabin sides). There are no other signs of water penetration problems. Are the meter readings an indication that these regions are suffering from water saturation, or is there some other explanation? If so what is it?

The Correct Answer is:
The answer is no. Though a number of “no” answers were submitted, the explanations were based on the presence of condensation, which is not the likely cause. In fact, condensation on the hull surface shouldn’t throw readings too far off. The most likely explanation for the apparent wet readings is that the builder has used a layer of CoreMat on the topsides and on the cabin sides, where the smoothest possible surface with no print-thru was desired. (There are other better ways to do this, but using CoreMat as a print blocker is common and acceptable.) CoreMat wasn’t used on the deck or cabin top, where print through is less of a concern. (The hull bottom is out of sight. The decks have non-skid, as well as fittings, which break up the surface so print through doesn’t show through as easily.)

CoreMat reads notably drier than standard glass. So taking the baseline readings on the dry topsides, is giving a poor reference in comparison with the other laminate areas without CoreMat.

Who Will Be The December 2009 Know It All Winner?
Want to see how much you know? Want to show everyone else how much you know? The first three people to submit the correct answer to the following question will win a Westlawn tee shirt and cap, and will also receive a Know It All certificate. The answer and winners to be published in the next issue of The Masthead.

You are designing a centerboard sailboat. The centerboard is of laminated fir plywood, glued and saturated with epoxy, and sheathed with 12 oz. glass cloth in epoxy. The geometry is as pictured in the drawing above. How much ballast should you install in the centerboard to ensure that it drops smoothly and surely when the centerboard hoist pennant is eased?
Westlawn graduate Patrick Bray has been involved with boating since high school, helping his father and his brother build a 30-foot sailboat—a cutter. This fixed his resolve to become a boat designer, and led him to apprentice with both designers and builders, gaining further practical experience to back up his extensive theoretical studies. He now has more than thirty years of design experience as a naval architect and a reputation for producing vessels that exceed the clients’ requirements and performance expectations.

Pat heads up a flexible design team, working with a core group that includes his wife (and business partner) Caroline and their daughter Jennifer, a specialist in 3D computer drafting. Consultants are brought on-board as their specialized knowledge is required by a certain project. This gives a design advantage ensuring that every project gets the maximum attention and input. Over the past 15 years, Pat has specialized in developing fuel-efficient, low-resistance, high-stability hull forms. Designed to go offshore as comfortably as a trip around the bay, Bray says these vessels show a 30-percent reduction in fuel consumption over the average motor-yacht.

Research is a part of the Bray’s company name and emphasizes their commitment to an ongoing quest for excellence. Designing boats has never been an exact science—it still contains a bit of art and magic blended with the technology. To confirm that the blend of art and science are working the way they should, many of the hulls are tested with both open water and model tank testing. Once the results are in, the design is optimized, and construction of the vessel can proceed with total confidence.

Working closely with their clients, the Brays ensure that the vessel reflects the owner’s personal choices as well as including the most technologically advanced design features. Incorporating safety, performance, and comfort in the design process, Pat works to provide each client with their dream yacht.

Work has not been limited to only pleasure craft but also includes work on the Polar 8 Ice Breaker (the world’s largest ice breaker), contracts for the Canadian Dept. of National Defense, and classified high speed vessel research. A recent project included the hull resistance optimization of the latest 33m (110-foot) Canadian Navy patrol vessel, the “Orca Class.” Fishboat and charter vessel compliance documentation and stability booklets round out this commercial work.

CLICK HERE to go to Pat’s website to learn more about Pat Bray, his company, and the boats and yachts he designs.
The New Canadian Boating Education Rule

A new law in Canada requires anyone operating a motorized recreational boat on Canadian waters to carry evidence of having taken and passed an approved boating safety course. This law, which went into effect on September 15th, 2009, would affect all boaters, foreign and domestic, who are cruising in Canada.

The Regulations are being phased in as follows:

- All operators born after April 1, 1983 are required to have proof of competency since 1999.
- As of September 15, 2002, all operators of craft of under 4 m (13’1’’), including personal watercraft, will be required to have proof of competency.
- As of September 15, 2009, all operators will be required to have proof of competency.

The Regulations applying to non-Canadian residents are:

- If they operate their pleasure craft in Canadian waters for more than 45 consecutive days or,
- If they operate a pleasure craft that is licensed or registered in Canada (including rented or chartered boats).
- The Regulations do not apply to non-residents who operate their pleasure craft in Canadian waters for less than 45 consecutive days. A proof of residence will be required on board at all times.

For non-residents, proof of competency can take one of three forms:

- A Canadian-issued pleasure craft operator card.
- A completed boat rental safety check-list (for power-driven rental boats).

An operator card or equivalent that meets the requirements of their state or country.

**For More information, please click here.**
Source: Boat US, Sept. 09 and Transport Canada

MRAA and ABYC Partner to offer Scholarships

The MRAA Educational Foundation and the American Boat & Yacht Council (ABYC) announced today that they have partnered to provide scholarships to attend any one of eight (8) ABYC technical workforce training and certification courses offered throughout the United States and Canada.

These scholarships will be available to any and all MRAA members in good standing, and will include course fees, the study guide and the certification examination free of charge to those awarded the scholarship. A total of ten (10) scholarships worth up to $849 each will be awarded and will be honored through December 31, 2010.

Ed Lofgren, MRAA Educational Foundation president, commented, “The ABYC technical workforce training and certification courses are ‘just what the doctor ordered’ for our industry. These courses will provide much needed training opportunities for technicians and others in the recreational marine trades, resulting in improved levels of expertise, and subsequently improved performance on the job. MRAA is delighted to participate with ABYC in providing these scholarships.”

ABYC’s President, Skip Burdon stated “We are both honored and proud to work with the MRAA Education Foundation in offering these industry technical workforce certification course scholarships.” He continued, “I know the value both MRAA and its Education Foundation place on having a technically proficient workforce and we know this scholarship opportunity will assist industry towards achieving that goal.”

To apply for the scholarship visit the MRAA website at www.mraa.com and look under “Foundation.” If you have any questions contact the MRAA Foundation at 708-763-9210

Source: MRAA Educational Foundation
(MRAA 9/25/09) 708.763.9210

Senators Introduce Mid-Level Ethanol Bill

On September 14th, Senators Susan Collins (R-Maine), Ben Cardin (D-Md.), Sheldon Whitehouse (D-R.I.) and Mary Landrieu (D-La.) introduced strong legislation designed to protect consumers, the environment, public health and manufacturers from the introduction of intermediate, or mid-level, ethanol blends in gasoline fuel, such as E15. S.1666, the “Mid-Level Ethanol Blends Act of 2009” would ensure new fuels introduced into the marketplace are compatible with the inventory of on-road and non-road gasoline engines, including boat engines, currently in use. Since the Clean Air Act (CAA) prohibits the sale of mid-level ethanol blends, the ethanol industry is currently seeking a waiver from the Environmental Protection Agency (EPA) to sell E15 as a general purpose fuel.

Taking a “science-first” approach, S. 1666 is designed to protect consumers with marine engines, outdoor power equipment, other non-road engines as well as automobiles. The bill requires that EPA’s Science Advisory Board (SAB) study the compatibility of such fuels with current engines before a waiver can be granted. The study would also include a comprehensive analysis of available independent scientific evidence on the compatibility of mid-level ethanol fuels with the emission requirements of the CAA and the operability of engines, among other things.

“During these difficult economic times, equipment damage due to ethanol-gasoline fuel blends only adds to the many challenges facing our nation’s farmers, fishermen, independent woodsmen, and recreational industry,” said Senator Collins. “As we pursue strategies to lessen our dependence on foreign oil, we must also take action to ensure that ethanol fuel blends are safe and efficient for small engines.”

Source: NMMA 9/15/2009

Continued on Pg. 16
**ABYC Names Technical Vice President**

November 6, 2009, Annapolis, MD: The ABYC announced today the promotion of John Adey to Vice President, Technical Division. This promotion comes after Adey has served for over 7 years as the standards organization’s Technical Division Director.

"This promotion is well deserved," remarked ABYC’s Technical Board Chairman, Dave Marlow. "As ABYC has grown into a global player on the standards front, John has played a key role in our development and leadership. He is clearly seen as the industry's "defacto" authority on all things regarding marine standards and has literally improved the output of both international and domestic standards through his staff's involvement."

Skip Burdon, ABYC’s President said in a statement, "I promoted John to this position quite candidly because he has earned it through mastering a steep learning curve, hard work and demonstrated professional commitment to ABYC, our industry and to the boating public. He is the face of ABYC standards around the world who has garnered and enjoys immense respect of industry and Federal and State governments’ most knowledgeable technical experts."

Source: ABYC, Nov. 6 2009

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**ABYC Offers 2 New Regulations Manuals**

EPA Regulations for Recreational Boats and the revised Rules & Regulations for Recreational Boats is now available. ABYC announced today that the first edition of its newest publication, EPA Regulations for Recreational Boats, is now on sale. This publication is published to provide an economical and convenient source for the laws and regulations, which govern the design and construction of boats in consideration of fuel and exhaust emissions. The excerpts of government publications contain all the amendments that were available as of the date of publication, September, 2009, and include relevant sections from the Code of Federal Regulations (CFR) Title 40, parts 1045 and 1060.

Additionally, the ABYC publication of the 2009 edition of the Rules & Regulations for Recreational Boats is also available for purchase. This publication contains excerpts from the United States Code (USC) and the Code of Federal Regulations as of September, 2009. The previously published edition is January, 2008 and is now out of date.

The 'Rules and Regs’ as they are commonly called are one of our most popular resources" says John Adey, ABYC’s Technical Director “Builders, surveyors and repair yards now have another resource that conveys the particulars of these new regulations put in place by the Environmental Protection Agency."

Both publications are conveniently sized in a spiral bound book and are available as a set for $55 (US) or sold separately for $29 each plus S&H. You can order your copy today by calling 410 990-4460 and asking for Judith, Sandy or Alice. Supplies are limited and a reprint of this edition is not scheduled before April, 2010.

Source: ABYC, Oct. 26 2009

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**Westlawn Celebrates 80 Years!** (continued from pg. 1)

marine surveyors, brokers, boatbuilders and manufacturers, production managers, production design researchers, instructors at institutions of higher learning, in boating safety departments of the U.S. Coast Guard, and as directors of standards organizations. This is why we are so excited to not only be celebrating the school's history, but how Westlawn has contributed to the industry as a whole through its students and many, many successful alumni."

Westlawn has produced more practicing small-craft designers than any of the other institution in the world. This includes Westlawn alumni as members of 19 different America’s Cup campaigns that we know of, and distinguished designers such as Jack Hargrave, Bill Shaw, Bruce King, Tom Fexas, Rod Johnstone, Dave Martin, and many, many others. The number of Westlawn alumni employed by marine industry companies is truly remarkable. (A partial list can be found at: Success Stories on the Westlawn website).

The Westlawn Institute of Marine Technology is the only nationally accredited distance-learning school of small-craft design in the United States. As the not-for-profit educational affiliate of the American Boat and Yacht Council, Westlawn’s primary function is to assure a continual source of trained designers to the marine industry. These highly skilled safety-oriented boat and yacht designers are helping to produce better products and services for the benefit of the boating public.
"If you can’t do it right, don’t do it at all!"

In the previous issue of The Masthead we addressed the history of cored composite construction in marine applications—what cores contribute to a laminate, what core properties are important, and what core alternatives are available. In this issue, we are going to address cut configurations that make rigid sheets flexible, production methods, laminate engineering, and in Part 3 we will address the most important topic of all—proper core installation. Also in Part 3, we will then look at the consequences of poor or improper core installation (wet core) and their ramifications for safety factors and repair options. The first topics, covered here in Part 2 are pretty specialized, occupying hours of discussions among core geeks, but they lead right into the other topics of core installation, and more importantly the question for when things go wrong—wet core.

Bruce Pfund of Professional Boatbuilder magazine often says, “When it comes to core installation, if you’re not going to do it right, don’t do it at all!” All core manufactures echo that sentiment. The last thing the boating industry needs is more core-related laminate problems. In the next two segments we will address what is required to “do it right.” That has to do with core selection, cut configuration, proper engineering and design, lamination procedure, and above all, proper core installation.

Available “Cut” Configurations

Rigid Sheet

All cores start as rigid sheets of a given thickness, and if significant curvature is not required, for the best structural properties, all cores are best left as rigid sheets. It is the slitting of cores to create “kerfs” to allow rigid sheets to adopt compound curves, that causes the majority of problems in core installation.

Perforations

When installing large sheets of rigid core, it is important that there is no air trapped under the core during installation. This is particularly true if the core is being installed over a lap or discontinuity in the laminate, or into core bonding adhesive. To allow air to “leak” out of the core, small 3 mm or 1/8” perforations are often added every few inches. If the core is being vacuum bagged into a core adhesive, you should be able to see this adhesive being forced through every perforation. During an infusion process, these “perfs” will also allow the transfer of resin from one side of the core to the other, and when combined with grooves, will allow the core itself to act as the resin transfer medium.

Contourable Configurations

As mentioned previously, if the core needs to adapt to compound curvature of the hull or deck, cuts or “kerfs” need to be added to the core in two directions (0 and 90 degrees). These kerfs can cause potential problems, especially if not completely filled with resin. Unfilled kerfs can lead to stress concentrations, resulting in earlier shear failure of the core, and can allow the transmission of water throughout the whole laminate. However, for all core installations that do not rely on thermoforming the core under elevated tempera-
ture and pressure, controllable configurations with kerfs are a necessary evil.

**Saw Cut Kerfs**

The simplest way to cut a series of parallel kerfs is to use a gang of thin saw blades, usually located 30 mm apart. The thickness (or thinness) of the blade, and thus the width of the kerf is determined by both the density and thickness of the core. You can imagine that thick, high density cores will put a lot of load on the blades, so that as cores get thicker and as they get denser, the blade thickness, and thus the kerf width, will increase.

The problem with saw cut kerfs is that they are more difficult to fill with resin or core bond adhesive, and during resin infusion can lead to “race tracking” as the resin races through the kerfs, leaving dry spots in the laminate behind. However, saw cut kerfs can be placed on the “compression” or concave side of the core curvature, allowing the kerfs to close rather than open, thus narrowing the kerf. Saw cut kerfs, when opened up on the tension or convex side of a laminate, when completely filled with resin (as they should be) can also cause cosmetic problems as these lines of thick resin shrink upon curing, causing core block “print through” to the gelcoat.

**Knife Cut**

To minimize the kerf width, knifes are often used. These can be sharp razor type knives that drag through the core at an angle, or circular “pizza” type knives that roll through the core to cut the kerfs. In both cases these knives too have their limitation on thickness and density before they start to tear or crush the core, rather than cutting. Obviously, as with saw cutting, it is the higher density, thicker cores that cause the problems. However, unlike saw cuts, once the limiting condition is reached, there is not another knife alternative. At this point saw cutting is the only alternative.

However, balsa cores are always knife cut, never saw cut. That’s because the end-grain nature of balsa results in the knife actually splitting the wood, rather than cutting the wood. Also with balsa, the knife spacing and resulting core module size is different in each direction. Rather than being a 30 mm x 30 mm or 1-1/2” x 1-1/2” square module as seen on most foam cores, balsa modules are always 1” x 2” rectangles. As with foam cores, balsa too has restrictions on both the thickness and density of core that can be cut, but balsa is never saw cut.

The obvious disadvantage of knife cut kerfs is that the kerfs cannot compress, as they do with saw cut kerfs. Therefore, knife cut cores can only bend in the direction that allows the kerf to open. This also creates a problem with forcing resin into the knife cut kerf, especially on the top side or compression side of a concave curvature. This is more of a problem with single, double and triple cut cores than with CK or scrimmed configuration.

**CK or Scrimmed and Scored**

The first attempt to create a contourable core configuration that would allow the hand lay-up of core into the compound curvature of something like a sailboat hull, was the CK or ContourKore® configuration from the Baltek Corp. in the mid ‘60s. This occurred soon after the introduction of end-grain balsa core to the marine industry. To date, the application of a fiberglass scrim to one side of the core, and then slicing almost all the way through the core to the scrim on the other side is still the most common method of making a rigid panel contourable, whether it’s balsa, foam, or plastic honeycomb. There are several variations of scrim available varying in the number of fibers per inch in each direction.

If the core is knife cut CK, then it will essentially bend in one direction only, that is, in the direction that will allow the kerfs to open. If it is saw cut CK then it can bend in two directions, since the saw cut kerfs will compress.

The method of scrim adhesion is a topic of some discussion in the core business. All foam cores to my knowledge have the scrim applied to the core with a “hot melt” system, where heat is applied to the scrim as it is being pressed to the core by a heated roller, melting a plastic adhesive to the surface of the core. However, scrims can be applied to balsa cores with either hot melt or adhesives. Alcan Baltek have long maintained that the “dot matrix” method of scrim adhesion, where in the adhesive is applied in a dot pattern over the fiberglass scrim, produces a better skin to core bond since the laminating resin can now work its way under the scrim in the areas were there is no adhesive to greatly
increase the area of bond between the skin and the core. The hot melt system will prevent this direct contact between the laminating resin and the core, potentially weakening the bond. This is more important in balsa since the skin to core bond is so much higher than in foam cores. You do not want to create a situation where the skin to core bond is weaker on the scrim side than the non scrim side of the core.

Scrim and scrim adhesion is an interesting topic, because the scrim itself contributes nothing to the strength of the laminate and can reduce the skin to core bond. The scrim is there only to hold the modules of core together to make the installation of the core easier. In this respect it is identical to the scrim being used to hold small tiles in place during installation in a bathroom or shower. Once the core is in place the scrim has served its only purpose. It is for that reason that a number of higher end builders will remove the scrim after installation of the core by peeling or grinding it off. Peeling the scrim has the added benefit of revealing any poorly bonded core modules, since these will inevitably pull away with the scrim, and will need to be rebedded in place. So the strength of the scrim bond to the core should just be sufficient to hold the modules in place when handling and installing the core. However, if the bond is not aggressive enough, blocks of core can fall off the scrim during installation or processing the core before installation (kit cutting, etc).

This condition, not surprisingly, is called “block fall-off”. This is the paradox of scrim adhesion – The better the bond between the scrim and the core, the better chance exists for a weaker bond between the skin and the core since the scrim will separate the skin from direct contact with the core. The weaker the bond between the scrim and the core, the better chance the resin from the skin laminate will penetrate beneath the scrim to bond directly with the core, but the greater chance of “block fall-off” when handling the core.

Until recently, all scrims have been in a 0-90 configuration, and reasonably tightly packed. Within the last few years however, a Texas company called Ply-Tech has introduced a more widely spaced tri-axial hot melt scrim that has been adopted by some core manufactures. However, as with all scrim materials, the bond between the skin and the core should be evaluated to confirm that it is not being compromised by the presence of the scrim, specifically in hot melt applications where the hot melt glue can spread over the core surface, not allowing the laminating resin to contact the core directly. This particularly true with balsa cores where the skin to core bond is extremely high in the absence of a scrim, so you don’t want the scrim to jeopardize that bond. With scrims, as with nuclear disarmament, trust but verify.

A final thought on this subject of scrim is the scrim on balsa cores can also cause the core to take a bow if the balsa absorbs moisture vapor and swells. If this happens, the scrim needs to be slashed with a sharp knife to relieve the tension after it’s placed into the bedding compound.

**Single Cut**

As we mentioned in Part I, the number of cuts in a core can dramatically affect the amount of additional resin a core consumes. This is especially important on curved surfaces where the kerfs will open up to allow the sheet to contour to shape. In order to reduce the number of cuts to a minimum, as well as to reduce the cost of a contourable core, the Single Cut configuration was developed. The SC configuration consists of kerfs running one direction only on one side (say zero degrees), and in the opposite direction on the other side (say at 90 degrees). The cuts...
should be deep enough so that the kerfs overlap each other, allowing air and resin to flow through the core. However, there are some caveats in its use. If the single cuts are saw cut, the kerfs will open in tension on the convex side of the core, and close in compression on the concave side. This provides a pretty contourable configuration for gradual curvature in both directions, and will adapt somewhat to compound curves. However, the saw cuts will consume more resin or core bond adhesives, and will be more difficult to fill, especially in hand lay-up. Knife cut SC configurations reduce the amount of resin required to fill the kerfs, but produce problems of their own. The knife cuts will open in tension, but will not close in compression. Therefore, SC knife cut cores are not as pliable as their saw cut brethren, and essentially bend in one direction only, making it difficult to adapt to a compound curvature. In addition, because the knife cuts on the compression side of the core (concave side) close up under compression, it is hard to force resin into these compressed kerfs, especially in hand lay-up, resulting in no bond between the modules and potential source of shear failure of the core. Therefore, single knife cut configurations should be used sparingly.

Double Cut
To introduce more curvature into panels without applying a scrim, the Double Cut (DC) configuration is often used. Some core manufactures are limited to supplying CK or scrimmed configuration to only 5/8” thickness, so DC is the only other alternative for thicker cores. With DC, the core is cut in a 0-90 pattern on one side with the cut extending 60% to 80% the thickness of the core. The core is flipped over and a similar 0-90 pattern of kerfs is applied to the other side, but off-set by half a module width in each direction, so the cuts on each side are off-set from each other. As with SC, the cuts do overlap, allowing air and resin to easily flow through the core. However, since there is now virtually twice the number of cuts in the core as in the comparable CK or Scrimmed and Scored configuration, resin absorption by the DC core also is almost twice as much as the CK equivalent. This is especially true with saw cut configurations. DC knife cut suffers the same difficulty as SC knife cut; that is the kerfs compress on the compression side of the core, making it difficult to fill these kerfs with resin, creating potential shear failure points.

Triple Cut
To allow increased flexibility of a DC type configuration to better match the contourability of a scrimmed CK configuration, especially by core manufactures who cannot supply CK configurations over 5/8” thick, the Triple Cut (TC) configuration was introduced. TC has a DC configuration on one side, but three times the number of cuts in one direction on the other side. Obviously, TC, which is only offered by one manufacturer, is only available in knife cut. Although popular at first, concerns did soon arise. It’s obvious that if DC absorbs almost twice the amount of resin, TC will absorb substantially more. It’s also obvious that this large number of cuts on one side, if not adequately filled with resin, will transmit and absorb a large amount of water. Even if filled with resin, the large amount of resin starts to determine the core properties, especially in shear elongation. That is, a linear core with Triple Cuts filled with resin becomes a brittle core. Needless to say, in most applications, TC should be avoided.

Infusion Groove
When vacuum infusion was first introduced, it often incorporated a separate, disposable infusion medium on the surface of the laminate. However, it soon became apparent that the core itself, if grooved and perforated properly, could act as this infusion medium. Therefore, almost all core manufacturers, except the honeycombs, now offer some configurations of grooves and perfs to allow the core to transmit the resin through the laminate in a vacuum infusion process. Some have grooves on both sides, some on one side only. In some, the perforations are coordinated with the grooves, in others not. Some even offered grooves

![Infusion Groove Diagram](image-url)
at 45 degrees, but now most offer predominantly at 0 and 90 degrees. However, if you are infusing, or considering infusion, by all means consider using the core as the infusion medium.

If a separate infusion medium is used, such as in the SCRIMP process, then conventional CK or DC contourable configurations can be used for vacuum infusion, since the resin flow tends to be through the core vertically, not predominantly horizontally. However, if you try to use these configurations as the primary flow medium, the larger module size will leave white dry spots in the center of each module that didn’t fully infuse as the resin rushed past in the kerfs and isolated these spots. It is for that reason that infusion grooves at about 3/4 inch are much closer together than conventional kerfs.

Thermoforming

As mentioned above, the vast majority of core problems can be traced to problems associated with the kerf systems. It goes without saying that for flat panels, rigid sheet (with perforations) should be used. However, for curved panels, the only way to use rigid sheet is to thermoform the core into the proper shape. This can only be done with foam cores, specifically PVCs, PETs, and SANs. However, some recent research has shown that perhaps even fiber reinforced polyurethanes can also be thermoformed. All core manufacturers can supply information on temperatures and time in the oven for different densities and thicknesses of their cores. Rather than heating the core in an oven, catalytic heaters can also be used to heat the core. However, only once the core is heated does the fun begin. At that point, the heated and very pliable core has to be placed under a vacuum bag on the mold to force the core to proper shape. Some builders use straps to force the core to shape, but the straps themselves can distort the core locally. Cores that have been thermoformed must be installed under a vacuum bag to compensate for any spring back in the core as it cools.

AL600 Coating on Balsa

Although not a cut configuration, the AL600 resin coating is a surface treatment for BALTEK® balsa cores that is designed to reduce the absorption of water vapor, and reduce the amount of resin absorption during hand lay-up, or especially vacuum bagging. However, the AL coating will only minimally affect resin absorption during vacuum infusion.

In the final installment of “All About Cores,” next issue, we’ll examine proper core installation procedure, we’ll discuss how things can go wrong in cored construction, and we’ll look at the controversy regarding cored hull bottoms.

Production Methods – Core Installation

Hand Lay-Up

The oldest and still most common form of core installation is to lay the core into the open laminate by hand. Most commonly, this involves bedding the core into a resin rich layer of at least 1-1/2 oz of chopped strand mat. This can be done in either a three-stage process, or a single-stage process. The three-stage process is the correct way to do it and is used by higher end laminators, often of larger boats. The three stages are, after applying the gel and skin coat:

1. Outside laminate
2. Core adhesive layer and core
3. Inside or closing laminate

That is, the core is bedded into a bonding layer that is applied to a still “green” mold side skin laminate. Since we are focused on the core, we will focus on this installation. The key here is to make sure the core is “primed” with catalyzed resin before it is placed into the bonding layer or adhesive. This priming of the core will force resin into the kerf system,
improve the bond and the strength of the laminate, and reduce or eliminating the possibility of water migration through the kerf system. The priming also ensures wet out of the core, filling of any open cells in the core, and a better bond to the mat or core adhesive bedding layer. Priming is best done by a thick nap roller with the core bent over a curved jig to open the kerf system when the resin is applied.

In a three-stage lamination process—after the installation of the core and after the core bedding layer gells and approached full cure—it’s possible to confirm the bond of the core to the outside skin by “sounding” the core with the handle of a screw driver or putty knife, or even a quarter, in order to listen for hollow areas of poor bond. If a non bonded area is found, the core can then be removed from these areas and rebonded. At this point the scrim can also be removed, further testing the integrity of the bond.

For hand lay-up it is common to use a CK configuration, even on flat surfaces. The individual blocks can be individually forced into the bedding layer, with excess bedding resin or putty, as well as entrapped air forced up into the kerfs. You can visually check for good contact by seeing the priming resin and core-bed layer being forced to the surface of the core through the kerfs. CK configurations also don’t suffer from “spring back” after lamination, leaving gaps and voids under the core.

After the core is installed, then the closing layer of glass and resin can be applied, with care to fillet all core edges and segregating the core from all openings.

The single-stage lamination process—where the outside skin, core, and inside skin are applied in one continuous process, without waiting for the previous layer to gel—although common in open mold production boat building, is fraught with potential problems. Air entrapment under the laminate is the most obvious potential ramification, as the closing layer is often applied before all the air has been forced out from under the core. Obviously, the initial bond to the bedding layer has not been tested, resulting in the potential for “never bonds” (a term coined by Bruce Pfund) and resulting voids in the laminate. The vast majority of what surveyors often term “delaminations” in the field were in fact already defects in the laminate when it left the shop. This is especially true in hot southern climates where the bedding layer can sometimes gel before the core is installed. I have walked around shop floors picking up deck plugs from hole-saw cutouts, and have been able to easily remove the outside layer from the core. Not good.

Vacuum Bagging
In order to ensure superior bond to the bedding layer, a vacuum bag can be used to apply as much as an atmosphere of pressure to the core. However, that much pressure has the potential to squeeze out all the bonding adhesive, so generally about half a vacuum is used to bed core. That still amounts to 7 psi or over 1,000 lb./sq.ft. of bonding pressure. When vacuum bagging, it’s always advisable to use a core-bond adhesives, as opposed to bedding the core into mat and resin. The higher viscosity of the adhesive will ensure that it stays in place under that much pressure, and the gel time can be better controlled. With that in mind, when vacuum bagging a core, it’s always wise to start with a “core block test” to confirm the working time of the adhesive and priming resin under exactly the same conditions of temperature and catalyzation. The priming resin specifically needs to cure in the smaller masses in the knife cut kerfs. Vinylester resin has trouble curing in such small masses and should be avoided as a priming resin when vacuum bagging. General purpose (GP) resins are best.

Vacuum bagging can be used to only bed the core (dry bag) or to consolidate the whole laminate (wet bag). However, if the latter, control of the laminate gel time becomes crucial. Therefore, often epoxy resins are used for wet bag applications. In wet bags, the core is generally bedded in the still wet outside skin, rather than using core bond adhesives. Wet bagging can also be staged, with the bag being applied after the core is placed into the wet outside skin. This approach is often taken when laminating over a male plug.

Vacuum Infusion
Once vacuum bagging has been conquered, then vacuum infusion is the next logical step. With vacuum infusion, a full atmosphere (14.7 psi) is applied over the whole laminate which has been installed dry. Because you are working with dry fabrics and core, there is no time constraint to lay the fabrics and core in exactly the orientation desired. Once the dry full laminate is installed, a vacuum bag is drawn over the full part, and resin forced (sucked) under the bag under a full atmosphere of pressure, wetting out the whole laminate. In vacuum infusion, there are no voids anywhere in the laminate and no “never bonds” and always exactly the same amount of resin used each time, achieving optimum glass to
Vacuum infusion has allowed composites to be treated as a true engineered material, much like steel and aluminum. This is what has allowed the US Navy to infuse the deckhouse on the DDG-1000 destroyer currently being infused with balsa core and carbon fiber by Northrop Grumman Ship Building in Gulfport Miss.

Because vacuum infusion applies such high pressures to laminates, single skin (uncored) laminates can be greatly compressed. This will result in a substantial reduction in panel flexural stiffness, in spite of the fact that the mechanical properties of the laminate increase. That is, the increase in “E” cannot compensate for the dramatic reduction in “I” because of the thickness cubed factor in BH^3/12 formula. The use of cores in infused laminates greatly reduces this laminate compression factor, restoring the “I” factor to the stiffness equation.

**Resin Transfer Molding (RTM)**

RTM is not often seen in boatbuilding, except perhaps in the manufacture of small parts such as hatches. The only significant exception is the VEC system developed by Genmar for the building of hulls under 22 ft overall. In RTM, catalyzed resin is driven into laminates at greater than atmospheric pressure using reinforce matched molds. If the mold is heated, rapid turn around of the part can be achieved.

**RTM Lite**

In RTM Lite, the lighter molds are clamped together using atmospheric pressure, rather than the high clamping pressure of RTM, and the resin itself is forced into the cavity containing the dry glass and core at slightly higher than one atmosphere. The core can be used as the resin transfer media, or special fabrics can be used for this purpose.

**Prepregs**

Epoxy resins have the unique ability to maintain a “B” stage of cure when held at low temperatures. This film of partially cured resin can either be pre applied to a fabric or applied as a separate resin layer in the lay-up process. The laminate is then subjected to high pressure and increased temperature to force the resin through the laminate and affect a cure. This increased pressure and temperature puts some demands on the core. The temperature and pressure have to be low enough that the core does not compress in the curing process. In addition, the core cannot give off gasses in the case of foam cores, or steam or water vapor in the case of balsa cores. PVC cores specifically are prone to outgassing if not “aged” properly, while some linear cores can be prone to thermal instability. Balsa, although thermal stable at high temperatures and pressure, must be properly conditioned to reduce the moisture content when prepreged.

**Proper Laminate Engineering**

It should go without saying that a cored bottom is an engineered structure that demands careful design. However, if unfamiliar with laminate design and bottom pressure calculations, don’t despair, there is help available. All three primary classification societies—ABS (American Bureau of Shipping), DNV (Det Norske Veritas), and Lloyds—have requirements for bottom-panel design, and there is laminate design advice and recommendations available from all the major core manufacturers. In deed, some fabric suppliers also provide laminate analysis and recommendations.

Laminate design is inevitably based on panel stiffness with the stiffness requirement based on the amount of deflection for a given span. This is expressed as a ratio of the amount of deflection per span (L), such as L/100, or stiffer laminate of L/200, etc. However, laminate failure can be based either on core shear failure or skin failure, and the key in laminate design is choosing core and skin thicknesses that balance the mode of failure so that one does not occur well before the other. While cores fail in shear, skins either fail in tension or compression buckling. That is why some classification societies will actually dictate a minimum skin thickness for a given laminate. However, bottom panels are subject to additional slamming loads and potential fatigue. Therefore, cores for bottom panels must be chosen with these slamming and fatigue loads in mind, with good shear elongation and toughness being requirements, or cores such as balsa which have inherently high compression and shear strength and modulus.

In Part 3 we will examine in more detail what constitutes proper core installation, and will look at the ramifications when cores are not installed properly. Again, quoting Bruce Pfund: “If you can’t do it right, don’t do it at all!”

**CLICK HERE** to read Part 1 of “All About Cores.”

Rob Mazza is manager, new market development, at Alcan Composites. With a degree in mechanical engineering and a masters in naval architecture and marine engineering, he has 25 years experience in custom and production yacht design, with the original C&C Yachts Design Group, Mark Ellis Design, and the Hunter Marine Design Group. He spent 14 years in structural cores with ATC Chemical (now part of SP under Gruit) and currently with Alcan Baltek Corp, part of Alcan Composites. Rob has been with Baltek 6 of those 14 years. Currently living in Bergen County, NJ, Rob sails his 40 year old C&C Corvette out of the Nyack Boat Club, on the Hudson River.
The Masthead

The Saildrive Conundrum
By Ed Sherman
Curriculum Development / Senior Instructor
American Boat & Yacht Council

Any good boat design must take into consideration such things as weight placement, overall weight, adequate power to propel, and construction costs. To that end we have seen many sailboat designs over the last decade utilize saildrive propulsion systems. Without question, saildrive systems have many desirable attributes. In theory, they should also reduce required maintenance costs. They definitely reduce propulsion system noise levels by a considerable margin. In tests I’ve conducted as a Cruising World magazine Boat of the Year judge over the last five years saildrive installations consistently produced anywhere from 5 to 10 db less noise in the cabin areas of the boats we tested at typical cruising speeds.

So the promise of quieter running, less expensive manufacturing costs and reduced maintenance would seem on the surface to tilt the scale heavily in favor of selecting a saildrive system as part of any sailboat design.

Unfortunately, we have seen some serious problems with these saildrive systems in service and they have nothing whatsoever to do with what some of the early naysayer’s predicted. A typical saildrive installation will have a robust rubber bladder that seals the perimeter of the drive mechanism which is hung from the engine’s output. This bladder is the only thing that prevents the egress of seawater into the boat around this drive leg. Early on, this rubber boot was considered to be the biggest reason to forego selection of a saildrive in favor of a traditional engine configuration. All people could think of was the boot rupturing and the boat sinking. Unfortunately I do not know the history of these two drives, which is of paramount importance in any corrosion analysis process. But, as you look at the three small water intake holes of the right drive you can clearly see that the paint coating simply began to lift off the surface around the perimeter of those holes.

The problem here may have begun as a small paint chip that grew into what you see in the photo. The bottom line on this is that one of the primary defenses against corrosion on any underwater metal is a high quality coating of epoxy and or appropriate paint. This coating will effectively isolate the highly corrosive aluminum case from the electrolyte (seawater). Any galvanic cell needs several things to function: You need two dissimilar metals (anode and cathode), they need to be physically connected by a conductor, and you need an electrolyte solution. Both of the dissimilar metals need to be submerged in the same electrolyte solution for corrosion to occur. Take away any one of the components required to make up a galvanic cell, and corrosion will not occur. Paint in effect isolates the metals from the electrolyte, so it is effective in stopping the corrosion process. So, this may have simply been a maintenance issue. This could have begun as a small chip in the paint down to the base metal that grew in size over time, exposing more and more of the metal. ABYC Standard E-2 describes this phenomenon as “cathodic disbondment”.

In Fig. 2 we know the history, and the resultant corrosion was caused by a very simple electrical design issue. This boat spent much of its time plugged in to shore power service at a dock. The boat was not equipped with a
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The Saildrive Conundrum

Galvanic isolator in the shore-power service. It’s important to remember that the anodes supplied by the saildrive vendors are engineered to protect only the drive unit, nothing else. Once the anode is depleted, galvanic corrosion will attack the next metallic object in the galvanic series food chain, in this case the drive.

Any boat plugged into a dock is vulnerable without a galvanic isolator because any anodes on the boat will also be contributing to protecting other boats also plugged in at that dock. The mechanical connection in that case is via the green grounding conductor that is a part of any AC shore power service. Fig. 3 illustrates this connection. In this diagram the aluminum outdrive on the power boat is vulnerable without protection from a galvanic isolator since the aluminum outdrive case is less noble than the bronze propeller.

The location of the galvanic isolator in the shore power circuitry is shown in Figure 4. This is a line drawing from ABYC Standard E-11:

There are several other electrical nuances that need pointing out and considered at the design phase. First we have the matter of bonding large metal objects that are in contact with sea water. Depending upon where you read it within ABYC standards, bonding may or may not be a voluntary design matter. One area of the standards states, “if a bonding system is used” it shall conform to a group of recommendations. ABYC Standards for thru-hull fittings suggests that all metal in contact with seawater be bonded. Certainly, it has been something that has been debated for years. Some boats are bonded and others are not. I believe that a case can be made against bonding under certain very specialized circumstances, but in general the party line within ABYC is to provide a bonding system under most circumstances. The idea here is that if all the metals in contact with sea water are at equal potentials, which they will achieve if tied together via bonding and connected to a suitably sized anode(s), they are protected. Also, if they are at equal potentials, no current can flow.

Unfortunately, part of the conundrum is that the two major suppliers of saildrives to our industry at the moment, Volvo-Penta and Yanmar, have two different recommendations as it applies to their engine installations. Yanmar sticks hard and fast to the ABYC recommendation to bond, that is the engine and drive assembly gets tied in to the boat’s grounding system at one point on the engine. Volvo Penta on the other hand, recommends isolation of their engines, meaning no bonding connection. Interestingly enough, I’ve seen far more corrosion problems with the Yanmar units than I have with the Volvo drives. That said, Volvos are vulnerable to another type of corrosion, stray current. Any battery potential current leak that comes into contact with the engine block or drive will induce a fault that will attempt to find a path back to its source out through the drive leg. This will induce rapid and profound corrosion of the drive leg in the water. Typical causes of this are internal alternator failures that short circuit to the case of the alternator, or battery positive connections to either a starter motor of from an alternator that got bumped into and...
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The Saildrive Conundrum

contacts the engine block or equipment case. These are all real-world things we have seen in service. Any of these faults will induce DC stray current and cause profound damage to a saildrive gear case, in a matter of days or weeks at the most. If bonded, as ABYC suggests, the damage will theoretically not occur as voltage potentials within the bonding system will equalize. If there is no difference in potential, current cannot flow.

Another potential problem, that I have recently run into, could have been mitigated with the addition of a secondary galvanic isolator as my colleague Dave Rifkin, ABYC’s primary corrosion certification instructor, has suggested in a Professional Boatbuilder magazine article on the subject.

On the boat in question, the Yanmar saildrive case was completely destroyed and had to be replaced at a cost of some $10,000 to the boat owner. The boat in question was only several years old and was equipped with a galvanic isolator in the shore power system. The captain of this 35-foot racing yacht had complained of rapid anode consumption on the drive installed anode, the only anode on the boat. The boat was equipped with Marelon (plastic) thru-hull fittings and had an absolutely minimal amount of exposed underwater metal by design. However, the vessel was equipped with a rather large lead keel, which had been coated as new with an epoxy barrier coating before the racing finish anti-fouling paint had been applied. As engineered—if this paint process is done according to manufacturer’s recommendations—the lead keel should have been isolated from the electrolyte. Unfortunately in this case, the boat owner did what most racing sailors are inclined to do, wet sand the anti-fouling paint to achieve that all-important race-ready, smooth bottom surface. During this wet sanding process, fairly significant portions of the lead keel became exposed as the periodic sanding eventually cut its way right through the epoxy barrier coat. We now had a major shift in the boat’s anode to cathode surface area relationship. The anode lost, and the aluminum drive came in next on the food chain. By design, if a secondary galvanic isolator had been installed in the bonding conductor between the engine and the keel, the boat would still be classified as ABYC compliant, and the damage to the drive would not have occurred.

In closing, let’s agree that all of the attributes of a saildrive system are truly valid but extreme care and thought needs to go into the concepts mentioned here to ensure trouble-free service. The problems in most cases that I’ve seen or have been involved with could have been prevented either at the design phase for the boat and with a little care and diligence during routine maintenance and servicing.

Ed Sherman is the author of:
- Advanced Marine Electrics and Electronics Troubleshooting: A Manual for Boatowners and Marine Technicians
- Powerboater’s Guide to Electrical Systems

Memoriam

Thomas C. (Tim) Windsor  1912 - 2009

New Zealand naval architect, Thomas C. Windsor, died on Sunday, September 6, 2009. He was 97 years old.

Tim was one of our earliest graduates, enrolling in the Westlawn School of Yacht Design in 1930, the year it was founded. He studied under Westlawn’s founder, Gerald Taylor White, graduating with a diploma in Advanced Yacht Design in 1939, and went on to have a distinguished career.

In recent correspondence with Westlawn, Tim recounted, “It was the start of the Second World War, and I was seconded into essential industry where I was the Draughtsman Designer with Shipbuilders Ltd. This firm was engaged in the building of minesweepers and Fairmile Patrol Boats for the N.Z. Navy. Then, when the U.S. entered the war after the attack on Pearl Harbor, we were building 114-foot Powered Lighters for the U.S. Army and the Navy. Fairmiles that were built here in Auckland, NZ were 112 feet in length and I think had about an 18 foot beam. There were twelve built for the NZ Navy and they were designed in Britain. The frames were laminated and they were shipped to us from India. We built the boats with Kauri timber, a very good native timber often used here for boat building. The boats were powered with three 600 hp triple screw Hall Scott gas engines each.”

After the war, Tim continued his design career with his first commission of a 27-foot patrol launch for the New Zealand Coast Guard, and then with many sailing and power boats. — Click Here to read more about Thomas C. Windsor
METAL CORROSION IN BOATS
(Course No: TT500)
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CLICK HERE for a detailed syllabus
CLICK HERE for more details and enrollment information on this and other Westlawn essential continuing education courses

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Topics include: Applicable standards; fuel-system piping and filter requirements; fuel-piping manifolds; anti-siphoning protection; access and fastening requirements; diesel-specific fuel piping considerations and day-tank piping; fuel-transfer pumps; return-oil coolers; fuel-line valves; calculating fuel consumption; calculating tank capacity and weight; specifying fuel hoses, hose clamps, and piping; tank fastening; considerations in tank location; protection against corrosion; restrictions and recommendations for location of openings in fuel tanks; tank-vent requirements and installation; fuel fills; fuel take-offs; common problems related to spills at vents and fills; tank construction; choice and selection of tank materials; requirements and recommendations for baffles and baffle openings; fuel-tank labels; tank pressure tests; flexible bladder tanks.

CLICK HERE for a detailed syllabus
CLICK HERE for more details and enrollment information on this and other Westlawn essential continuing education courses

ABYC Courses and Schedule for 2010
The ABYC Education Department has been providing industry certifications, training, high school and college curriculum, and industry seminars for over twenty years. They are providing the marine industry with the skilled workers required to build and maintain modern small craft of all types.

ABYC is currently scheduling on-site factory training for 2010. Please call ABYC for custom tailored, flat rate, instruction by top industry trainers at your facility (410-990-4460, Ext. 31).

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For course dates and descriptions **Click Here** or see listing on Masthead Page 30

*NOCTI (National Occupational Competency Testing Institute) is a regular provider of the assessments on which many certifying bodies depend for measures of applicants’ standards-based knowledge and skills. Certificates benefit employers by showing that applicants have acquired specific skills. The status of having a certified staff can lead to higher sales and customer satisfaction.*
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To register for an ABYC Education Program, click on the event name you would like to attend.

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### 2010 NMMA Boat Shows

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**2010 Conference & Training Programme**

- **2010 Conference on Ship and Offshore Technology**
  10-11 December 2009, Kharagpur, India

- **PACIFIC 2010 – International Maritime Conference**
  27-29 January 2010, Sydney, Australia

- **RINA 2010 Conference & Training Programme**
  **International Conference on Ship and Offshore Technology**
  10-11 December 2009, Kharagpur, India

- **PACIFIC 2010 – International Maritime Conference**
  27-29 January 2010, Sydney, Australia

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  27 - 28 January 2010, London, UK

- **MARINE & OFFSHORE COATINGS**
  17-18 February 2010, London, UK

- **FUNDAMENTALS OF CONTRACT & CHANGE MANAGEMENT FOR SHIP CONSTRUCTION, REPAIR & DESIGN**
  April 2010, London, UK

- **MARINE RENEWABLE & OFFSHORE WIND ENERGY**
  21 - 22 April 2010, London, UK

- **INNOVATION IN HIGH PERFORMANCE SAILING YACHTS (INNOV’SAIL 2010)**
  May 2010, Lorient, France

- **WARSHIP 2010: REFIT, REPAIR AND MAINTENANCE**
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- **Dec 2007** Tech. Article: Basic Criteria for Powerboat Stability
- **Mar 2008** Tech. Article: The Concepts and Applications of Tons and Tonnage
- **June 2008** Tech Article: Practical Speed and Powering Calculations
- **Sept 2008** Tech Article: Speed and Powering Update & Conducting Speed Trials
- **Dec 2008** Tech Article: Quiet Science (Noise Control)
- **Mar 2009** Tech Article: High Strength Metals – Part 1, Stainless Steel
- **June 2009** Tech Article: High Strength Metals – Part 2, Copper & Nickel Alloys
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Founded in 1930, the mission of the Westlawn Institute of Marine Technology is threefold:

- To provide our students with the skills and knowledge required to build a rewarding career in the profession of yacht and small-craft naval architecture.
- To support continued growth of the recreational and small-craft marine community through the development of well-trained, safety-oriented, boat designers developing better products for the benefit of the boating public.
- To provide continuing education to marine-industry professionals.