

Practical Sailor™



C&C 33

A racer-cruiser that continues to deliver.

PAGE 27



PAGE 6



PAGE 11



PAGE 16

6 **Winning the Algae Wars**

The best offense and defense against mold and algae.

16 **Anchor Swivels**

Are anchor swivels worth the inherent risks they present?

21 **Fiber Lifeline Chafe**

What's the best way to protect fiber lifelines from chafing?

11 **Editors' Choice picks**

Practical Sailor editors name the year's top sailing gear.

20 **The Cuban Yo-yo**

Every cruiser should have one of these simple fishing tools.

27 **Used Boat Review**

The C&C 33 Mark II fulfills its dual-purpose design goals.



ALSO IN THIS ISSUE

- 2 **Rhumb Lines** — Catch PS Technical Editor Ralph Naranjo on tour this fall
- 5 **Product Updates** — Latest findings in the Raymarine EVO-1 autopilot test
- 32 **PS Advisor** — Where can you find your boat's stability curve information?



PS Guru on Tour this Fall

Those who enjoyed our recent three-part special report highlighting the trends in sailboat design and construction—focusing on structure, stability, and performance (February 2015, June 2015, and August 2015 issues, respectively)—can thank *PS* Technical Editor Ralph Naranjo, who called upon his decades of experience as a voyager, boatyard manager, and marine safety consultant to weave those pieces together. The articles offer a peek at what you'll find in his outstanding opus, "The Art of Seamanship," which was published last spring and is now available in the *Practical Sailor* online bookstore, www.practical-sailor.com/books.

Technical Editor Ralph Naranjo's opus, "The Art of Seamanship," distills more than five decades worth of experience.

I'm obviously biased toward Naranjo's work, but you'll find plenty of other experts saying that this is the best book on sailing seamanship to be published in decades—maybe ever. Although anyone headed offshore will benefit from Naranjo's wisdom, the book is aimed squarely at the sailor. It's not a book for the novice tying his first bowline, or the yachtsman interested in flag etiquette. The topics it addresses—particularly those dealing with weather-routing, anchoring, sail-handling, and navigation—are examined with a depth and insight that only come through on-the-water experience.

Early on in the book, Naranjo uses a simple diagram of a right triangle to demonstrate the three essential facets of safety at sea. The shortest side of the triangle is the onboard safety gear, the next longest is the vessel's seaworthiness, and the longest side, forming the hypotenuse of the triangle, is seamanship—sadly this is the element few books bother to address. To someone with Naranjo's experience, the distribution of priorities is obvious. The best gear and best boat is no substitute for right practice and sea sense.

Naranjo's brief introductory section—an entertaining walk down memory lane in boats ranging from a Carl Alberg-designed Typhoon 19 to Dodge Morgan's *American Promise*—distills as much wisdom as you'll find in some so-

called "encyclopedia" works (some on their 10th reprint!).

If you don't yet have "The Art of Seamanship," buy it. Hell, buy two copies—one for the house, one for the boat. If it's not as good as I say it is, Naranjo will buy you a drink on *Practical Sailor's* tab. My guess is you'll be the one wanting to treat him. You can find him at the following venues this autumn, talking seamanship and safety, and no doubt, spinning a few yarns. For more details about the particular events, check the listed websites.

• **The Wooden Boat Festival:** Port Townsend, Wash.; Sept. 11-13, 2015; <http://nwm maritime.org/events/wooden-boat-festival/>; Saturday, Sept. 12: "Art of Seamanship;" Sunday, Sept. 13: "Practical Sailor Tech Talk"

• **US Sailboat Show:** Annapolis, Md.; Oct. 8-12, 2015; www.annapolisboatshows.com/united-states-sailboat-show/; Oct. 11-12: afternoon book signing at Landfall Navigation booth; Oct. 9-11: Take the Wheel workshop; Oct. 12-15: Cruisers University, "Handling Heavy Weather," "Gulf Stream," "Anchoring, the Art of Staying Put;" *Cruising World* Seminars; TBA: "The Cruising Side of Seamanship."

The 1988 C&C 33 Sea Dancer heads home to Chicago's 31st Street Marina. Photo courtesy of Karl Olson and Olson Classic Yachts.

Practical Sailor

September 2015 • Vol 41 No 9

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Practical Sailor (ISSN #0161-8059) is published monthly by Belvoir Publications Inc., 535 Connecticut Ave, Norwalk, CT 06854-1713. Robert Englander, Chairman and CEO; Timothy H. Cole, Executive Vice President, Editorial Director; Philip L. Penny, Chief Operating Officer; Greg King, Executive Vice President, Marketing Director; Ron Goldberg, Chief Financial Officer; Tom Canfield, Vice President, Circulation. Periodicals. Postage paid at Norwalk, CT, and at additional mailing offices.

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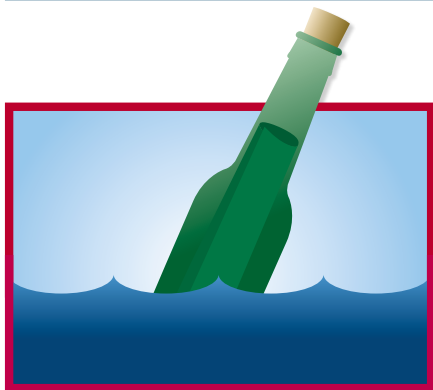
Subscriptions: \$84 annually. Single copies, \$7.50 (U.S.). Bulk rate subscriptions for organizations and educational institutions are available upon request.

Postmaster: send address corrections to PO Box 8535, Big Sandy, TX 75755-8535. *Practical Sailor*, P.O. Box 39, Norwalk ON, N0J 1P0 Canada. WDS return address in Canada: Station A, P.O. Box 54, Windsor, Ontario N9A 6J5.

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WELL WATER IN TANKS

In regard to your July 2015 article, “Keeping Water Clean and Fresh”: We have well water at our dock, and the water tanks in our boat are integral to the hull. How does this impact the process for cleaning and sanitizing?

Diane and Grant Woodside
Sablier, 1994 Pacific Seacraft 37
London Towne, Md.

Well water presents two special challenges. First, the water is not chlorinated, so there is a significant chance of it going “bad” in the tank. Even good wells can go bad if they are left stagnant, and the tank almost certainly contains some dirt. Second, most wells near the ocean have some degree of saltwater infiltration and generally elevated sulfate. This can lead to a sulfurous smell and taste, since bacteria under aerobic conditions (a sealed tank) convert sulfate to hydrogen sulfide. The cure for both is annual sanitizing and continuing treatment (1 to 2 parts per million residual after reaction time) with chlorine bleach or equivalent chlorine-containing preparations.

As long as the tank is physically clean (water filtered during filling, and scrubbed and rinsed annually), there is no special sanitizing requirement. As for the sulfur taste, bleach will oxidize the hydrogen sulfide back to sulfate (harmless and tasteless), and a carbon filter at the tap will remove the excess chlorine.

Unless the water is used very rapidly, chlorination is generally required with coastal well water to prevent off tastes. Carbon alone is not effective.

For more on cleaning your water tanks and keeping the water tasting



Readers Diane and Grant Woodside have well water at their dock and wondered if this would impact the water-tank treatment aboard their Pacific Seacraft 37, Sablier.

fresh, check out our multi-part series on clean water in the June 2015, July 2015, and August 2015 issues. We also offered a how-to on a do-it-yourself water filter in the April 2015 issue.

AWLWOOD

In response to your October 2014 Chandlery on Awlgrip’s Awlwood varnish: I brushed on Awlwood four years ago, and it still looks pretty good.

The product was originally formulated by Uroxxsys in Auckland, New Zealand and called Noroxsys, and Awlgrip purchased the formula, renaming it Awlwood. We bought the product on the change over and probably got the first Awlwood tins in Australia in 2011.

I applied six coats over two days in 25 knots of wind and full sun. It went on like a thick enamel paint with workable time using a brush, per instructions. I’ve done zero maintenance on it since, and my boat lives in hot, humid conditions year round.

I am so glad to have a product for teak that works for more than a year. I love it and will use it again.

Steve Abernethy
1997 Beneteau 461
Mackay, Queensland, Australia

BOSUN’S ALTERNATIVE

I read your July 2015 Chandlery article about the latest bosun’s chair alterna-

Reader Steve Abernethy’s Awlwood varnish still looks good after four years.

tive, which was \$495. I have for years used a saddle from New Tribe (www.newtribe.com) in great comfort. These folks have everything for recreational tree-climbing—an activity that implies you’re going to spend an extended time in the saddle and are doing it for fun; these are made for people who camp in trees!

I find the New Tribe equipment eminently well thought out, comfortable, and cheaper by far than the “marine” stuff. Their state-of-the-art saddle is \$199.

They also have a great line bag that allows me to store over 100 feet of line with never a tangle. I suggest you test some of their products next time you look at mast climbing alternatives.

Boyd Bundy
Prout 34 Esprit Catamaran
Fort Lauderdale, Fla.

We’ll definitely add the New Tribe saddle to our next round of bosun’s chair tests.



Starting Off-season To-do's

The summer sailing season is winding down, which means it's time to start planning those big, off-season boat projects.



SYSTEMS UPGRADES

The off-season—when the weather is cooler, and it's less tempting to bail on boat work to go sailing—is an ideal time to mount projects like replacing or installing a new watermaker, fridge, or water heater. If converting your **ice box to a refrigerator** is on your to-do list, check out our June 2009 review of aftermarket kits and the April 2009 comparison of traditional and digital thermostats. Another worthwhile read is the October 2013 article evaluating fridge smart controls and looking at how to fine-tune fridge efficiency.

This is also a good time to invest in a **water heater**, if you don't have one or your's needs replacing. Our December 2013

issue featured a performance test of four marine water heaters, as well as some tips on installing them.

Cruisers planning to **install a watermaker** should be sure to read the February 2013 head-to-head test of DC watermakers from Spectra and Racor; you'll also find some tips on installing and maintaining a watermaker.



SAILS

Looking to **replace your sails** this fall? Boat show season gets rolling this month and next, so now is a great time to start shopping for sails as many lofts will be offering boat-show deals. Before buying, be sure to read the March 25, 2014 blog, "Upgrading the Cruising Main." It includes links to archive articles on selecting a sailmaker, selecting new try-sails and cruising mains, and the results of *Practical Sailor's* reader survey of favorite sail lofts. It also links to *PS's* three-book e-book series, "A Look at Sails," which can be found in our online bookstore at www.practical-sailor.com/books.

BOATYARDS

If your fall project requires a haulout, our articles on do-it-yourself boatyards (see *PS* June 2009 online) and do-it-for-me boatyards (see *PS* December 2013 online) are must-reads.



FRESHWATER ANTIFOULING

Which bottom paints might be recommended for fresh water?

James Smith

Via www.practical-sailor.com

All of those we Recommended in the March 2015 issue, except for Interlux's Micron 66, are fine for freshwater, but most will be overkill. Many fresh water sailors we've talked with like Interlux's VC17 and Pettit's SR-21, which are specially designed for this. If you go back to past tests (March and October issues each year), you'll find data on these paints. We didn't include them in the last round because they did so poorly in salt water. If you look at paint performance by type (freshwater, eco-friendly, low-copper single-season, water-based paints, etc.), freshwater paints are usually the first to go (see *PS* March 2012 online).

Another article that might be helpful is the March 2014 report on favorite bottom paints by region. We also suggest the Aug. 31, 2011 *Inside Practical Sailor* blog post on choosing a bottom paint.

EDITORIALS ALWAYS PUBLIC

I found your July 2015 editorial, "Pitfalls of Going Paperless," regarding the *Vestas Wind* accident, to be highly pertinent and timely regarding a race series we are about to commence in the North Channel of Lake Huron. I would like to include a copy of the editorial with our Sailing Instructions as a cautionary tale. If you have concerns regarding my making copies of this single page, please let me know.

Gordon Simpson

North Channel Race Week

Planning Committee

Sault Ste. Marie, Ontario, Canada

PS's editorials are always public (free to non-subscribers), as are the *Inside Practical Sailor* blog and our *Way-points* newsletter; you're welcome to share these digitally. To print and distribute anything from the *PS* website or print magazine requires our

EVO-1 Autopilot Test Update

Photo courtesy of Raymarine

After three separate three-month cruises—on a Niagara 35 in the Great Lakes and a Gulfstar 36 in Florida—we have found no problems with the EVO-1 autopilot by Raymarine that we first reported on in *PS*, September 2014. Although we experienced no gale or storm conditions (we're cautious in our old age), we did get plenty of practice in heavy winds (15 to 25 knots) and light winds (12 down to drifting), and a great deal of motoring. In all conditions, the autopilot steered the boat exactly to our requirements.

We keep our boats well-balanced under sail, but the EVO-1 had no problems even when the helm loaded up. We never once had to disconnect the autopilot to steer the boat ourselves because of conditions.

The autopilot has three settings—leisure, cruise, and performance—and we found that the “performance” setting worked best, correcting most frequently and rapidly, and we used it exclusively. The “leisure” and “cruise” settings would draw less 12-volt power to the wheel drive and might be suitable for sailboats with minimal battery capacity, but the “performance” setting never put a heavy drag on our four six-volt batteries and our solar panels.

The main drawbacks of the EVO-1 are those we noted in our original report—you have to adopt the Raymarine version of NMEA 2000, called SeaTalk ng and

buy their expensive cabling. Getting the EVO-1 to interact with anyone else's instruments or nav devices will be a challenge. One of our readers discovered that to update the software in the EVO-1, you have to do it through a Raymarine MFD (multi-function display), which many sailors don't have or want. It seems generally true that Raymarine works best if you totally commit to Raymarine products.

As we said in our original report, the EVO-1 is more of an incremental improvement in autopilots rather than a significant upgrade. If we have a fully operational earlier version—ST4000 or even an Autohelm 4000—we wouldn't upgrade. The easy “set-up” function and the brainy self-adjustments for steering by the EVO-1 sensor and ACU are nice improvements, but not overwhelming.

If we found it necessary to upgrade our autopilot or all our electronics, we'd seriously look at other brands.

WINCHRITE REDESIGN

The original WinchRite, which we reported on in the Feb. 15, 2010 blog, has been discontinued. The power-assisted winch grinder was redesigned to address performance problems and complaints from customers (including some *PS* readers), according to the manufacturer, Sailology.

The new, improved model is called the WinchRite ABT (Advanced Brushless Technology). Sailology's Sven Tooth-



man explained that every component of the ABT has been improved, including a brushless motor, the battery, PC electronics, gearbox, and accessories.

The manufacturer has created two programs for current owners of the discontinued original WinchRite, which was in production from 2010 until summer 2014. Owners can trade in their discontinued or out-of-warranty WinchRite, regardless of condition, for a \$300 credit toward the new ABT model, redeemable only through Sailology; this amounts to almost a 45-percent discount off of list price, making the purchase \$449 with free shipping. The second program allows owners to have any out-of-warranty, original WinchRite refurbished for \$239. This includes having the motor and gear box serviced or replaced and the battery exchanged. For more information, contact Sailology at www.sailology.com.

Practical Sailor plans to test the new WinchRite ABT for an upcoming report.

publisher's permission, as does posting online the subscriber-only articles. That being said, he is always happy to support safety-oriented projects such as yours. We also try to make many of our safety articles public for digital sharing and viewing after they have been in circulation for 18 to 24 months. For non-subscribers, the “Safety at Sea” ebook series is also a good buy (<http://www.practical-sailor.com/books>).

MECHANICAL RIGGING

In response to the May 19, 2015 blog post on sealing mechanical rigging ter-

minals: Any concerns about rust staining are unwarranted. Such staining is probably due to transferred iron from the tools used to cut the wire and/or assemble the fitting. Most commercial 304 stainless parts go through an iron removal (electro-polish or passivation) to remove transferred iron from the manufacturing process. That can't be done at the assembly step in the boat yard.

Ed Carter
Islander 37
Galveston Bay, Texas

CORRECTION

The May 2015 boat review of the Pacific Seacraft 31 gave the incorrect hull number for the boat we tested; it is hull number 127. And while the test boat has a Selden in-mast furling system, the gear is not standard.

Practical Sailor welcomes reader comments and questions. Send email to practicalsailor@belvoirpubs.com; include your name, homeport, boat type, and boat name. Send Gear Graveyard samples to *PS* at 7820 Holiday Dr. S., Suite 315, Sarasota, FL 34231.



Fighting Mildew, Mold, and Lichen

Over the years, Practical Sailor has tested dozens of concoctions that claim to combat mold and mildew. Ultimately, we have found that some home brews are the best choice for excellent, cheap protection.

Quaternary amines provide long-lasting protection, even outdoors.

Most boat owners regard their boat as a living, breathing thing, but when real living things—especially the microscopic variety—move aboard and start occupying large swaths of damp real estate, it's time to draw the line. We've done a series of reports on mildew in past articles, but those black spots on the deck, lines, and canvas probably aren't mildew. Mildew and mold require darkness, and even the shaded areas on deck are too well lit. Those spots are more likely black algae and lichens, the latter a symbiotic combination of algae and fungus.

Bleach doesn't work very well on algae or lichen; it doesn't penetrate the cell walls well, and plants in general are not very sensitive. Also, bleach doesn't really remove color from most materials or stains that have been in the sun; if they are colorfast in UV, they can usually resist bleach as well. The best we can do is find something to kill the organisms, and then remove the dead bodies with scrubbing and surfactant. After the heavy

scrubbing is done, weak acid cleaners and bleach can be used to remove metal stains and break down organic material, respectively.

WHAT WE TESTED

For this round of testing, we will be exploring quaternary amines, both silicone and benzyl substituted. The silicone variety offers greatly improved water resistance (it is commonly found on sportswear), while more common benzyl amines (ubiquitous in cleaning and non-bleach sanitizing products) offer better economy for cleaning and mildew prevention inside the boat. (For an extended explanation of quaternary amines, and links to past reports on mildew prevention and treatment, see the *Inside Practical Sailor* blog post "Conquering Mildew Wars," Nov. 4, 2013.) Although you pay premium prices for .02 to .5 percent benzalkonium chloride (BAC) solutions in sanitizing cleaners and algae removers, there is a

cheap source: Swimming-pool algae treatments contain 30 to 50 percent BAC at a far more attractive price.

One of our main goals with this evaluation was to compare the performance of Elite Marine Shield and Gold Shield, two silicone-substituted quaternary amines that were the subject of a previous report. Both promise durable, weather-resistant protection.

We also picked two BAC-based swimming pool algae eliminators available at any big-box and hardware store: HTH Algae Guard 3x concentrate (30-percent active), and Clorox Pool and Spa Algae Eliminator (50-percent active). Both looked to be effective and cheap alternatives, well suited to exterior cleanup and indoor applications. Several other BAC products marketed for exterior use that we did not test also promised long-lasting protection outdoors. For example, Wet and Forget, which is sold through some hardware store chains and widely available on the Internet, is a 10-percent BAC solution that is diluted to 1 to 2 percent BAC for use. It claims to remove algae from

Gold Shield GS75



AS VALUE GUIDE ALGAE KILLERS							
TYPE	SILICONE QUATERNARY AMINES			BENZYL QUATERNARY AMINES		CONTROLS	
PRODUCT	PROGENICS ELITE MARINE SHIELD \$	GOLD SHIELD GS75 SPRAY ★	GOLD SHIELD GSS* ✓	CLOROX POOL & SPA GREEN ALGAE ELIMINATOR ✓	HTH ALGAE GUARD 3X CONCENTRATE ★\$	FORMULA B ✓\$	UNTREATED
COLOR	Milky white	Milky white	Milky white	Blue	Clear	Clear	N/A
ACTIVE INGREDIENT	5%	1%	5%	50%	30%	N/A	N/A
SIZE	8 ounces	32 ounces	128 ounces	32 ounces	128 ounces	N/A	N/A
MILDEW/ALGAE GROWTH PREVENTION RATINGS							
COTTON SHEET BAGS (DAMP / EXPOSED)	Poor	Poor	Poor	Poor	Poor	Poor	Poor
CANVAS STRIPS (DAMP / SHELTERED)	Good	Good	Good	Good	Good	Excellent	Poor
NYLON PFD (DAMP / OUTDOORS)	Excellent	Excellent	Excellent	Very good	Very good	Good	Fair
CANVAS STRIPS (DAMP / OUTDOORS)	Poor	Poor	Poor	N/A	N/A	Excellent	N/A
NYLON PFD (DAMP / INDOORS)	Excellent	Excellent	Excellent	Very good	Very good	Very good	Fair
CANVAS STRIPS (DAMP / INDOORS)	Poor	Poor	Poor	N/A	N/A	Excellent	N/A
SUNBRELLA WITH WATER REPELLENT	Excellent	Excellent	Excellent	Excellent	Excellent	N/A	Fair
SUNBRELLA WITHOUT WATER REPELLENT	Excellent	Excellent	Excellent	Very good	Very good	N/A	Fair
SUNBRELLA WASHED	N/A	N/A	N/A	Excellent	Excellent	Good	Poor
PRICING							
DILUTED TO 1%	1 gallon	0.25 gallons	6 gallons	12.5 gallons	30 gallons	N/A	N/A
PRICE	\$35.25	\$20	\$195	\$12.98	\$15.65	N/A	N/A
PRICE / GALLON @ SUGGESTED RATIO	\$35.25	\$80	\$30	\$1.04	52 cents	9 cents	Free
★ Best Choice ✓ Recommended \$ Budget Buy					* Diluted to same concentration as GS75.		

home roofs and keep it away for at least one year.

Our current benchmark for this type of protection is our do-it-yourself blend, “Formula “B,” which costs just pennies to make. (See accompanying sidebar and the “Homemade Mildew Preventers that Really Work” *Inside Practical Sailor* blog post, Oct. 14, 2013).

HOW WE TESTED

In this article, we are continuing the work we did in “Mildew Treatments and Stain Removers” (see *PS* November 2013 online). We dusted off the fresh samples of stock of cotton canvas rectangles to use as algae incubators, just as we did in the mildew test. We used

untreated canvas and our Borax/baking soda/TSP Formula B as controls.

We tested each product on Sunbrella (nine removable window covers), dock lines, smelly rain gear, and shoes. We also tested each product on nylon, type IV PFDs that had been taped off in sections; each section was treated with a different product. The test platforms were stored in damp locations, both exposed to the elements and sheltered. We experimented with both pool algae treatments and Borax treatments to eliminate green coatings on a garden shed and a heavy moss accumulation on a shingled roof.

We also sprayed each prod-

uct on clear plastics to observe any damage and tried several combinations on algae-spotted fiberglass decks.

OBSERVATIONS

Because these are all organic chemicals, like wax, it is only reasonable to expect limited lifespan with UV exposure. We found that performance started to fade after 12 months in the sun. Both silicone and alkyl quaternary amines provide longer-term protection in indoor environments, but for deck areas and indoor/outdoor carpet, one should not expect more than a single season of protection. To-



Formula B: Effective DIY Mildew Spray Recipe

We've dubbed the most effective homemade, anti-mildew spray formula tested as "Formula B." It costs about one penny per ounce and is our Best Choice for protecting materials like cotton or wood.

Like the other mildew preventers, you should use Formula B by simply spraying the product on, wiping away any excess, and then leaving it on the substrate. Before applying to any fabric, test the spray on an inconspicuous sample spot.

FORMULA B RECIPE

- 1 quart of hot water
- 2 tablespoons baking soda
- 2 tablespoons Borax
- 1 tablespoon trisodium phosphate (TSP)

ward the end of our test period, the silicone formulas seemed to have a significant edge. If any product is to be used to kill existing algae and followed by aggressive cleaning, the product will be removed in the process. To reduce cost and the amount of wasted product, you can instead use a generous volume of a less-expensive BAC product to produce a gross kill, wait a few weeks for the UV to do its work, scrub away the bodies, and then lightly spray the area with one of the more expensive silicone-substituted products as a preventative. BAC worked as a preventative too, just not quite as well.

Although benzalkonium chloride can quickly kill micro-organisms on all surfaces, time is your friend. Unlike bleach, which provides a quick kill and dissipates just as quickly, benzalkonium chloride works over longer time periods, slowly soaking into the thicker layers and delivering a deeper kill. Don't be in a rush. There is no concern over leaving the solution in place to soak for hours or days. Unlike bleach and alkaline cleaners, which kills and also chemically attack the cell structure and surface bonds, BAC only kills.

Time, exposure to UV, and scrubbing with alkaline cleaners are needed to remove the debris after it has decomposed a bit. The heavy layers of algae on our roof, which we spray with a 2-percent solution of Clorox Pool and Spa, turned brown within a week, and the rain removed most of the remnants over the next few months.

We tried soaking Sunbrella

followed by scrubbing and laundering; this was no more effective than straight cleaning. However, if we sprayed the canvas in place, left it in the sun for two weeks, and then scrubbed with a brush, the algae was considerably easier to remove and was removed more completely. The improvement was even more noticeable on lichen, which are unaffected by most cleaners once they get a good grip. In our test, the BAC made the lichen crumbly and loose; the improvement was much greater than the photographs convey.

Warm weather also helps. Although BAC is effective down to freezing, the greater the cell metabolic rate, the faster it works. However, in hot weather, it might dry too quickly to fully penetrate, so often morning or evening treatment is best.

While all of these products were effective in protecting nylon life jackets and acrylic canvas (Sunbrella), don't expect miracles. Previously, we tested these products on cotton canvas sheet bags (constantly damp), and they all failed miserably, performing no better than untreated canvas.

It seems that Borax-based treatments are considerably more effective than BAC on cellulose-based materials like cotton. Interestingly, we were first intrigued by Borax-based treatments when exploring the totally non-sailing related topic of preserving totem poles. We learned that the National Park Service uses glycol borate es-



Clorox Green Algae Eliminator

ter solutions to preserve historic wooden structures, and wood is primarily cellulose. Silicone substituted and benzyl quaternary amines, on the other hand, have much higher affinity for synthetic fibers and materials (nylon, polyester, fiberglass, and even roofs) than Borax, which washes out of these very easily.

Our conclusion? The best algae and mildew preventative for all fabrics remains an effective water repellent treatment (see "Keeping Canvas in Tip-top Shape," PS February 2014). Mildew preventatives clearly add additional protection. Some of the dirty covers we tested had been treated with water repellent, and the quaternary amine treatments boosted that protection.

In terms of specific fabrics, silicone quaternary amines are best for synthetics, and Borax-based treatments are best for natural materials and for all interior applications, including synthetics. We suspect this is because the Borax better attacks the soil that feeds mildew.

Human toxicology of these products has been extensively tested, and they are generally accepted as safe. However, many BAC products are not sold in California because of the state's strict environmental laws, and some users have reported breathing difficulty after spraying large areas with high concentrations (2 percent or greater). Solutions of greater than 0.1-percent BAC have not been associated with negative effects and are permitted in cosmetics and hand sanitizer.

Gold Shield GSS



BAC Keeps Mold Away

Protected fabrics and an unprotected control were inoculated with mold, then checked periodically for growth. Untreated panels were kept in a clean and dry place for comparison, allowing testers to gauge the level of protection. The formulas were also field-tested on a boat deck and a dodger.

1. These samples were stored indoors for six months. The fabric samples, from left to right, were treated with Elite Marine Shield, Goldshield, and PS Formula B (see PS tester Drew Frye's accompanying recipe). The untreated control is on the far right; the original fabric is behind. Formula B did not do as well as the others outdoors.

2. One week after treatment with BAC, even tenacious lichens on this roof died. (The green, living patch has been placed for comparison.) Rain washed away the dead lichen.

3. The right side of this Sunbrella dodger was treated with our home-brew, which helped ward off mildew.

4. Using a spray-on water-repellent, such as 303 Fabric Guard, helped to boost the performance of all the preventatives when used with Sunbrella.



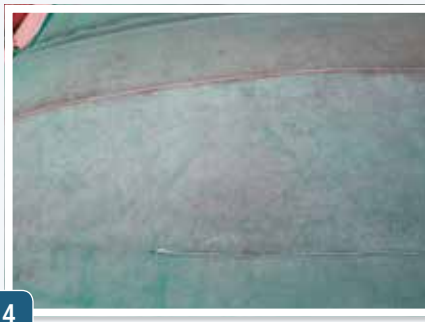
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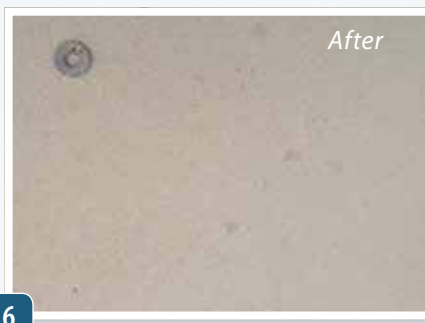
3



4



5



6

5. Some of the lichen stains on our test deck were quite large before treatment.

6. After the lichen was killed by spray-

ing it with a 2 percent solution of benzalkonium chloride (4 percent solution of Pool and Spa Algae Eliminator), most of the lichen stains could be scrubbed off.

People with asthma or other sensitivities should use a chemical respirator when spraying large areas. Exposure can also be reduced by soaking or brush application. Our testers did not notice any effects even when spraying very large areas at high concentration; they were careful to use a coarse spray, to work from leeward to windward, and to keep their backs to the light breeze. Marine toxicity is moderate and is avoidable with reasonable care.

OTHER USES

Odor control. We also observed that BAC is the primary ingredient in treat-

ments sold for deodorizing wetsuits, sneakers, waders, and rain gear. After a good scrubbing, we applied BAC inside sneakers and seaboots; they still stunk, even weeks later. While it is certain these products can control the growth of odor-causing bacteria, we noticed no effect on gear that was already stinky. Most probably the odor-causing agents are already deeply impregnated in the materials, and quaternary amines can do nothing to decompose or mask what already exists.

What about foul-weather gear? Certainly a 0.2-percent solution used as a rinse would provide an odor-fighting

film throughout the garment, but the practice would need to start before the gear was smelly.

Bilges and lockers? We didn't have any smelly spaces to test, but we think it might be useful here. It is non-corrosive and non-bleaching.

Harm to fabric also was a concern. To test for this, we applied each test product at five times the recommended doses to canvas, gelcoat, acrylic, polycarbonate, and soft vinyl window materials, allowing them to dry through multiple cycles. None of the test products harmed fabric or caused discoloration. Unlike bleach, these products

As in previous tests, we used fabric samples to serve as incubators. Some samples were stored indoors; others were exposed to weather.

trate strikes us as the Budget Buy in this category.

CLOROX POOL AND SPA ALGAE ELIMINATOR

Like several nearly identical pool treatments (concentrations and package sizes vary), this product contains benzalkonium chloride and a small amount of co-solvent required to stabilize the solution. For heavy-duty algae killing, we diluted this product 50:1 to make a 1-percent solution (about \$1.04 per gallon). For algae and mold preventative, we diluted it to 100:1 (about \$0.52/gallon).

Unlike aggressive cleaners containing bleach and alkalis, it does nothing to help remove the growth, but it did a good job of providing a deep kill, even through heavy layers (we used it on algae, heavy moss, and lichen colonizing). A 32-ounce concentrate costs \$13.

Bottom line: Recommended. This product is great for killing algae on canvas, controlling mold inside or out, and even on roofs.

ALGAE GUARD 3X CONCENTRATE

Made by HTH/Lonza Chemical, Algae Guard 3x Concentrate is another common swimming pool product, but it is sold in a large bottle at a slightly lower concentration and lower price per unit. We could see no difference of performance between it and the Clorox. Unless you plan to use it at home, you'll want to share with a neighbor, because the one-gallon of concentrate makes up to 250 gallons (depending on dilution) of treatment formula. It costs about \$16 for one gallon of concentrate.

Bottom line: This is our Budget Buy for killing algae on canvas and controlling mold inside and out.

CONCLUSIONS

Goldshield and ProGienics are effective mold and algae preventatives that show better wash-off resistance on polyester and nylon than benzalkonium chloride or our Formula B when exposed to rain;

we recommend these as premium-price treatments that will last a little longer on your sail covers and cushions. For killing and cleaning in one step, Formula B is a little more effective due to its alkaline cleaner function. Additionally, Formula B is the better preventative on wood and cotton products.

For cleaning synthetic canvas (Sunbrella, Top Gun, etc.), if you have a little patience, the best product is generic benzalkonium chloride spray, diluted from pool algae treatment; it is non-damaging to every surface we tested and provides a good kill for both algae and lichens. The primary downside is time; it only kills the algae, and time in the sun is required to weaken the bonds before it can be removed by scrubbing. However, with planning, it offers a low-impact and low cost way to increase cleaning effectiveness and reduce cleaning labor. A single gallon of concentrate yields 25 to 250 gallons of cleaning solution, at a cost of 4 cents to 50 cents per gallon—that's a bargain for even the most frugal sailor.

We still recommend our Borax-based Formula B as the Best Choice and Budget Buy for natural materials (cotton and wood) and for interior applications, where it has proven to be a dependable workhorse.

Whatever product you use, don't expect miracles. Damp cotton canvas always mildews, water repellent treatments prevent the damp required for growth, and regular cleaning still helps. Yep, it's still just like owning a boat. 

CONTACTS

HTH/LONZA CHEMICAL,
800/484-7665, www.hthpools.com

CLOROX, www.cloroxpool.com

ELITE MARINE SHIELD
(PROGIENICS), 248/947-5219,
www.elitemarineshield.com

AP GOLD SHIELD, 516/375-2927,
www.goldshield1.com

can be left on for a prolonged period so they can soak in. However, we always recommend covering clear vinyl during any chemical application.

GOLDSHIELD GS5/GS75

Based on a silicone-substituted quaternary amine salt, Goldshield GS5 and GS75 claim to have antimicrobial properties that can last up to 50 laundry cycles. We tested the concentrated GS5, and it performed very well on our life jackets, preventing all growth, even after exposed to a full year of rain and partial sun. (One small spot appeared as spring arrived.)

It is available both in ready to use form (GS75; 1-percent active; \$195 for one gallon, certainly a multi-year supply) or as a concentrate (GS5; 5-percent active; \$20 for a 32-ounce spray bottle, enough to do your canvas once or twice; or \$195 for one gallon, which provides 6.5 gallons of ready to use product at .75-percent active).

Bottom line: Recommended. This is an effective product for treating acrylic, nylon, canvas, and for interior upholstery.

PROGIENICS

ProGienics is a microbiostat agent made by ProVetLogic and distributed by Elite Marine Shield. It is based on a silicone-substituted quaternary amine salt. It provided lasting protection through a full year of partial sun and rain exposure, in our tests. It costs \$36 for 8 ounces of concentrate to make one-gallon of application solution.

Bottom line: The 8-ounce concen-



Mainsail halyard shackles from Schaefer and Tylaska earned spots on the 2015 Editors' Choice gear list.

Editors Tap Top Gear of the Year

From water filters to halyard shackles, here are the best of the bunch.

Each fall, *Practical Sailor* editors sort through the best test products of the past year to pick those deserving of a spot on our PS Editors' Choice roster. To be named to the list, products must earn the Best Choice rating among their respective peers and clearly stand out above others in their field.

Chosen from test products covered in the September 2014 through the August 2015 issues, this year's Editors' Choice picks represent nearly every category of marine gear—from rigging and hardware to maintenance, systems, electronics, and apparel. These products are the if-money-were-no-object picks. Budget-minded and small-boat sailors may be better suited with our Budget Buy or Recommended picks in certain test categories; for more on those products, refer to the online archive articles cited in this report.

RIGGING & HARDWARE SPINLOCK ROPE CLUTCH

In the November 2014 issue, we compared rope clutches from Antal, Gar-

hauer, Karver, Lewmar, Ronstan, and Spinlock. Testers were amazed by the wide range of approaches to the seemingly simple task of seizing a rope.

The clutches faced a series of bench tests using different rope of varying sizes. The protocol included tension testing, grip testing, and pull tests; testers also considered construction quality, mounting support and ergonomic factors.

The top performer was the Spinlock XTR0812/B, which comes with what the maker calls a "reactor cam" that engages top and bottom line grippers. Toothed edges on both the top and bottom aid the locking cam design. Testers found this approach worked very well on smaller-diameter ropes. The modular design makes it easier to disassemble the operational parts while the frame remains attached to the boat. The combination of stainless steel and fiber-filled plastic components and smooth-working cam levers make this a user-friendly clutch.

The quick disassembly and all-

around performance of the XTR made it our Editors' Choice pick.

SCHAEFER & TYLASKA SHACKLES

A mainsail halyard shackle needs to be as reliable as an on/off switch on a table saw. In the September 2014 issue, we tested hard and soft shackles to determine which would best serve the cruiser, who prizes durability and strength, and the racer, who makes lightweight a priority. Testers evaluated metal shackles from Schaefer Marine, Ronstan International, and Tylaska, as well as fiber shackle from Equiplite and Colligo. The

Spinlock XTR0812/B





Schaefer 93-75



Tylaska H8

protocol included faux-halyard bench tests—repeatedly point-loading pins and loop locks—and handling observations in the workshop and on board.

The heavy-duty Schaefer 93-75 earned a spot on the Editors' Choice lineup as the best mainsail halyard shackle for a cruiser because of its structural quality and tried-and-proven design. The non-magnetic, investment cast 93-75 utilizes a dual-thread clevis pin that is threaded at both ends, a very useful design features for cruisers. The finely finished shackle got high marks for engineering and attention to detail.

The top pick, and Editors' Choice winner, among shackles for racing sailors looking for a lightweight, metal mainsail shackle was the Tylaska H8. This machined, high-strength, hard-anodized aluminum shackle has a built-in thimble that can be used in either 2:1 or 1:1 halyard configurations. A screw-type 17-4PH clevis pin positively locks the gate. The H8 features offset drilled holes for the clevis pin; this design helps spread the shackle's load more easily.

PEERLESS ANCHOR SHACKLE

Shackles are generally available in two grades: Grade A and the stronger Grade B. For our anchor shackle test in the August 2015 issue, we focused on Grade B shackles from Peerless, Campbell, Crosby, and Canada Metals Pacific (CMP)/Titan, as these are the established names in the industry. Testing was carried out at J.L. Robertsons, an approved test facility in Newcastle, Australia, on a test rig that is used to certify lifting components for the mining industry.

Peerless is the United States' biggest chain manufacturer (Acco). Its Peer-Lift shackles, differentiated from other suppliers by a blue pin, are well suited as anchor shackles. The Peer-Lift quarter-inch, Grade B, shackle we tested had a rated working load limit of 1,500

pounds with a 6:1 safety factor. This gives it a minimum breaking limit of 9,000 pounds. In our test, the shackle exceeded its load limit by almost 10 percent, failing at 9,800 pounds. The failure was at the thread; the pin sheared.

The blue-pin Peerless shackle exceeded all expectations in this evaluation, earning it a spot on this year's Editors' Choice lineup.

ROBLINE NO. 10 WHIPPING TWINE

In the December 2014 issue, we evaluated various sizes and brands of whipping twine used for handsewn boat projects like lockstitching lines and burying splices. We measured how strong the twines were and learned which ones tangled the easiest. We also tested each type on our chafe machine to see which material best withstood the rigors of use. Testers focused on waxed polyester twine and unwaxed Dyneema twine.

The No. 2 through No. 8 waxed whipping twines from Robline are laid polyester twine, rather than braided, while the Nos. 10 and 15 twines are more heavily waxed and braided, resulting in much better handling and far fewer tangles.

Larger spools and ready availability make any of the Robline waxed polyester twines a good option, but the braided No. 10 was our favorite for general use. It has excellent strength and makes sewing easier, garnering it a spot on the Editors' Choice roster.

FRESHWATER SYSTEM SHURFLO & HYDRONIX FILTERS

When significant accumulations of dirt and biomass are allowed to build up in the tank, no final filtration system can make the water right again. Water-pump life is reduced by sediment, and fun-

gal mats will clog your water lines. In 2015, we looked at how to prevent contaminants from entering your onboard freshwater tank (PS June 2015), chemical treatments for cleaning tanks and keeping tank water fresh (PS July 2015), and filtration systems between the tank and faucet that keep tap water sweet and safe (PS August 2015).

We tested common commercial hose-end filters and universal cartridge filters, along with our DIY Baja filter. Our testing included basic observation, tests for flow rates and chlorine removal, and filter dissection when expended.

The best off-the-shelf, hose-end filter was Shurflo's Waterguard filter, made by Pentair Residential Filtration. Like most other filters in this category, these are also filled with a carbon/KDF blend, but the Waterguard filters provide slower flow rate due to finer filtration (5 microns). Finer filtration means less chance of biological growth, and we like that, but whether this is acceptable may depend on your tank size. At \$37 each, these are not cheap, but they last about two years.

Testers' top pick for a cartridge filter was the Hydronix SPC-25-1010, a 10-micron pleated polyester element. The Hydronix represents the optimum compromise of flow, filtration, and usable life. The molded ends can serve as gaskets, a much better arrangement than a no-gasket system, at some increase in cost. Like the Waterguard filter, the Hydronix is rated for more than 6,000 gallons, which represents 150 40-gallon fill-ups; more than any seasonal coastal sailor will need.

AQUAMEGA & PURICLEAN TABS

In the July 2015 issue, we compared a host of tank-cleaning products, sanitizing chemicals, and tank-freshening chemicals. We dosed each fresh-

ening product into reverse osmosis (RO) water, and then stored the water in our pseudo, mini "water tanks." We graded how well the chlorine residual endured after 24 hours, and how well

Shurflo Waterguard

Pentek FloPlus-10



The Best of Maintenance

Our Editors' Choice roster would not be complete without the top performers in our semiannual bottom paints tests (PS October 2014 and April 2015). The most recent test looked at 55 different paints from Blue Water Paints, Interlux, Epaint, Pettit, and Sea Hawk.

This year's hard paint standouts were Interlux's Micron Extra with Biolux and West Marine's Bottomshield. Made by Pettit, the West Marine-branded PCA Gold was the top ablative paint. Micron Extra and PCA Gold tied for best performance of the bunch.

SPICE CHAFE PROTECTION

In a March 2015 report, we evaluated chafe protection for line splices. We tested coatings and physical coverings—everything from electrical tape to leather, webbing, heat shrink, and vinyl tubing—and coatings from Spinlock, Yale Cordage, West Marine, 3M, New England Ropes, and Loctite.

The top-performing anti-chafe coating was Yale Cordage's Maxijacket (\$8/4 ounces), while the best physical protection for splices was New England Ropes' Dyneema chafe guard tubing (\$2/foot). Both earned their places on the Editors' Choice list.

Maxijacket is a quick-drying, waterborne polyurethane coating that soaks in deeply and stiffens line considerably. However, the 10-fold improvement in chafe resistance was very impressive. It is the Best Choice for protecting polyester line.

NER's Dyneema tubing is very similar to nylon webbing, except it is thinner and far more durable when wet. Testers noted that the Dyneema tubing will last longer than the line it's protecting; it's the best option for heavy-duty protection.

residual odor and taste were removed. We repeated similar tests for tank cleaning-chemicals and tank-sanitizing chemicals. We also placed aluminum corrosion coupons in the solutions and graded them after regular checks during a three-week period; chlorine-induced corrosion is a major concern with aluminum tanks. For real-world testing, we used each of the freshening chemicals during a summer of cruising, dosed as recommended, and evaluated taste.

Testers favorite tank-cleaning product in our test was the AquaMega tablets. Based on sodium dichlorisocyanurate, AquaMega tablets are available in amounts matched to tank sizes.

We observed a more stable residual and much lower aluminum corrosion rates compared to bleach.

The convenient packag-

ing, long shelf life, ease of use (nothing to measure), low corrosion rates, and stable residual made AquaMega our Editors' Choice among tank freshening and disinfecting chemicals. It was also our favorite to use.

The sodium dichlorisocyanurate-based Puriclean Clean Tabs tank sanitizer has the same basic chemistry as the AquaMega Tabs, and it also lasted longer than bleach. Testers noted much lower aluminum corrosion rates with Puriclean than with other sanitizing

products. This plus a stable residual earned Puriclean the Editors' Choice pick among tank-sanitizing chemicals. Both AquaMega and Puriclean also will work well in aluminum tanks.

AquaMega



West Marine (Pettit) and Interlux antifouling paints topped the field of 55 paints, earning Editors' Choice picks.

SPRAY-ON WAXES

The December 2014 issue reported on our search for affordable spray waxes—liquid waxes that offer a glossy finish and some surface protection and that are applied after rubbing compounds, fillers, waxes, and polishes.

The test field featured 14 liquid spray-on waxes advertised for boat, RV, and car applications. We applied each product to a taped-off section of an old, white fiberglass hatch cover, left the panel exposed to the weather for 30 days, then rated the products for water-beading ability and gloss.

Overall, the best performer in both the water-beading and gloss tests was Turtle Wax's Ice Premium Care. Turtle Wax Ice—which is also one of the least expensive sprays tested (bonus)—earned our Best Choice pick and a spot in the Editors' Choice roundup.



PENTEK FLOPLUS-10

Our final filter test focused on carbon-block filters, since these offer the best combination of affordable price, ease of installation, and effectiveness in improving taste and eliminating microorganisms. Testers sought a filter that would remove chlorine residuals, cysts, and most bacteria with inexpensive and simple 0.5-micron, carbon-block filters. All of the filters we tested can be used to filter water from a reverse osmosis (RO) watermaker.

For the test, we installed a carbon-block filter (Pentek CBC-5) in a 2-by-10 housing to provide faster water flow. With the NSF-certified products, we measured flow rates and chlorine removal efficiency, to confirm what they reported. We used a combination of lab equipment and aquarium test strips during testing; the test strips never con-

VHFs, SSBs, and Reading the Weather

In the April 2015 issue, *Practical Sailor* evaluated four handheld VHF radios loaded with all the bells and whistles, including longer battery life, positive flotation, internal GPS, and digital selective calling (DSC) capabilities. Out performing VHFs from Icom, West Marine, and its own product line was the Standard Horizon HX870, which grabbed a spot on our Editors' Choice list.

A fully compliant Class D DSC radio, the HX870 has an advertised 6 watts of transmit power and an 1800 mAh Li-Ion battery. The large-screened HX870 has a long, long list of useful features, including a full dot-matrix display with channel names, position request, position report, 10-channel preset key selection, GPS position logger, a water-activated SOS strobe light, NOAA weather, programmable memory, priority scan, and dual- and tri-watch scan functions. Testers also like the intuitive menu interface and the MOB soft key. The easy to use, easy to view HX870 is a solid radio that covers all the bases for a reasonable price: \$249.

ICOM M802 SSB RADIO

A marine VHF radio is more than adequate for the average weekend sailor, but for those venturing farther from shore, a high-frequency single-sideband (SSB) radio is a better choice for reliable two-way communications.

As we reported in our November 2014 issue market scan of SSB radios, Icom dominates the marine SSB realm, so it's no surprise that its M802 marine transceiver got the Editors' Choice pick for SSBs.

A basic Icom M802 system package consists of an M802 transceiver, RC-25 remote control head, and an antenna

*Standard
Horizon HX870*

Icom M802 SSB



Davis Vantage Vue

tuner (with the AT-140 antenna tuner being the most popular choice). Features include a large LCD display with easy-to-read dot matrix characters. For fast channel selection, the control head features two dials—one for banks (groups) of channels and one for individual channels.

The M802 also features built-in, one-touch digital selective calling (DSC) for both emergency and "direct dial" communications. With tuner and antenna, the system sells for about \$2,500.

DAVIS VANTAGE VUE BAROMETER

In the July 2015 issue, we evaluated three mid-range digital barometers from recognized names in weather sensing: La Crosse Technology, Davis Instruments, and Weems & Plath. We also looked at other "network" options for receiving and displaying barographic data from B&G and Starpath.

The top pick in the test was the Davis Vantage Vue Wireless Weather Station. Although it is also a predominantly shore-based product, the Davis Vantage Vue is rugged enough to find a home on board.

The system has lots of useful weather-sensing extras. It has a crisp display that gives very detailed graphic information about barometric trends and other tracked stats. Its solar-powered sensor array can be mounted on a pole or arch, and it has 22 user-selectable alarms. A good combination of easy installation and sea-ready ruggedness, the Vantage Vue is an Editors' Choice pick.

flicted with our lab results.

We evaluated 2-by-10-inch and 2-by-5-inch filters from Pentek, Kx Matrikx, General Ecology, General Electric, and Doulton. The Pentek FloPlus-10 was our favorite all-around choice among NSF-53 filters. It costs more than others (about \$16 each), but we liked the combination of high flow-rate, acceptable clogging resistance, a fair price, and an NSF-53 rating.

The 2-by-10-inch FloPlus-10 fits standard housings, is NSF-53 certified to remove cysts, and offers all of the flow and longevity we could ask for. This filter is a good choice for U.S. and around-the-world-sailors.

STAR BRITE ANTIGEL -50 & -100

We tested antifreezes for winterizing potable water systems (PS September 2014) from Star brite, Sudbury, Camco, and West Marine. Winterizing products are formulated using propylene glycol (PG), a relatively non-toxic liquid similar to glycerin, or denatured ethanol, which is generally less expensive and performs much the same function, preventing freezing and bursting. Ethylene glycol, common in engine coolants, is not appropriate for

potable water systems because of significant acute toxicity. We tested each product for glycol content, freezing and burst point, corrosion protection, and chemical compatibility.

All of the test products were effective freeze-proofing agents, with some small variation in glycol/alcohol concentration, but the Star brite Antigel -50 and Antigel -100 offered the best value and protection, earning them spots on the Editors' Choice list.

A premium propylene-glycol product, Star brite's -50-degree Antifreeze and Antigel provided the best



freeze- and burst-point protection of the group. It was typically the last to freeze and showed the greatest glycol content. It also performed very well in corrosion testing. It is formulated to be used without being diluted.

A more concentrated version of the Star brite -50, the -100-degree Antifreeze and Antigal has twice the glycol—perfect for boats in extreme climates. The extra glycol allows for inevitable dilution with undrained water.

ENGINE COOLANTS DETROIT DIESEL POWER COOL PLUS

Our October 2014 search for an engine coolant with corrosion protection focused on light-duty coolants for gasoline engines and heavy-duty products for diesels. The test field included products from Star brite, West Marine, Zerex, and Cummins.

Samples were tested for corrosion protection for two weeks, then cleaned, dried, and evaluated for both a change in appearance and loss in weight. We also tested the products' freeze points, and diesel coolants were tested for cavitation pitting; any evidence of pitting or freckling was considered to be a failure.

A common premium factory-fill coolant for heavy-duty trucks, Detroit Diesel Power Cool Plus scored very impressively in all of our corrosion tests. It is available through Detroit Diesel parts dealers as either a concentrate (\$20 per gallon) or pre-diluted (\$12 per gallon). We rated Power Cool Plus as the Budget Buy and Best Choice

pick among engine coolants, garnering it a place on this year's Editors' Choice lineup.

APPAREL GILL OS2 FOULIES

In early 2015, *Practical Sailor* tested mid-range, men's and women's foul-weather gear from Gill, Grundens, Helly Hansen, Henri Lloyd, and West

Marine. We set the price maximum at approximately \$500 for a jacket and bibbed trousers combo. Each foul-weather kit was worn for several months and was subject to a series of rigorous tests designed to measure resistance to the elements, breathability, wearability, reflectivity, functionality, and abrasion resistance.

Testers reported on the men's gear in the February 2015 issue and women's in the March 2015 issue. In both tests, the Gill OS2 kits got top billing. The OS2 jacket and trousers, which rated Good or Excellent in every test category, are the ideal mid-range kit for the serious sailor who is headed offshore but isn't looking to spend \$1,000 on foul-weather gear. Priced at \$550 per set, the men's and women's OS2 kits are the Editors' Choice because of their versatility, comfort, and superior quality and construction.



Gill women's OS2



Gill men's OS2

Testers noted that the waterproof and windproof men's jacket is comfortable and relatively lightweight with a fleece-lined collar, a mesh liner at the neck and shoulders, and is available in high-visibility colors. Handy details include sufficient pockets, a fluorescent, rollaway hood with good visibility, shock cord at the bottom, and reflective patches. The bibs, which have an elasticized waist, are designed for comfort and can be easily donned, doffed, and adjusted.

The OS2 women's jacket had the same features and high marks for comfort, light weight, quick drying, water and wind resistance, and breathability. The women's trousers have an elasticized waist, a dropseat, and wide, adjustable shoulder straps, and the fastening system at the ankle is superior to other brands tested, testers noted. ▲

CONTACTS

AQUAMEGA, www.cleantabsusa.com

DAVIS INSTRUMENTS,
www.davisnet.com

DETROIT DIESEL,
www.demanddetroit.com

GILL, 800/822-6504, www.gillna.com

HYDRONIX, 909/527-6996
www.hydronixwater.com

INTERLUX YACHT FINISHES,
800/468-7589, www.yachtpaint.com

NEW ENGLAND ROPES,
508/678-8200, www.neropes.com

PENTEK, 262/238-4400
www.pentairaqua.com

PEERLESS, www.peerlesschain.com

PURICLEAN, www.cleantabs.co.uk

ROBLINE, www.fse-roblines.com

SCHAEFER, 954/587-6280
www.schaeferhardware.com

SHURFLO, 800/854-3218
www.shurflo.com

SPINLOCK, 877/465-6251
www.spinlockusa.com

STANDARD HORIZON, 714/827-7600
www.standardhorizon.com

STAR BRITE, 954/587-6280
www.starbrite.com

TYLASKA, www.tylaska.com

TURTLE WAX, 800/887-8539,
www.turtlewax.com

WEST MARINE,
800/262-8464, www.westmarine.com

YALE CORDAGE, 207/282-3396,
www.yalecordage.com

Anchor Swivels: Caution Required

Stroll down the docks at any boat show, and you'll see a surprising number of boats equipped with expensive, stainless-steel swivels between the anchor and the chain. Almost all of these swivels are highly polished, machined and/or welded gems that cost anywhere from \$80 to \$200 or more. By comparison, a galvanized anchor shackle rated to withstand the same or greater loads as the chain rode we rely on costs less than \$15. (See PS August 2015 online.)

The rising popularity of anchor swivels can be traced to a number of factors. The swivel proponents say that it reduces the amount of twist in the chain so that the windlass can more easily flake the chain down a chain pipe and into the chain locker without jamming. A twist-free chain also spills more easily out of the locker when deploying.

A more commonly touted advantage is the swivel's ability to help coax the anchor up into the anchor roller. The swivel helps the anchor to rotate into the right orientation so that it can self-stow.

In most cases, these problems amount to mere nuisances. You can usually overcome them without the use of an anchor swivel, and without too much expense or effort. (See "Chain Jams and other Windlass Woes," *Inside Practical Sailor*, May 20, 2014.)

A few long-term cruisers, some windlass manufacturers, and others have promoted the use of anchor swivels, but we—like several anchor makers we spoke with—remain unconvinced.

"Generally swivels are only really required when anchors spin (hydro-rotate) in the water on deployment and retrieval," said Ned Wood of Manson Anchors. "Evidence of this would be



The maker of the Kong ball-and-socket swivel (top photo) suggests adding a chain leader between the anchor and the swivel to avoid side loading. An eye-and-eye, galvanized cup swivel (bottom) is easy to inspect for corrosion. A bow shackle between the chain and anchor prevents side loading and allows for an oversized, load-rated swivel that will exceed the chain's tensile strength.

when you hear the chain skipping on the gypsy."

One of our concerns is material. Stainless steel, in our view, is to be avoided for any load-bearing components in the anchor rode. (For more details regarding our aversion to stainless steel, see our special report, "Marine Metal Warning" PS February 2007 online).

In the course of researching this topic, we tracked down several examples of broken swivels, both stainless and galvanized. Although we have no data showing how widespread swivel failure is, the bottom line is that adding an anchor swivel adds a potential failure point, something we want to avoid in the anchor rode.

To get a better understanding of how they can fail, we conducted simple tests on a few swivel samples to induce various modes of failure. We also put several swivels to use in the field, hoping to discover how well they work and whether any advantages are worth the expense.

TYPES OF SWIVELS

There are a few types of anchor swivels: box swivels, cup swivels, ball-and-socket swivels, and universal swivels. To further confuse things, box swivels are

also sometimes called "barrel swivels."

In box swivels, the parts that rotate are largely hidden from view. Cup swivels, also known as "open swivels" because you can see nearly all of the working parts, are more easily inspected.

Box swivels have a common design. At each end is a two-pronged fork, and there is a clevis pin (often threaded) that closes the forks. In effect, each end is a shackle. One fork is slightly narrower, to fit the chain. The wider fork is often attached directly to the anchor.

The rotating "swivel" in a box swivel is a simple rod that joins the two forks in a manner that allows each end to independently rotate. AnchorLift, Imtra, West Marine, and Seadog all offer swivels of this type.

Cup swivels are commonly used for moorings (preferably above the water for easy inspection) and sometimes in anchor rodes. They are typically galvanized steel, but we've also seen stainless cup swivels. Cup swivels are relatively large and look more utilitarian than box swivels. A large number of unrated, no-name cup swivels (stainless and galvanized) come from factories in China. However, you can find load-rated, galvanized cup swivels from reputable U.S. makers like Peerless, Campbell, Crosby,

MAKER & MODEL		FITS CHAIN SIZES	PRICE	MINIMUM TENSILE STRESS*	WORKING LOAD LIMIT	TYPE / STYLE TESTED	MATERIAL	SIZE RANGE AVAILABLE
BOW SHACKLE AND CHAIN **	AVERAGE G30 CHAIN (SHORT LINK)	5/16 in. (actual dia.)	NA	9,000 lbs. (PS tested)	2,250 lbs.	Short link chain	Galvanized	NA
	AVERAGE G43 CHAIN (SHORT LINK)	5/16 in. (actual dia.)	NA	12,000 lbs. (PS tested)	3,000 lbs.	Short link chain	Galvanized	NA
	CROSBY ANCHOR SHACKLE G209A (SILVER PIN)	5/16 in. (actual dia.)	NA	19,905 lbs. (PS tested)	4,400 lbs.	Anchor shackle	Galvanized	3/16 in. and up
ANCHOR SWIVELS	PEERLESS/ACCO 4406-4001	5/16 in.	\$43	None published	1,500 lbs.	Cup / Jaw & eye	Galvanized	1/4 - 3/4 in.
	CAMPBELL 3640535	5/16 in.		None published	1,500 lbs.	Cup / Jaw & eye	Galvanized	1/4 - 3/4 in.
	WEST MARINE 226753	3/8 in.	\$29	11,250 lbs.	2,250 lbs.	Cup / Jaw & eye	Galvanized	1/4 - 3/4 in.
	ULTRA FLIP SWIVEL UFS10	5/16 - 3/8 in.	\$480	37,230 lbs.	12,410 lbs.	Ball & socket / Jaw & jaw	Stainless	1/4 - 1 in.
	WASI POWERBALL M8304-5-8	5/16 - 3/8 in.	\$272	8,992 lbs.	Not published	Ball & socket / Jaw & jaw	Stainless	1/4 - 2 1/8 in.
	ANCHORLIFT 964410	5/16 - 3/8 in.	\$70	11,000 lbs.	Not published	Box / Jaw & jaw	Stainless	5/16 - 3/8 in.
	SUNCOR S0190-X008	1/4 - 5/16 in.	\$85	8,500 lbs.	2,1000 lbs.	Universal / Jaw & jaw	Stainless	1/4 - 3/4 in.
	SUNCOR C0156-HD08	5/16 in.	\$24	4,800 lbs.	1,200 lbs.	Cup / Jaw & eye	Stainless	1/4 - 5/8 in.
	MAXWELL P104370	1/4 - 5/16 in.	\$27	None published	1,650 lbs.	Box / Jaw & jaw	Stainless	1/4 -1/2 in.
	OSCALATI (01.738.01)	1/4 - 5/16 in.	NA	None published	None published	Jaw & eye	Stainless	1/4 - 5/8 in.
	IMTRA SPA-801	1/4 - 5/16 in.	\$80	4,650 lbs.	1,550 lbs.	Box / Jaw & jaw	Stainless	1/4 - 3/8 in.
	SEADOG 182612	5/16 - 1/2 in.	\$60	17,000 lbs	Not published	Box / Jaw & jaw	Stainless	1/4 - 5/8 in.
	WEST MARINE 289290	5/16 - 7/16 in.	\$109	None published	750 lbs.	Box / Jaw & jaw	Stainless	1/4 - 1 in.
	KONG, ITALY ASP 644.10	5/16 - 1/2 in.	\$96	11,020 lbs.	4,400 lbs. (side load)	Ball & socket / Jaw & jaw	Stainless	1/4 -3/4 in.

*Maker provided (calculated) minimum tensile strength, except where noted for shackles and chain. ** For comparison only

and Chicago Hardware.

The ball-and-socket swivel is a cross between a cup and box swivel; the working parts are visible but some of the internal socket is hidden. Ball-and-socket swivels that have earned a good reputation among cruising sailors include Wasi Powerball and Ultra Flip Swivel, expensive swivels that have been designed from the start to eliminate weaknesses found in other designs. Apart from a voluntary, 2010 swivel recall by Ultra-importer Quickline (see *Inside Practical Sailor* blog, Dec. 15, 2010), we're not aware of any of these brands being prone to specific problems. However, because of the relatively low numbers of these swivels in the field, it's hard to draw any firm conclusions regarding their reliability.

Nevertheless, it is prudent to steer clear of unrated, stainless-steel swivels selling for what seems like bargain prices.

The universal swivel is a variant of the box swivel.

The swivel mechanism not only rotates, it has an additional but separate articulation (a hinge). The joint slightly reduces the extra leverage on the forks when connected directly to the anchor shank, but the hinge is yet another potential point of weakness. Suncor is among the reputable brands of universal swivels.

Swivel styles can be described as eye and eye, eye and jaw, or jaw and jaw. When the swivel rod connects two forked ends, each of which is closed with a clevis pin or sexbolt, it is described as a jaw-and-jaw swivel. A swivel with one forked end with a clevis pin

and one end that is metal ring (or eye) is called a jaw-and-eye swivel; one with two eyes connected by a swivel rod is appropriately called an eye-and-eye swivel. Most makers offer swivels in all three configurations.

Some makers advise against attaching swivels directly to the anchor, instead recommending a shackle and even a short length of chain "leader" to prevent any side loading on the forks. Some swivels are much weaker under side loads, making it more likely that the forks can be pried open, ultimately leading to a failure at the fork or clevis pin.

We would also worry about older swivels, even from well-known makers. Some older designs had thinner forks that were not strong enough to withstand the side loading that can occur

Failure Points Often Hidden

Nothing on a sailboat is immune to failure, and our sampling of broken swivels, sent to us by readers and others, represents a small percentage of those actually in use. Nevertheless, many elements regarding anchor swivels—choice of materials, difficulty of inspection, lack of consistent labeling, to name a few—concern us.

1. This swivel shows distortion of the fork, resulting in misalignment of the clevis pin. The clevis pin that held the chain failed.
2. We made up a sex bolt assembly in a rigging toggle and loaded it to destruction. The sex bolt failed when the head of the smaller-diameter male bolt sheared off.
3. This hot-galvanized, Chicago Hardware cup swivel probably failed at the spot weld that kept the end nut from rotating (not shown).
4. Oscalati's anchor inverter is made by Xinghui Precision Casting. It incorporates a swivel at the chain end. We were unable to find any published load data for this swivel.
5. This photo shows a cross-section view of the swivel in a box



swivel like those shown in photos 1 and 6. The swivel shaft is simply a threaded stud with a cap welded on it.

6. The welded-on cap (shown in cross-section in photo 5) on this unidentified box swivel eventually succumbed to corrosion and failed under load. The failure illustrates the risk of not being able to inspect a stainless-steel fitting used underwater, particularly one which has been welded.

when the swivel is no longer aligned with the load. Side-loading is more common with the newer, deep-setting anchors, which require far higher loads to reset when the wind shifts.

FAILURE MODES

The cause of failure in the field often remains a mystery because all or most of the evidence is never recovered. Based on our research, limited testing, and the samples we have received, the most typical failures are the following.

BENT FORK

Bending at the fork is very common. Many swivels we see are attached directly to the anchor with the clevis pin secured directly to the anchor shank.

Modern anchors are capable of holding under very high loads, and don't rotate so easily as the load direction changes. The swivel is quite long, so that the fork acts as a lever, amplifying any side load. When the angle of pull comes from one side of the anchor, something has to give. Usually, this is the swivel.

One way to prevent the fork from bending is by introducing a shackle, or a shackle and a few links of chain, between the fork and shank. In fact, Kong strongly recommends isolating the swivel using a shackle and length of chain in this manner, but few owners seem to follow this guidance.

Because stainless steel is not a very ductile alloy, a component showing

signs of bending may be significantly weakened and should be replaced.

PIN FAILURE

The most typical failure occurs at the clevis pin on the end that is secured to the anchor. The failure is often preceded by the fork's side loading. The side load causes one or both of the forks bend, and this, in turn, shears the head off the clevis pin, or causes the threaded components to tear apart.

A close examination of the construction of an inexpensive box swivel reveals how these failures occur. In reality, the clevis pin is not a solid, high-tensile, clevis pin but a machined "sex" bolt, a bolt made of two threaded parts, one male and one female. The longitudinal

Ultra claims its ball-and-socket swivel (top) is stronger than the chain it is meant to pair with, even when side-loaded, so attaching it directly to the anchor is no problem. Nevertheless, it's obvious how the forks on a streamlined, jaw-and-jaw barrel swivel could pry open as side-loading increases. We saw evidence of this in our samples.



center of the female part is drilled and tapped to accept the matching male bolt, and this assembly helps lock the clevis pin in place. Obviously, the hole in the center of the female component reduces its strength. The head of the male component is often welded on, and the weld can be weak.

In some of the swivels we examined, the failure occurred when the forks began to bend and the increased tension on the bolt assembly ripped the male bolt out of the threaded female part, or the head off the male bolt simply sheared off. In other cases, the clevis pin sheared near the center, because it simply could not withstand the load.

The clevis pin at the chain end of the swivel is a similarly engineered sex bolt. As a result of this two-part design, on some swivels, the 3/8-inch diameter pin is actually much weaker than a 5/16-inch G43 chain.

In our destructive testing, these clevis pins failed in the similar way bow anchor shackles failed in our previous tests (see PS July 2015 online). The forks began to spread, and the pin pulled out or sheared at the thread.

BEARING FAILURE

The bearing where the two forks join and rotate is also prone to failure. Commonly, the bearing is a threaded stud set into one-half of the component and secured by welding the stud (see "A Closer Look"). The bearing surface is a simple cap welded onto the stud. The quality of the welding at the cap can be questionable and the weld is often weakened by corrosion, which can lead to failure.

FALSE CONFIDENCE

As we saw in our report on the hidden causes of rigging failure in the May 2015 issue, many swivel failures can be traced to our own ignorance. Because stainless-steel swivels are relatively expensive, we think they should last forever. But just as with rigging, the dynamic loading takes its toll over time. Moreover, the weak

components are hidden from view. It is impossible to see the swivel mechanism at all, and unless you disassemble the swivel and inspect it regularly, the condition of the clevis pins remains a mystery.

The cup swivel lets you see all the critical components. We tested two galvanized cup swivels, one from Peerless (Acco) and another from Campbell; both U.S.-based manufacturers' anchor shackles did well in our recent test (see PS July 2015 only). The two swivels were surprisingly similar; both were 5/16-inch models, for a 5/16th inch chain, and both failed at 7,500 pounds. One of them failed in the body of the swivel, and the other failed at the clevis pin.

The ultimate tensile strength (UTS) for these swivels is consistent with the advertised working load limit (WLL) of 1,250 pounds (with a 3:1 safety factor). But this is well below that of a typical 5/16-inch G30 chain, which has a UTS of 9,000 pounds. If you insist on having a swivel for your 5/16-inch anchor chain, you should at least upgrade to a 3/8-inch swivel (WLL of 2,250 pounds), or even a half-inch swivel (WLL of 3,600 pounds), if it fits. If you use larger chain, you also will want to upsize the swivel to match the chain's UTS.

Unlike a box swivel, all the potential wear points in a cup swivel are easily visible. The swivel mechanism is a bolt with the nut welded on, so it's secured by two means—the threads and the welded cap. The clevis pins are threaded like many anchor shackles (secured then Loctite applied and/or mousing), or use clevis pins locked.

CONCLUSIONS

Except in special circumstances, we have seen no evidence that a swivel solves any significant issues. There is evidence that the cheaper, stainless box swivels fail for a number of reasons related to poor engineering or poor assembly. Also, attaching swivels directly to the anchor shank can exacerbate the



potential of failure.

If you must use a swivel—and we have great difficulty in endorsing the practice—then a galvanized, cup/open swivel that is the same size as the chain is too weak. Be sure to go up two sizes, and we'd suggest choosing an eye-and-eye cup swivel so that you can attach a secure, quality shackle to each end. Steer clear of any low-priced, no-name stainless swivels, even if they're oversized. In our opinion, no swivel should be attached directly to the shank of an anchor, because side loading greatly reduces the safety factor. Unless your swivel or shackle can match 100 percent of chain's ultimate tensile strength at any angle of pull, it is not worth the risk. ▲

CONTACTS

ANCHOR LIFT, www.anchorlift.com

CAMPBELL,
www.campbellchainandfittings.com

CHICAGO HARDWARE,
www.chicagohardware.com

IMTRA, www.imtra.com

KONG, www.kong.it

OSCULATI, www.osculati.com

PEERLESS, www.peerlesschain.com

SEA DOG, www.sea-dog.com

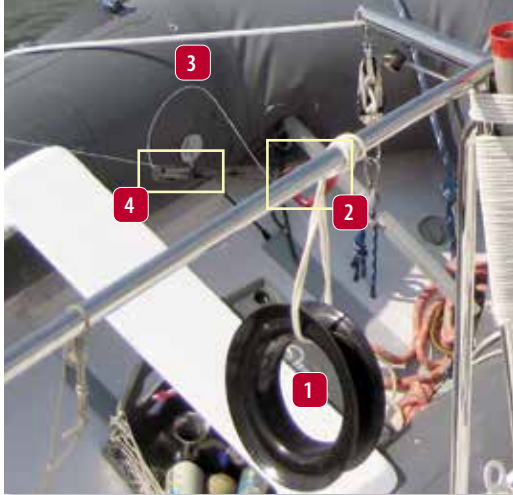
SUNCOR, www.suncorstainless.com

ULTRA, www.ultraanchors.com

WASI, www.wasi.de

XINGHUI, www.xinghuicasting.com

WEST MARINE,
www.westmarine.com



This is how we set up a fishing yo-yo aboard a PDQ 32. The Challenge reel (1) is tethered to the stern rail with a length of line and a carabiner (2). We make a loop (3) in the monofilament and attach it to a Cannon flatline/outtrigger clip (4). When a fish bites, the clip releases and the tension pulls the yo-yo up and back, allowing it to strike the stern rail and sound the fish-on "alarm."

Fishing Rigs for Sailors

The low-cost, space-saving yo-yo hand reel is the most basic, efficient fishing gear you can find—it's essentially a handline modernized with a molded plastic reel wrapped with monofilament.

Every cruising boat should carry at least one fishing rod and reel for fooling around and catching dinner, but carrying a proper trolling rig can create a storage problem on board. Enter the simple yo-yo: Pre-rigged for trolling, it is a compact, cost-effective, and efficient tool for the cruising sailor; a whole stack takes up less room than a typical tacklebox. The wide, deep spool allows for the line, inline sinker, leader, and lure to be stowed, ready for use, right on the yo-yo.

The 6-inch-inside-diameter yo-yo is best for handlining and typically comes pre-loaded with 300 feet of 40-pound test monofilament, a 1-ounce sinker, and a hook; the 8-inch yo-yo is typically sold empty and is better suited to a trolling setup.

RIGGING THE YO-YO

A broad ridge on the inside of the yo-yo allows a good grip for playing and landing any fish you can manage with one hand. (For most, however, a rod and reel is still easier to use; casting is simpler, it's easier to feel the bite, and playing the fish is more dependable.)

To set up a yo-yo, secure 150 to 200 feet of 80- to 100-pound test line to the spool with a mono knot such as a clinch knot. If you're fishing for mid-depth

gamefish, add a 2- to 8-ounce inline sinker with a swivel; vary the weight when you're trolling multiple rigs at the same time.

Follow that with a 20-foot leader of 80- to 100-pound test and a lure of your choice. Local knowledge rules, but yellow hose eels, large Rapala trolling plugs, high-speed chrome spoons, and parachute jigs with soft baits are all popular, depending on the target fish. Size the lures according to what you can actually catch and eat.

Attach the yo-yo to the stern rail with a sling of one-eighth-inch double-braid and a carabiner. Make a small loop in the monofilament about 2 feet from the yo-yo, and place it in the flatline clip or outrigger clip (this creates a cleaner release than clipping straight line), removing the tension from the yo-yo and allowing it to hang down; when a fish bites, the clip releases, the yo-yo lifts up and back as it pulls taut against the tether, striking the stern rail and sounding the "fish-on" alarm.

Trolling speeds vary from 3 to 4 knots to 4 to 7 knots. For pelagic fish such as tuna and mahi-mahi, skip the weights, switch to feather jigs and kona clones, vary the line lengths, and troll at 6 to 10 knots. Though you can certainly troll with the engine on, we seem luckier under sail—or perhaps we just don't care as much when we strike out.

To land the fish, slow down but do not stop; maintaining a minimum of 3 knots keeps the slack out of the line, preventing the fish from throwing the hook. It also helps reduce tangles by keeping everything straight. To reel in, simply wind the line back on the spool with a figure-8 motion of the arm and wrist, just as you would wind in a kite. The reel does the work and you should only touch the line to guide it and to feel the fish. If you hope to fight a large fish—and these can mangle some big fish—donning sailing gloves may be a good idea.

Aboard our PDQ 32 catamaran, the typical trolling setup includes four yo-yos—two about 3 feet in from each stern corner, and two on stubby outriggers. When casually trolling, we often set just two on the corners.

To use the yo-yo, simply bait up and lower the line over the stern. If you're fishing from the beach or a tender, you can cast by letting out about 3 feet of line, then pinching the line against the yo-yo's side with your thumb, and whirling the bait and sinker over your head like a slingshot. Face the low edge of the spool in the direction of the cast, and the line will whirl off, just as it does on an open-faced spinning reel.

YO-YO PRODUCTS

For the average sailor, any Cuban-style yo-yo will likely suffice (just look for a good finger ridge and smooth molding), but we like the Challenge-brand plastic hand reels (\$4, www.amazon.com). The larger size is better suited to 80- to 100-pound monofilament and has room to store an attached sinker and lure.

We also prefer Cannon's Unistacker downrigger release clip. We've tried many brands, and they all work fine, but we Recommend Cannon (www.cannondownriggers.com) as we've found them to be very reliable, easily adjustable, and the best value (\$15/set of two).

For outrigger release clips, we Recommend the Tigress brand. These allow the trolling line to release from the outrigger, indicating a hit. The Tigress clips (\$25 for a pair, www.westmarine.com) are reliable and a good value.

Bottom line: A lot of fun for little bitty money, yo-yos are compact enough for day sailors, yet durable enough for world sailors. For the casual angler, stick with the 6-inch diameter sizes. We Recommend Canon, Tigress, and Challenge gear for setting up your yo-yo rig. ▲



Although the extreme hiking portrayed on this Melges 24 (above, left) is usually frowned upon, racers certainly impose more abuse on lifelines than cruising sailors. However, incidental hand grabs (above, right), and sheet chafe take their toll over time.

Fiber Lifeline Protection Plan

Don't let hidden chafe doom your efforts to ditch wire lifelines.

New, single-braid, high modulus polyethylene (HMPE) lines, such as Amsteel Blue from Samson Ropes, WR2 (wire rope replacement) from New England Ropes, and Vectrus from Yale Cordage, have revolutionized the way sailors think about standing and running rigging. Bit by bit, these low-stretch ropes are replacing wire rope on board. But the changeover is not without controversy.

In several reports, *Practical Sailor* has examined the pros and cons of high-modulus fiber in standing and running rigging. We have evaluated fiber halyards as a cost-effective replacement for wire halyards (see *PS* August 2007 online), and we have discussed the challenges in finding terminals for fiber standing rigging (see *PS* September 2007 online). We also recently looked into replacing wire lifelines with fiber (see *PS* September 2012 online).

We still encourage using uncoated wire lifelines (without any sheathing)

for cruising sailors, but we are well aware of the allure of fiber lifelines. In this report, we'll explore the pros and cons of fiber lifelines in more detail and compare results of our most recent tests.

It's easy to understand why fiber lifelines have become all the rage. They enable racers and multihull enthusiasts to save critical pounds. Do-it-yourself sailors find them easy to splice. They look cool, save weight, and are gentle on the hands. A key advantage is that they don't corrode like wire does.

Practical Sailor has long advocated uncoated, 1 x 19 strand 316 grade stainless-steel wire lifelines (7 x 7 strand may be used for installations with more bends). Although uncoated lifelines lack the aesthetic appeal of vinyl-sheathed wires, corrosion and frayed wires offer warning when replacement is due. In our September 2012 report, we found that corroded, vinyl-coated lifelines failed at less than 20 percent of their stated breaking strength.

Fiber lifelines also have inherent problems. Ultraviolet light weakens the fibers, although recent studies show that this weakening occurs at a fairly predictable rate—a loss of 30 to 50 percent in strength over five years. You can compensate for this by using a larger-diameter fiber lifeline with a tensile strength that far exceeds the wire lifeline specifications, or by replacing the fiber lifeline at more frequent intervals.

Manufacturer testing and anecdotal reports suggest that one-quarter-inch, single-braid HMPE lifelines can retain the required strength for eight years in average usage in northern climates, but durability can be highly variable, depending on conditions or use. Some recommend using covered line, but we have no proof that a cover reduces UV exposure any more than simply using larger line. Our investigation into sewn splices (see *PS* October 2014 online) revealed that in most cases, cover and core both lose strength at the same rate.

PS VALUE GUIDE LIFELINE CHAFE PROTECTION			
TYPE	CHAFE PROTECTION	PRICE PER FOOT	OVERALL CHAFE RESISTANCE
DYNEEMA SINGLE BRAID	SAMSON 	\$1.68	Fair
	UNTREATED AMSTEEL BLUE (CONTROL)		
LIQUID COATINGS	YALE CORDAGE MAXI JACKET 	10 cents	Fair
	SPINLOCK RP25 	30 cents	Fair
PLASTIC TUBING	CLEAR VINYL	\$2.02	Poor
	POLYETHYLENE AIRLINE TUBING	\$1.64	Fair
	TYCO ELECTRONICS HEAT SHRINK TUBING	\$4 / 8 inches	Poor
FABRIC	BLUE WATER ROPES 9/16-INCH TUBULAR NYLON WEBBING 	28 cents	Good
	NEW ENGLAND ROPES DYNEEMA SLEEVE 	\$1.15	Excellent
	MALDIN MILLS SUNBRELLA 	1 cent	Fair
DYNEEMA COVER & CORE	NEW ENGLAND ROPES WR2* 	\$1.75	Excellent
★ Best Choice  Recommended  Budget Buy * See "How We Tested" for notes on WR2			

The ultraviolet rays easily penetrate the cover.

Fiber lifelines' second weakness is chafe. As a result of some fiber lifeline failures caused by chafe, the racing rules allowing for fiber lifelines have changed. The fundamental standard is the International Sailing Federation (ISAF) Offshore Rule. Section 3.14.6 of the rule defines acceptable materials and diameters for lifelines. (Most interpreted the new rule to exclude the cover from the minimum required diameter, since the cover does not add any strength to the splice.)

In 2012, ISAF accepted Dyneema. However, in January 2105, the international governing body of sailboat racing (ISAF) banned the use of Dyneema in all offshore races (Categories 0-3).

The U.S. national body, U.S. Sailing, allowed Dyneema for the 2015 race season, but a Dyneema ban is expected for 2016. Dyneema is still permitted for in-shore racing (Category 4 and 5). Individual race rules may vary. (Dyneema is permitted in the Chicago-Mac, but

not the Newport-Bermuda race.) All known failures have occurred on racing boats, which see far more chafe on their lifelines than cruising boats.

Chafe usually occurs when lifelines are used as handholds (a bad habit) or where sails and sheets bear on them. Chafe also occurs where the lifeline passes through stanchion holes. In more than one reported incident, race crew members were lost overboard (unharmed) as a result of this hidden chafe. Clearly, if you're considering switching to a fiber lifeline, you'll want to closely inspect any possible chafe points, and deburr and polish (with 600-grit sandpaper) any places where the line makes contact with stanchions.

WHAT WE TESTED

Although you can buy covered HMPE lines, we focused on bare single braids and double braids, which are more commonly used for lifelines. We looked at some familiar chafe guard materials: nylon tubular webbing and Dyneema chafe sleeves, as well as some non-tra-

ditional materials, such as heat-shrink and plastic tubing. We also tried the liquid coatings that proved effective for polyester rope protection (see *PS* March 2015 online). We then tested line with an integral Dyneema cover (NER WR2) versus oversized Amsteel to see which was stronger after equal torture (see accompanying "A Closer Look").

OBSERVATIONS

Our rope abrasion machine was slightly modified to include a sawing (side-to-side) movement, in addition to the back-and-forth (lengthwise) abrasion; see "How We Tested" for more details. Although the test data proved revealing, some of the most useful observations regarding the performance of the various chafe protection materials couldn't be quantified; real-world results will be highly dependent on the type of installation.

Floating: Some chafe materials molded to the stanchion and stayed in place without being secured; others slipped/floated through the stanchion hole no matter what we did. Generally, those that stayed put worked best. We recommend testing fit to see which material/style works best on your stanchions.

Heat shrink: Commonly used to seal electrical connections, heat-shrink tubing shrinks when heat is applied, allowing it to snugly conform to whatever it is sheathing. One problem with using heat shrink tubes on fiber lifelines is that applying heat to polyethylene line, which melts at a lower temperature than polyester, is risky. But even more damning, heat-shrink tubing simply didn't hold up in our test. Any burr will cut through it in a few cycles at heavy load.

Plastic tubing: Clear vinyl tubing doesn't like to stay in place and is difficult to secure. Compressed-air hose held up better, but it was hard to secure and wore on the line when it deflected at a sharp angle.

Fiber guards: Fiber guards were relatively effective, but getting a good fit and finish required different techniques. We got the best results by sliding a round mandrel inside the tubing (small artist's paint brushes worked for us), cutting the fiber guard to fit with a razor,

Slicing, Dicing Abrasion Data

For testing, we used the same abrasion rig we used to test sewn eyes and rope (see *PS* March 2015). A modified wood lathe sawed line samples back and forth (a 3/4-inch stroke) at seven cycles per second through a 10-millimeter test stanchion hole. We tested each sample to failure, effectively condensing months or years of wear into just minutes.

During some trials, we held the chafe guards stationary in the hole, allowing the line to slide inside the guard; this provided the best protection against wear. We also tested each sample against a medium-grit, aluminum oxide grindstone "hole," simulating a worst-case scenario. We compared these results with our experiences with polyester line and steel cable.

To test each rope or chafe material's resistance to side-to-side cutting, we passed each material sample through a saw-cut piece of stainless steel so that it exited at a 30-degree angle; then we attached a 100-pound weight to the end. To produce the sawing motion, we swung the weight like a pendulum through 30-degree arcs.

We tested three styles of stanchion hole: rough drilled with no finishing, fin-



Tick-tock, tick-tock: The slowly swaying, 100-pound stump (above, right) simulated the wear at the point where fiber exits a bare, poorly prepped stanchion hole (above, left). We also performed our standard "sawing" abrasion test on a grinding stone (right).

ished with a counter sink and polished with emery cloth, and a hole that had been finished, but then grooved by running a rigging wire through it on an oscillating abrasion machine for 20 minutes.

In both cases, the holes were prepared fresh for each sample. Typically, most of the damage came early in the test, since the hole became smoother as testing progressed.



and then melting the ends while slowly turning the mandrel. This procedure was essential for using Spectra tubing, which doesn't melt and fuse as easily as other materials. Coating fiber chafe sleeves with Yale Maxijacket also increased durability and reduced fraying.

Some covers, like the APX, contain a high proportion of Aramid fibers and can't be fused by heating. In these cases, we resorted to whipping them onto the fiber lifeline or splicing them in place. Since the best guards are rather thick—much heavier than typical line covers—splicing in the tails will weaken the lifeline by about 20 percent. Although you could taper the ends of the cover to

create a smooth transition, it was easier and effective to simply whip the covers in place.

Coatings: While the paint-on (or dip) coatings provide some protection for light abrasion and oscillating wear, they were ineffective against the sawing motion inside stanchion holes. We would use Spinlock RP25 to combat superficial wear in places where sheets and sails might chafe the lifelines, but you will need a physical cover to prevent stanchion chafe. Coatings are convenient since you can apply (and re-apply as needed) in places where line chafe appears. You can coat chafe sleeves as well as the line itself. They will increase

the sleeve's life four to eight times, and keep the chafe guards looking neat, but the sleeves don't need extra protection.

Retrofitting: If you've already installed new fiber lifelines, you can still fit sleeves without taking everything apart. The best option is to split two-inch nylon tubular webbing, wrap it around the lifeline, and then whip in place as a chafe sleeve. One *PS* reader said his nylon sleeves have held up for over five years in the Caribbean. Another option is to wrap Sunbrella around the lifeline. Although the Sunbrella doesn't resist chafe that well, it wore better than plastic tubing in our tests and is easily replaced.

Visible Harm Doesn't Tell Whole Story with Amsteel

Our testing made us wonder whether we are better off with a core-and-cover lifeline with a tough cover, like New England Ropes WR2, or an uncovered rope like Samson Amsteel, which is much stronger than the smaller-diameter WR2 core. (Because of the way WR2 is spliced, the cover should not be counted toward strength.)

The adjacent photos show the WR2 and Amsteel lines after pendulum testing but before pull testing. The WR2 has no core damage, and the Amsteel was about 20 percent worn, based on measuring the adjacent cross-section.

Although the Amsteel line was far stronger to start (ultimate tensile strength of 8,600 pounds versus 6,150 pounds), after the 50 strokes the WR2 retained full strength, while the Amsteel had dropped to 3,100 pounds, which puts it out of compliance for a lifeline according to ISAF standards. Proof of the value of chafe sleeves and the toughness of WR2.



New England Ropes WR2



Samson Amsteel

After pendulum testing, the Amsteel had lost only about 20 percent of its diameter, but it had lost more than half of its strength.

Although it is obvious that the Amsteel is damaged, the damage gives little hint that only 36 percent of the rope's strength is remaining; this may explain some of the unexpected failures reported on the racing circuits. If the line were the minimum size that was previously allowed by racing boats (4 millimeters), its ultimate strength would have been less than 1,000 pounds, hardly enough to support the weight of several sailors leaning outboard as external ballast, or "rail meat." It seems clear that Amsteel loses more strength than it appears to when

it chafes.

One reason for this is the slippery nature of the polyethylene fibers in Amsteel and similar ropes. When a few strands of polyester rope are damaged, the other strands carry the weight, and friction between them is sufficient that all strands carry load. However, on Amsteel and other high molecular polyethylene ropes, the strands are so slippery that load is not shared. Our testing supported findings of other tests that found that the loss in strength is roughly proportional to cross-sectional area loss. Each strand must carry an equal amount of the load.

LIFELINE CHAFE RESULTS

This report focused on chafe guards, not the lifeline materials themselves, so we only evaluated a few samples. In addition to our ongoing field test of lifeline materials, we are planning a more exhaustive review of lines in the near future. Here we briefly introduce a few common lifeline products.

SAMSON AMSTEEL BLUE

Perhaps the best-known HMPE line, Amsteel Blue finds widespread use on towing, logging, and commercial trawling vessels. Light, strong, low stretch, abrasion-resistant, and relatively inexpensive, it's the benchmark against which other lines are compared. Wearing 20 times slower than common poly-

ester rope, this line is stronger than steel. For better handling and durability, most boaters buy a larger diameter than they need, giving it a large safety factor. Based on manufacturer tests, even after five to eight years in the sun, a quarter-inch Amsteel line will retain the strength specified under ISAF standards. Splicing is a snap; a bury splice (Brommell splice) is no more complicated than a knot. If you prefer not to splice, you can use Dyneema whipping twine to lock-stitch eyes in place (see *PS* October 2014 online).

Bottom line: With proper stanchion hole preparation, chafe guards, and conservative sizing, Amsteel Blue should provide years of service. Recommended.

NEW ENGLAND ROPES STS

New England's STS is another 12-plait, hollow-braid line, very much like Amsteel. It performed the same as Amsteel in our tests, but it has a lower price tag. *Practical Sailor* has this line installed on a test boat in the Chesapeake, and it is holding up fine.

Bottom line: Slightly less expensive than Amsteel, and indistinguishable in terms of performance thus far, New England STS is our Budget Buy.

NEW ENGLAND ROPES WR-2

New England Ropes (NER) introduced this covered line to avoid the need to install chafe protection. Although the Dyneema cover is tough, it isn't as resistant as a true chafe sleeve and is suscepti-

Check for Abrasion Before Switching to Fiber

To see how chafe points can develop on stanchions, we ran standard steel cable through our test stanchion holes for an hour. As expected, the sawing action wore a rough-edged groove, but several other things became apparent.

Surprisingly, the steel wire wore more severely than Amsteel. At the end of one hour, about 15 percent of the wire strands had failed, and most of these failures were invisible until the cable was flexed. Most of the failures were deep inside the cable, clearly a result of flex and fatigue and not wear.

Hunting around a local marina, we found many examples of lifelines with broken strands inside the stanchion holes or other places where the lifeline saw more flexing. When we stripped back the covers on covered lifelines, we



Broken strands were hidden unless the wire lifeline was very closely inspected.

found the same pattern of strand failure at the stanchion holes, even in places where the cover itself was still intact.

The bare wire formed a sharp burr on the inside of the test stanchion, equivalent to a freshly drilled and unfinished hole. We ran Amsteel over the freshly

burred hole, and the wear was significant, though not as severe as with the wire.

Stanchion holes should always be polished before switching to fiber lifelines, especially if bare cable has been used. Burrs on the lip should be rounded with a countersink or a Dremel tool fitted with a fine grindstone. Next, both the lip and interior should be polished with fine emery paper, down to 600-grit.

Any groove in the stanchion hole usually indicates sharp edges on the inside of the stanchion that will also require careful polishing. After the stanchion hole had been polished, we found that Amsteel wore better than steel cable and actually polished the steel even smoother.

ble to burrs. NER suggests that the cover protects the core from UV rays, but our own testing indicates that a cover provides insignificant protection for small lines. Typically, the eye-splices are core-only—a cover-and-core splice is tricky on this line—so the eyes will likely be exposed to UV anyway. The small diameter (4-millimeter core) limits this product to boats of less than 28 feet, according to U.S. Sailing guidelines.

Bottom line: We Recommend the 5-millimeter size; the 3 millimeter diameter does not meet U.S. Sailing specifications. Be sure to smooth the stanchion holes anyway.

CHAFE PROTECTION

The range of materials available for chafe protection is nearly infinite; this comparison is fairly narrow in scope, but we tried to evaluate products that were representative of each category. If you have found success with a particular product not reviewed here, let us know at practicalsailor@belvoir.com.

LIQUID COATINGS

Liquid coatings provide one of the easiest solutions. We looked at two different liquid coatings, Yale Cordage's Maxijacket and Spinlock's RP25.

SPINLOCK RP25

Though it goes on thick, the solvent-based Spinlock RP25 is nearly invisible once it soaks in and dries. Yale Cordage's Maxijacket offered better overall performance in our previous testing with polyester, but the two were evenly matched when it came to protecting Amsteel. Unlike Maxijacket, RP25 does not stiffen the line, making it perfect for coating high-wear areas. Spinlock recommends this product to protect against chafe in rope clutches as well.

Bottom line: Recommended. This product is our preferred choice among liquid coatings for chafe protection on high-wear lifeline sections and Dyneema splices.

YALE CORDAGE MAXIJACKET

Yale's Maxijacket is simple to brush on and dries sufficiently for installation in a matter of hours, although we let it dry two weeks before testing. Expect the line to be stiffer after coating. It matched RP25's chafe protection on Amsteel Blue, and provided greater protection for both Dyneema and nylon chafe guards.

Bottom line: Recommended. If you have a variety of rope materials that you want to protect, and don't mind the added stiffness, this is a good choice.

PLASTIC TUBING

The advantage of clear plastic hose is that you can see what is going on underneath. The disadvantage is that it wears easily. Our generic brand, bought at a local hardware store, sold for about \$2 per foot.

Bottom line: Better than nothing, but don't expect much.

COMPRESSED AIR HOSE

Used to deliver air from compressors to various tools, this polyethylene compressed-air hose was the stiffest sample we tested. We found that it gave great protection when it was wedged into the stanchion hole; otherwise, it slipped out of place and gave no protection. The stiffness was a problem when the lifeline angled down to a deck fitting.

Bottom line: Fine for straight runs, but not for lifelines that enter or exit stanchion holes at relatively sharp angles.

TYCO HEAT SHRINK TUBING

Heat-shrink tubing offered practically no protection to the lifeline in our tests. It must be installed at temperatures that might damage the HMPE line, and costs about \$12 per foot.

Bottom line: Heat shrink for chafe protection of HMPE is a mistake.



FABRIC GUARDS BLUEWATER CLIMB-SPEC

This nylon tubular webbing fits neatly over lines up to a quarter-inch. Testers were pleased with the way the surface fuzz on the webbing gripped the stanchion hole, keeping the webbing in place. During bench testing (which simulated nearly 10 years' normal use), testers saw virtually no wear.

When we seized the webbing to the line so that it moved with it, the chafe resistance was less, but still impressive. UV rays will tatter this material over time, but it is thick and densely knit, so it isn't unrealistic to expect 10 years of life. Coat it in Maxijacket, and it will surely last that long.

To use, simply cut three-inch lengths, melt the ends on a mandrel (described above), and thread the webbing through the stanchion holes, followed by the lifeline itself. This product stayed in position without any additional measures, and we know cruisers who have left tubular webbing chafe guards unsecured for years. If you feel the need to secure them to the lifeline, a simple lockstitch will do, or a whip-lock will be very secure. For lifelines, you have a choice of sizes from 5 to 12 millimeters. It is available from outdoor stores and climbing outfitters.

Bottom line: This cheap and very effective chafe protection is our Budget Buy among fabric guards. You can find it at online outdoor sports retailers like REI (www.rei.com).

NER DYNEEMA CHAFE SLEEVE

This Dyneema chafe sleeve is sim-

ilar to nylon webbing in appearance. After bench testing, we saw no visible signs of wear on the webbing or lifeline. Although it was more difficult to fuse the ends than with nylon, it is simple to whip in place. Because it is thicker than the nylon, it is prone to slipping out of place in larger (10 millimeter) holes, but will fit better in the 8-millimeter holes. A little Maxijacket or RP25 over the whipping will make it very durable.

Bottom line: Tough as nails and economical for the small amount required, this product is our Best Choice.

SUNBRELLA WRAP

While we preferred tubing products for neatness and staying in place, we knew there would be sailors who want to add chafe protection after installation. We cut 2 x 2-inch squares, formed them as a snug double wrap, and it performed nearly as well as nylon and Spectra tubing. We think a simple lock stitch will be needed to keep it from slipping out of place. Although this will add more friction to the cover, it should still prove fairly durable.

Bottom line: Recommended. If you did not install chafe guards when you threaded your new fiber lifelines through the stanchions, this is a quick and easy retrofit.

CONCLUSION

Fiber lifelines will never have the lifespan of stainless cable, but proper deburring of stanchions holes, chafe guards, and regular inspection should ensure a respectably long life. If you use oversized, quarter-inch Dyneema line with Dyneema sleeves at wear points, you will undoubtedly extend the life of the lifelines. Although double-braid line offers simplicity, single braid with chafe guards offers greater reserve strength, durability, and economy. Like many things, it comes down to per-

sonal preference.

New England Ropes' WR2 is very impressive. The cover is nearly impervious to damage. The shortcoming is that in the largest size (5 millimeters), the core is only 4 millimeters, so it only meets ISAF requirements for boats 28 feet long or less. For small cruising boats, a WR2 upper and an Amsteel lower would be a durable, light, and affordable option.

For retrofitting, we preferred the fabric guards to plastic tubing; they seemed less prone to damage from bending, wore better, and were easier to fit. The Dyneema sleeves provided the ultimate in protection, but less exotic materials will do well if the guards stay put in the stanchion hole.

Among the paint-on products, Maxijacket excels at providing heavy-duty protection for nylon and polyester, extending wear by four to eight times, but at the cost of considerable increase in line stiffness. RP25, on the other hand, protects HMPE line fairly well without noticeable stiffening, making it more useful on lifelines. Given the small amount required to treat a line, we recommend you purchase the product that best fits your needs; RP25 for HMPE or Maxijacket for polyester and nylon. ▲

CONTACTS

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SUNBRELLA,
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SPINLOCK, www.spinlock.co.uk

YALE CORDAGE, 207/282-3396,
www.yalecordage.com





The Dual-Purpose C&C 33 Mark II

The old 'new' C&C 33 proves to be a formidable racer that can also deliver you over the horizon.

More than 200 C&C 33s were built, including the Chicago-based *Sea Dancer* (above), a 1988 hull. Designed as a club racer and coastal cruiser, the 33 fit a growing niche of sailors looking for quality but not luxury, and speed balanced with seaworthiness.

When the C&C company shut down operations in 1986, it was big news in the North American boating community. Since the company's formation in 1969, it had been a stalwart of the industry—the leading Canadian builder, by far, and one of the major brands wherever fiberglass sailboats raced or cruised.

C&C's lineup always featured the dual-purpose racer-cruiser, and always aimed for quality construction and detail, fitting a market niche below the outstanding luxury yacht but above the standard, midline fiberglass auxiliary. C&C boats are known for good-looking moderate designs, a tradition started by the original partners—the two Cs, George Cuthbertson and George Cassian—and the company's chief designer, Rob Ball. Performance also was a C&C hallmark. Most of its models were heavily marketed as serious racers, and even old C&Cs continue to be actively raced in PHRF fleets today. (For example, there were 14 registered to compete in the 2015 Chicago to Mackinac Race.)

C&C was the first major company to commit to cored hull construction, and only Tillotson-Pearson compared to C&C in terms of experience with balsa-cored laminates. The builder also was the first major company to commit to solid rod rigging, and they had a tradition of rigging and equipping their boats with first-class spars and fittings. The C&C 33 is often referred to as the “new” C&C 33 or the C&C 33 Mark II (33-2), to distinguish it from the C&C 33 Mark I, which was produced between 1974 and 1977. While some of the specs are similar, the Mark II is an entirely different boat, not sharing any of the tooling of the Mark I. The Mark I was widely regarded as one of the prettiest racers around, and 209 of them were built.

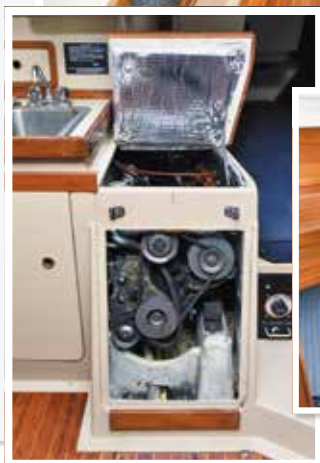
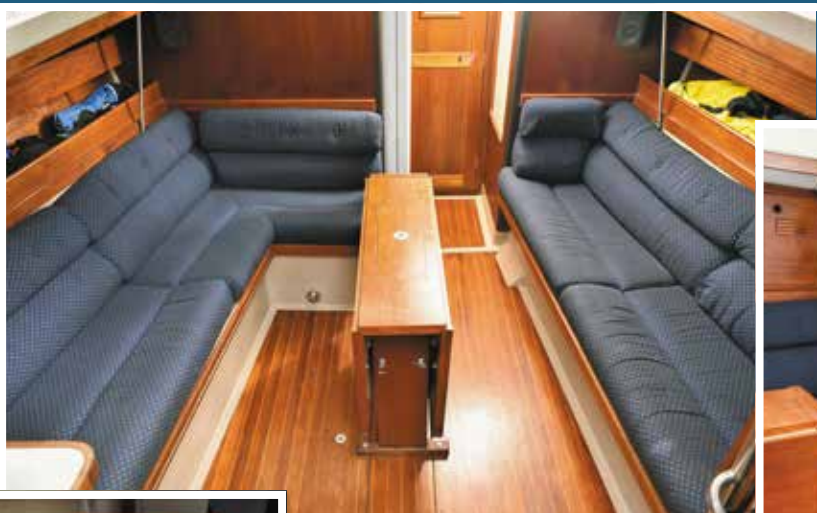
In design, the C&C 33 Mark II has conservative lines. Like other C&C models, it has a flat sheer, sharply reversed transom and sharply angled bow. The hull has a fine entry and cutaway forefoot. There's a hard turn to the bilge about a foot below the waterline, and the very

center of the hull is flat. A fin keel was the standard, but a shorter fin and a keel/centerboard combination were available options. A small skeg is fitted ahead of the spade rudder. According to owners, this setup allows for precise turning in tight spaces.

The Mark II was introduced in 1984, and over 200 of them were built in the four years the boat was in production—impressive considering the company's business problems in the middle of the run, and the heavy competition in this size from American and European companies.

CONSTRUCTION

The Mark II's hull construction represented a departure from typical C&C practices, in that only the forward panels of the hull are balsa cored. The rest of the hull is a conventional hand lay-up of mat and roving, with an isophthalic gelcoat and skinning resin. The 33's larger sisters (35, 38, 41, and 44) have balsa coring throughout their hulls, while the



The C&C 33 has ample room belowdecks for a coastal cruising couple or long-distance racing crews. While the galley is a bit cramped (above), it offers an icebox and a propane stove/oven with a crash bar. The cabin features plenty of seating and dining versatility (top left), and the V-berth (at left) has a built-in bureau and shelving for storage. Access to the engine is by removing the companionway ladder and opening panels on the sides of the engine, and through the cockpit seat locker. Poor engine access was the most common complaint among owners that PS surveyed.

smaller sisters (30 and 27) have no coring at all in the hull.

The cored laminate offered stiffness and strength combined with light weight, and it was one of C&C's keys to building tough, lightweight race boats that wouldn't flex too much. To achieve stiffness and strength without the coring, C&C used what they call a "spider" system: basically a structural framing bonded to the hull and integrated with the attachment points for the rig and keel. The hull laminate itself becomes relatively less important structurally, as the frame becomes the primary load-bearing structure of the boat.

The deck is one-piece molding with balsa core in the horizontal surfaces, and hardware is backed with both aluminum and Coremat for strength in the attachment points.

The hull-to-deck joint is standard, with an inward-turning hull flange on which the deck is set. Stainless bolts run through the joint and through an aluminum toerail that covers the joint. The whole stem fitting as well as the corner pieces for the toerail are the heavy aluminum castings that are tradition-

al on C&C boats, but it is interesting that C&C used plastic moldings for the stanchion bases on the 33.

When new, the Mark II's had good quality gelcoat and generally fair hulls. But if you're considering buying a used one, be sure to look for signs of stress cracking or crazing as most of these have been raced a lot—some quite hard—over the last 25 years. Our reviewer examined one, built in 1988, that had only minor crazing and a surprisingly good quality deck, but the owner explained it had not been actively raced in the past.

The standard fin keel (6-foot, 4-inch draft) is external lead, bolted to a stub on the hull. The centerboard option is unusual in that it is a fiberglass molding with some lead inside, and the board is fitted entirely inside a shallow keel (4-foot, 4-inch draft) fitted to the hull.

The fiberglass board is lighter (for lifting) and quieter than a more common steel board, which tends to bang around in the centerboard trunk. The fiberglass molding also makes for a better-shaped and fairer fin for upwind work. The lifting cable is housed inside the keel, so it presents no drag and makes no noise

at speed. The cable passes through the cabin and is housed in a stainless-steel tube, which also supports the cabin table, and is led to a stopper and winch on the aft end of the cabin house.

The fin keel weighs 3,975 pounds (42 percent of total displacement); the keel/centerboard, at 5,258 pounds, is much heavier. Nominal displacement for the fin-keel version is 9,450 pounds; for the centerboard version, it's 10,733 pounds.

The 33's rudder is fiberglass over a webbing of stainless welded to the stainless-steel rudder stock. If you're considering buying a C&C 33, be sure to look over the rudder and skeg carefully.

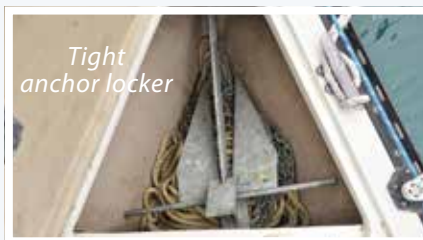
Also, as is the case with most 25-year-old, external ballast keel boats, the ballast should be lowered and the keel bolts inspected before purchase, especially if the boat is sailed offshore. C&Cs are among the production boats (like Catalinas, Hunters, and Cals) that have been known to show a keel "smile," where the keel bolts work loose and water gets in between hull and keel, causing the bolts to corrode. Usually a product of not torquing the keel bolts periodically, the keel smile is due more to a lack of proper maintenance than design.

PROS

- Clear foredeck and adequate sidedecks
- Throttle and shift controls are integral to the pedestal
- Teak grab rails and double lifelines make going forward more safe
- Inboard chainplates and shrouds
- All lines are led to cockpit to quality hardware
- Minimal exterior brightwork

CONS

- Toe-stubber forward hatch
- Narrow foredeck makes anchoring and sail changes challenging
- Sloped, high cabintop
- Inboard sheet tracks offer fewer trim options with big genoas



THE RIG

The model that we sailed had a rig from the C&C spar shop, known in its time as a builder of sturdy high-performance rigs. The spars on later models were from Offshore Spars in Detroit.

The mast and boom are fairly heavy extrusions, painted white, with integral grooves for taking bolt rope or slugs. The mast came standard with internal halyards and lifts, as well as an internal wiring conduit and VHF cable. The boom has built-in slab reefing gear. The mast is stepped on the keel.

The standard standing rigging is made up of Navtec stainless rod, tangs, and turnbuckles, with 1 x 19 stainless for the adjustable babystay and for the split part of the lower backstay. Original main and jib halyards were stainless with rope tails. The shroud chainplates, set inboard for close sheeting, are attached to the hull by stainless rods between the deck and hull anchor points.

The Mark II came standard with good

quality hardware for rig control. Spinnaker winches and gear, boom vang, and backstay adjuster were options.

ENGINE/MECHANICAL SYSTEMS

The original Yanmar 2GM engine is a bit tight in the 33's engine compartment, but otherwise the installation is first rate. The engine beds are actually part of the structural "spider" beams. The engine box is insulated with sound deadener, and the engine is about as quiet as you can expect a two-cylinder diesel to be. The standard solid prop should be replaced with a folding prop.

The electrical system and plumbing are well done. Electricity includes a 12-volt system with ample interior lighting. A 120-volt shore-power system, with a 50-foot shore cord, was standard equipment.

A three-burner, propane stove with oven also was standard, as was hot-and-cold pressurized water. The 30-gallon water tank is adequate for typical cruis-

ing, though ocean sailors may want to convert the standard 24-gallon holding tank to freshwater storage.

PERFORMANCE

The 20-horsepower Yanmar is big enough to handle the boat in most conditions. We were under power only in fairly flat water. The boat was fitted with an optional Martek folding prop, and we had no problems backing or turning. The engine pushed the boat to hull speed easily. We suspect a big head sea would challenge the peak output of the engine, probably slowing the boat to 4 knots or so, but the amount of power is ample for all reasonable sailors in almost all conditions.

Steering is with the standard 36-inch destroyer wheel. Throttle and shift controls are integral to the pedestal, and visibility over the deckhouse is good when you are sitting on the skipper's "bubble hump" behind the wheel.

The aluminum fuel tank holds 20 gal-



The C&C 33's cabinhouse edges are sculpted, giving the profile fewer hard edges, but making the step up from the sidedecks more challenging for some.

lons, which should be good for about 180 miles of powering under normal conditions. The engine control panel is in one "bay" of the T-shaped cockpit. You can't see it easily from the steering position, but that's a very minor inconvenience.

Access to the engine is through the removable companionway steps, through opening panels on both the port and starboard side of the engine, and through the cockpit seat locker.

The boat looks like it should be an all-around wholesome boat, but we initially thought of it as not particularly a stand-out in its size and price range. Our test sail convinced us otherwise. We found the 33-2 to be a fine sailer, just about everything we would want in its size.

The C&C 33 Mark II performs well without demanding the incessant tweaking and crew movement of so many high-performance boats. We sailed the centerboard version and evaluated a deep-keel version, and reviewers found no particular shortcomings in either's performance.

With a good set of sails, the centerboard test boat was at least as weatherly as any boat in its PHRF division. We tried sailing the reaches and the runs with the board up and with the board down, and we could not discern any difference in speed—though as charterer, we deferred to the owner's conviction that the boat was faster off the wind with the board up. The boat seemed to steer as well with the board up as with it down.

With the extra weight, the centerboard model is a little harder to push around a race course in light air, but in 15-knot winds, she had to ask no favors, and in 22-knot winds, she was a pleasure to sail compared to the other boats on the race course.

In absolute terms, we know that

long, rainy slogs that we often encounter in cruising. Shorthanded, most of the faster boats are miserable. The C&C 33, in contrast, is an easy sailer, respectable in light winds, and a pleasure in heavy.

ON DECKS

The deck layout on the C&C 33 is conventional. The double lifelines with lifeline gates, pulpit, and pushpit are sturdy, well made, and came as standard equipment. The pushpit has a gate that can be fitted with stern ladder—a good idea for both the racer and cruiser.

The foredeck is quite narrow, so anchoring and headsail handling can be difficult. The sidedecks leading aft are wide because of the inboard shrouds and easy to move along.

Because of the sculpting and window shape, the cabinhouse looks low, but it is actually quite high—a difficult step up from the sidedecks or cockpit for some. Fortunately, because all the lines lead aft to the back edge of the cabin, there's not much occasion to walk on the cabintop abaft the mast. Forward of the mast, the cabin slopes gradually into the deck, and movement is easy. However, the skylight over the head and the forward hatch are slippery stumble-makers and need to have nonskid tape put on them.

Our test boat did not have a dodger, and the sculpting of the cabin house may make it difficult to design a wide one. A narrow dodger, fitting just over the companionway, would work well.

The cockpit is a conventional T-shape with a bridgedeck-mounted traveler. A cabintop-mounted traveler was an option, but there seems to be little to recommend it. The cockpit seats are comfortable for sitting but too short to lie down on. The forward part of the coaming is OK for sitting, but you'll be

inclined only to stand on the cockpit sole, aft of the bench seats. The cockpit is definitely skewed a little toward the racing side of this boat's dual purpose, and it's a much better cockpit underway than dockside.

Hardware is good quality and well arranged. The standard winches are of adequate size, though the boat is stiff enough to carry a heavy 150-percent genoa in 20 knots of wind, and that's a handful for the No. 24 primaries, unless the racing crew is on board.

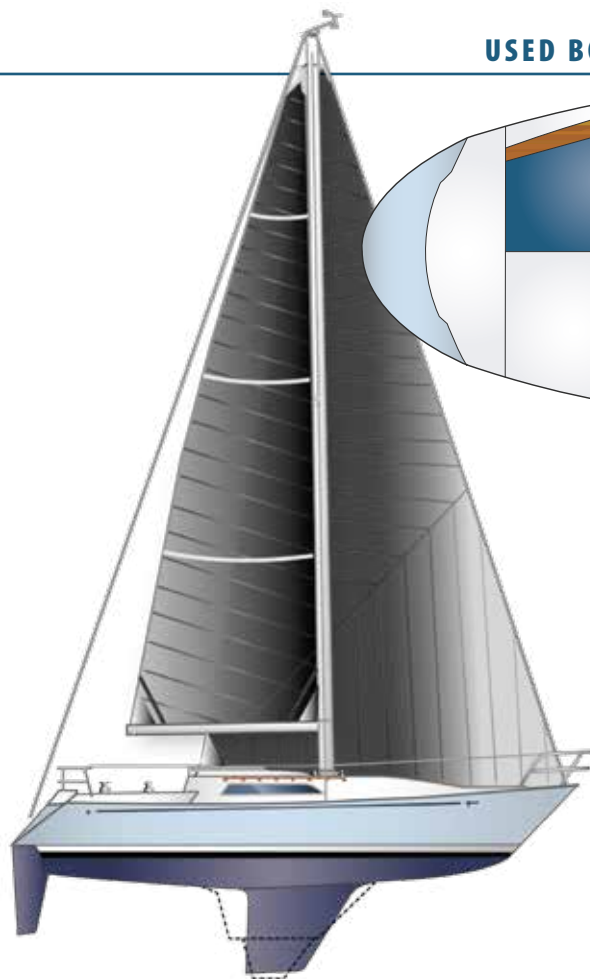
As is the case in most boats of the 33's vintage, there's not too much above-decks storage room. An anchor well forward will stow a Danforth, but everything else will have to go into the one aft locker under the starboard cockpit seat. It's a cavernous locker, but the serious cruiser will have to devise a way to subdivide it to make it more usable. Behind the helmsman are a small locker for propane bottles and a small stowage spot for winch handles.

BELOWDECKS

The arrangements belowdecks are conventional: V-berth forward, head with shower opposite a hanging locker; port and starboard settees outboard of a saloon table; L-shaped galley; nav station at the head of a double quarterberth (well, maybe a one-and-three-quarter quarterberth). From the center bulkhead aft, the boat is wide open, which seems to us like a more sensible arrangement than the "Euro" compartmentalizing of the aft cabin and aft head, at least in a boat this size.

A few notable details: A decent built-in bureau in the forward cabin is a nice touch. The head compartment is a single fiberglass molding, including the wash basin—all compact, well designed, and easier to clean. The galley is quite serviceable, with a good stove and a stainless bash bar to keep you from crashing into it.

The teak overhead and bulkhead veneer contrast with the off-white hull liner. The liner is well done, with removable



The C&C 33 Mark II came standard with a deep fin keel, but a shorter fin and a centerboard/keel combination were keel options. A dual-purpose racer/cruiser, the C&C 33 combines J/Boat-like performance with Tartan-like cruising comforts.

C&C 33 IN CONTEXT

	C&C 33 MK II	TARTAN 34-2	J/33	MASON 33
LOA	32' 7"	34' 5"	33' 5"	33' 9"
LWL	26' 2"	28' 10"	28 ft.	25' 5"
BEAM	10' 6"	11'	11'	10' 10"
DRAFT	6' 4"	6' 3"	6' 2"	5'
DISPLACEMENT	9,450 lbs.	11,000 lbs.	8,100 lbs.	14,269 lbs.
BALLAST	3,975 lbs.	4,400 lbs.	3,180 lbs.	5,320 lbs.
SAIL AREA	511 ft. ²	538 ft. ²	561 ft. ²	602 ft. ²
ENGINE	20 hp.	27 hp.	18 hp.	35 hp.
WATER	30 gals.	57 gals.	30 gals.	65 gals.
FUEL	18 gals.	23 gals.	15 gals.	35 gals.
SA/D	18.36	17.46	22.31	16.64
D/L	235.38	204.93	164.73	387.81
PRICE *	\$32,000	\$45,000	\$30,000	\$95,000

* Average used price (varies greatly)

panels for servicing hardware fittings, wiring, and so on.

Overall, the cabin is comfortable. We've often heard older C&C's rapped as "leaky" boats, with drips around windows and under heavily loaded deck hardware, but the boat we sailed was completely dry.

OWNERS' COMMENTS

The biggest complaints among the C&C 33 Mark II owners that *Practical Sailor* surveyed were engine access and cabin ventilation. Nearly all noted that it was a challenge to access the engine easily, and most reported that their boat upgrades including increasing belowdecks ventilation with solar vents or other openings.

Interestingly, most gave the boat an average rating for stability but rated the seaworthiness as good or better. The majority of those surveyed rated the boat's

upwind and off-the-wind performance equally good; only a handful said the upwind performance was better.

Some things to keep in mind if you're shopping for a C&C 33: Check for leaks around the chainplates and look for stress cracking in the deck, signs the boat had a hard racing life and the backstay likely saw too much pressure. A few surveyed owners reported blisters, but both said the problem was minor. One owner cautioned others to check the transmission shaft cable as his was not installed and adjusted properly, resulting in premature clutch failure.

CONCLUSIONS

If you're entirely devoted to racing, we'd probably suggest looking at something different—maybe a J/33, or possibly a J/35. For those who solely cruise, we'd also recommend different boats—maybe something more like a Tartan 34 or

a Mason 33. But if you plan to do a good share of racing, some serious weekend-ing, and at least one long, shorthanded cruise per season, then the C&C 33 is among the boats we suggest checking out. Although in some ways, it seems plain and indistinctive, the C&C 33 is admirably suited to be both a racer and a cruiser. It's a boat for sailors who truly want a racer-cruiser. C&Cs also hold their value well, so buying one would be a sound investment, and there are plenty in good condition to be had on the resale market, especially in Canada.

Editor's note: This review is an updated and expanded version of one previously published. 

RESOURCE

C&C 33 MARK II OWNERS,
www.candc33mkii.com



ON THE HORIZON
FURLING FAIRLEADS TEST
BOTTOM PAINT REMOVAL
PDQ 32 BOAT REVIEW
SMALL ANCHOR TEST

Where Can I Find a Boat's Stability Curve?

The commonly used Stability Index (STIX) does not show a complete picture.

The article “Dissecting the Art of Staying Upright” (see *PS* June 2015 online) was very timely for me, but I am struggling with how to apply it to real life and specific boats. How do I find information on the angle of vanishing stability for specific boats? Can you point me to other articles like yours where I can learn more?



PS ADVISOR

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Unfortunately, stability (GZ) curves showing angle of vanishing stability (AVS), also known as the limit of positive stability (LPS), are not commonly published. Even yacht designers can find it hard to accurately quantify stability based solely on a boat's dimensions and mass.

To find more information, our first stop would be the maker of the boat. Manufacturers of boats for export to Europe, or those built to race under the International Measurement System (IMS), should be able to provide a GZ curve, because this is an element in determining a boat's stability index (STIX), which is one of the requirements for export to EU countries or for participating in an IMS event.

But even if you track down your boat's GZ curve, it doesn't necessarily reflect reality. Some curves may be mathematically derived from estimated measurements. Then there is

the question of what elements were included in the analysis. Davits, radar arches, in-mast furlers, and any mast-mounted equipment—can nudge a borderline offshore boat

(with an AVS less than 120), into the near-shore category.

Ultimately, the most accurate assessment involves getting the vessel inclined and “wanded” by an IMS measurer authorized by US Sailing (or comparable national body abroad). US Sailing (www.ussailing.org) can provide a list of authorized measurers who do this work.

In this process, the measurer applies a few hundred pounds of weight near the rail and starts to heel the vessel. He or she then extrapolates that heel data with the digitized shape of the hull and key weights and volumes to come up with an AVS. Bottom line: Greater than 120 is good, 110 to 115 marginal, less than 110 not appropriate offshore.

As for the STIX number: both the IMS and the Euro-

pean Union use this to categorize boats. Under an EU directive, Category “A” boats, those that are most capable of offshore work, must have a STIX number of 32 or higher. The number takes into account a variety of factors (location of hatches, for example), not just the AVS. Many experts feel that 32 is too low of a number for an “Ocean” rating. (A vessel with an AVS of 110 can still score a 32.)

Naval architect Dave Gerr wrote a succinct article in the Westlawn Institute's Newsletter that offers other ways to approximate a boat's stability (www.westlawn.edu/news/WestlawnMast-head03_Sept07.pdf). Technical Editor Ralph Naranjo's book, “The Art of Seamanship,” (www.practical-sailor.com/books) explores stability in more depth. Another good book is “The Principles of Yacht Design” by Lars Larsson and Rolf Eliasson, and Gerr explains stability in layman's terms in his excellent book, “The Nature of Boats.”

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Selden Spars inclines a Santa Cruz 37 to determine rigging loads. A similar procedure can be used to predict the angle of vanishing stability.



Bottom photo courtesy of Selden Mast