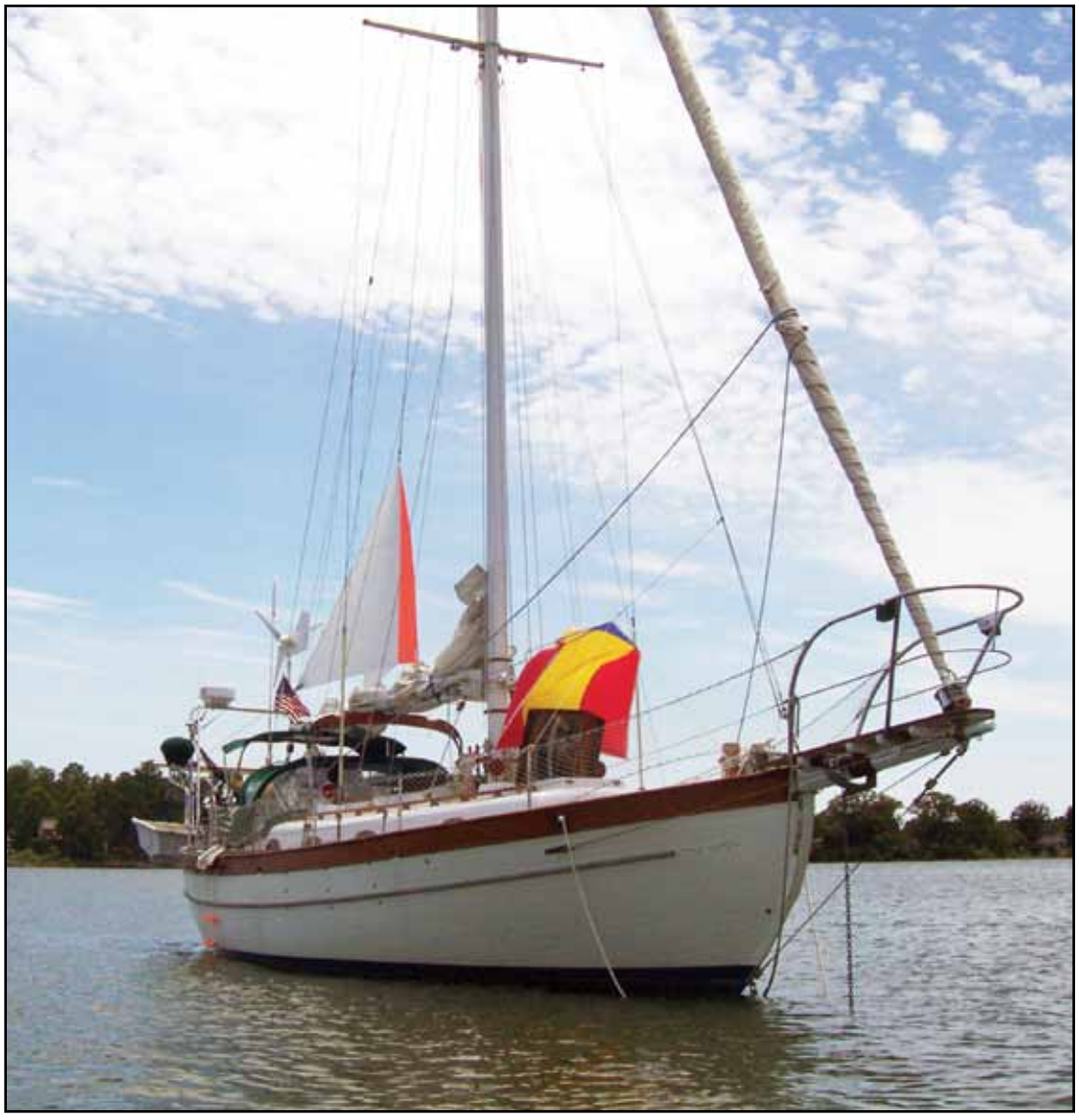
From the Editors of

Practical Sailor™

Specialty Sails & Hardware



A Look at Sails Volume 3

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Chapter 1

Don't Forget the Accessories

In addition to the requisite mainsail and headsail, most cruising boats—even coastal cruisers—should consider adding a specialty sail or two to their inventory. A storm trysail is essential for the ocean passagemaker, while a reefing staysail can serve as a heavy-weather headsail or a double-headsail power punch. And while anchor-riding sails may not be must-have items, they can tame an anchor-dancing boat, turning a miserable stay at anchor into a bearable, or even pleasant, experience. These sails give you versatility under sail and having them onboard means you'll be prepared for any weather.

If you find yourself pondering the purchase of a specialty sail—or any new sail—perhaps the following tale by *PS* Editor at Large Nick Nicholson, written during his circumnavigation, will help shine a light on how having the right sails for your sailing conditions and your rig can boost your boat's performance. While you may not be ready to buy a full new suit, you may want to at least accessorize the old one.

Calypso *Gets a New Suit*

PS readers sometimes comment on our seemingly profligate ways: trying one thing, getting rid of it if it doesn't perform perfectly, replacing it with something else, repeating the cycle. This criticism fails to recognize the manner in which we use our boat.

Calypso is a *Practical Sailor* test platform. As such, we are never satisfied with things the way they are. Instead, we experiment, discard, and replace in a manner that is sometimes costly and often unnecessary. Our goal is to save other cruisers money, not necessarily to do things that are the most cost-effective for us. In fact, using our boat as a test bed—and keeping it in top condition—probably doubles the cost of our cruising.

A perfect example is the recent replacement of almost our entire sail inventory in New Zealand.

Calypso's original Doyle inventory was built several years before her launch, in part because we thought the boat was going to be finished years before it actually hit the water. Our relatively large (137%) roller-reefing genoa was built in the belief that we would see a lot of light air in our trip around the world, when the additional sail area would pay off.

The fairly heavy, flat mainsail was intended to be bulletproof, rather than powerful. Likewise, the small, hank-on staysail was designed to be flat and strong, our heavy-weather headsail.

Both the rig and our needs have evolved significantly over three years and almost 15,000 miles of ocean sailing, and our original sails, although still in reasonable condition, no longer suit our sailing style.

The big, low-cut headsail simply proved to be too large in most conditions, and was usually used in a partially reefed configuration. In common with reefing headsails in general, it had poor shape when reefed, with the draft too far aft either for effective upwind sailing or good helm balance.

The small staysail was re-cut even smaller when we switched to a reefing inner forestay two years ago. The shape of that sail was altered so drastically during this re-cut that it really was pretty useless.

The mainsail held up well, with only some minor chafing at the batten pockets and the reef points. Its flat shape proved to be satisfactory, but contributed to our helm balance problems. I should stress that these sails were designed, built, and modified according to my specifications. Both sail design and cruising sail technology have evolved significantly in the years since these sails were built, and my own understanding of what constitutes a good cruising sail has changed as well.

During our sojourn in New Zealand, we went to Chris "Curly" Salthouse of North Sails, New Zealand, for a new inventory.

There is a story behind this particular matchup. During a Whitbread race stopover in Brazil, I had told Curly, sailmaker and crew on a Whitbread 60, that I was sailing my own boat to New Zealand. "Come see us at North if you make it," he joked, "and we'll take care of you." Sure enough, two years later, I was knocking on his door for a new suit of sails.

Ironically, we had met Salthouse's father-in-law on his cruising boat in Tahiti six months earlier. He and his wife were wrapping up a five-year circumnavigation on a fast 54-foot sloop that he had designed and built in New Zealand. The serious cruising community is indeed a very small place.

A NEW GENOA

While Dacron is still the preferred sailcloth for most cruisers, we decided that the additional shape stability of a laminated fabric made sense for an all-purpose cruising headsail. At North's recommendation, we chose their NorLam Mylar/polyester laminate, rather than the more expensive Spectra SR laminate. The Spectra SR laminate is stronger and more dimensionally stable for a given weight, but is significantly more expensive.

Because the new headsail is just a little over 500 sq. ft. in size, North suggested that the additional cost of the Spectra sail was not justified. In effect, he was saying that the extra strength was not needed in a small sail.

Our old genoa was a low-cut, 600-sq.-ft. Dacron sail. Our new genoa is more of a hybrid sail, with a clew about 6' off the deck. This higher clew helps equalize the tension on the sail when it is reefed, giving a better all-around shape.

The radial panel layout of the new sail has resulted in a dramatic improvement in shape compared to our old sail. The new sail has a fairly full entry and a straight exit, more like the shape of a racing sail. The additional stability of the laminated fabric yields a good shape throughout the sail's wind range.

We expected a loss of performance in light air, both upwind and downwind, but haven't seen it. Upwind, it's like night and day. The boat has absolutely come alive. Downwind, our 20' spinnaker pole controls how much headsail can be effectively poled-out. Even with the old, larger headsail, we had only a little more projected area downwind than with the new, smaller sail.

North has a variety of luff options for reefing headsails. We chose Rope Luff, a tapered bundle of Spectra ropes sewn inside a Dacron luff sleeve, rather than the more conventional foam luff padding. While this arrangement probably has more drag in light air, it seems to control partially reefed shapes better than our old foam luff, because it does not compress significantly under load.

The smaller overlap of the new sail—115% as opposed to 137% for the old sail—eliminates the need for spreader patches, at least for the lower part of the sail. We may add patches for the upper spreaders, but have not felt it necessary so far.

The higher clew of this sail makes it much more forgiving of errors in jib lead position as the sail is reefed—a big plus. The fact that the sail is smaller has also made it a little easier to reef, a significant bonus.

MAINSAIL

Our old mainsail was a conventional, full-batten cruising main. The new main is different.

It is slightly larger. We are constrained in the amount of roach the sail can have by our long boom, which places the leech very close to the backstays. In fact, both our old and new mains had to be re-cut to keep them from fouling the backstays, since sailmakers cannot believe how little room there really is.

We re-used the old Battslide luff fittings, as they were still in good shape, if looking a little ratty. The new main has externally adjustable batten tension for fine-tuning shape. The new full-length battens are fiberglass, and are substantially stiffer than the old flat fiberglass battens. Batten pockets are protected by a chafing strip where they come into contact with the aft lower shrouds when sailing off the wind.

The new main is about a foot longer on the luff, and 6" longer on the foot compared to the old main.

We went with a loose-footed main. Coupled with our custom Harken outhaul car, fabricated by Metalmast when the rig was built, this gives us much better shape in the lower part of the sail than a captive foot.

The new sail is very easy to power up in light air, with a much fuller shape than our old sail. We primarily flatten the sail with outhaul tension as the wind increases, but also had a Cunningham fitting installed in the luff if it proves necessary to flatten things even more.

The leech line of the new main dead-ends at the clew, then runs up through a block at the head of the sail, then down the luff. This new arrangement is infinitely easier to adjust either upwind or downwind, with no more precarious perching on the rail while trying to calm a fluttering leech.

There is no headboard. North suggested 8.8-oz. Dacron for the sail, and we had it triple stitched with UV-resistant thread as a precaution.

STAYSAIL

Our new staysail is radically different from the old one. At just under 150 sq. ft., it is similar in size to the old sail as originally built, but is quite different in shape. The new sail, of 8.8-oz. Dacron, is longer on the foot than the old sail, with a higher clew. This allows it to sheet farther aft on the staysail track, and reduces the necessity of shifting the lead if the sail is reefed.

Yes, this new sail is reefable. It is a full-size ORC (Offshore Racing Council) storm headsail for our rig dimensions, but is larger than would be desirable for winds much over 40 knots. Fitted to an oversized Furlex system that is suited for a genoa of about 800 sq. ft., we are not concerned with the strength of this setup in very heavy going.

The old staysail was very flat, which is desirable in heavy air. The new sail is cut more with the shape of a racing no. 3 genoa, with substantially more shape. The fact that we can sail effectively upwind with this sail in lighter winds has radically altered the way we sail the boat.

The old regime for increasing breezes close-reaching or upwind was as follows: First, reef headsail at about 17 knots true. Next, reef mainsail at about 20 knots. Next, reef headsail more. Then, take second reef in main at about 25 knots. At 30 knots, switch to staysail and double-reefed main.

Now, it's full main and genoa to about 20 knots. Then, a small roll in the headsail, or switch directly to the staysail if it looks like the wind might continue to build but the seas are still flat. The mainsail stays unreefed to about 22 knots, and the second reef goes in at about 27 knots. With a smaller genoa and a more powerful staysail, we have much more flexibility and power in the middle wind ranges. The staysail gets much more use as a headsail, thanks to its shape.

We also have re-tuned the rig, substantially increasing the pre-bend by carrying much greater tension on the inner forestay and forward lower shrouds, and less tension on the aft lowers. Coupled with more running backstay tension in heavier air, we go upwind in a breeze much, much better.

BALANCE

The biggest change has been in the balance of the boat. Having a fuller main and a smaller genoa with a full entry and straight exit has completely changed the balance of the boat. Our lee helm is gone, and the boat points substantially higher in all conditions.

The new main is easily flattened, so we have no balance problems as the breeze increases.

Improved balance allows us to sail the boat more aggressively, because we do not feel so overpowered as the breeze comes on. No longer do we struggle to balance the boat and keep her on her feet.

All these sails were designed by Burns Fallow of North Sails, New Zealand. Not coincidentally, he also has designed the winning North mainsails and headsails for Team New Zealand in past America's Cups.

This e-book offers *Practical Sailor*'s latest reports on specialty sails—riding sails, trysails, reefing staysails—and sailing handling hardware, including travelers, snatch blocks, and vangs. For further reading, check out Volume 2 of this series, "Headsails & Furling Gear." That e-book dives into light-air headsails and headsail furlers. "A Look at Sails Volume 1" covers sail buying, sailmaking, mainsails, and mainsail handling and furling options.

Chapter 2

Riding Sails

FinDelta vs. SailRite • Sail Materials Comparison

There are a few options when dealing with a boat that sails around on its anchor. A bridle, an all chain rode, or a kellet will reduce or eliminate sheering in lighter winds. However, a riding sail, which lessens yawing by bringing windage aft, is also a viable strategy. Ketches and yawls have the option of using their mizzen as a riding sail, but this unnecessarily exposes a working sail to sunlight and weather. A dedicated riding sail is a better choice for this situation. The riding sails *PS* examined for this comparison are suitable for use on a variety of rigs, including sloops or cutters.

Most riding sail manufacturers base their recommendations on vessel length; however, hull design and displacement are important considerations as well. Regardless, the sail cloth itself should be resistant to ultraviolet rays and chafe that can result from flogging as the sail backs and fills. While their benefits may be more pronounced in higher winds, riding sails are also useful in light air as they keep the vessel heading into the wind, maximizing airflow through hatches and wind chutes for ventilation belowdecks. In squalls, too big a riding sail can result in a 3 a.m. fire drill.

Traditional riding sails are typically a flat cut, heavily constructed single panel with heavy-duty stainless rings and closely spaced bronze hanks (for attachment to the backstay on a sloop). They're normally hoisted using the main halyard and are typically set with the head roughly a third of the way up the stay, which would be adjusted depending on conditions and your particular boat, lower being better in strong winds.

Practical Sailor evaluated a radically new designed riding sail, the FinDelta Anchoring Sail from Banner Bay Marine, which uses three panels instead of the traditional single panel. While the traditional riding sail has served sailors well for centuries, this new design intrigued our testers, and a head-to head-comparison was launched.

A riding sail kit from Sailrite was purchased to represent the traditional riding sail. To help evaluate both sails from a sailmaker's perspective, we turned to David W. Baxter, owner of Baxter Sailmakers, a well-respected loft in Norfolk, Va. What follows is the first report on our findings.

The Sailrite riding sail easily mounts on the backstay. The abrasion-resistant Top Gun fabric is durable, but stretches more than Dacron. (Photos by Frank Lanier)

THE SAILRITE KIT

Sailrite offers two riding sail kits for those wanting to try their hand at sailmaking. The smaller kit (for boats up to 35 feet, or so) is 12.5 square feet in area and costs $82, while the larger kit (for boats to 50 feet) is 20.25 square feet and runs $99. For the test boat, a heavy-displacement Union 36, we purchased the larger kit for our evaluation.

Both kits include all materials needed to construct the sail—pre-cut sail panels of white Top Gun fabric, thread, Seamstick, hanks, twine, hand needles, instructions, and a duffle bag for storage once the sail is completed. Sailrite advertises its choice of sail material (Top Gun fabric) as highly resistant to chafe and UV damage.

Rigging the Sailrite riding sail on a sloop is simple. Hank the sail onto your backstay, then sheet it forward. Traditional anchor sails are often sheeted so that they run down the boat's centerline (like the fletch of an arrow), however a center-rigged sail produces the greatest potential for lateral movement as the sail backs and fills, which in itself can produce a jerky movement at the end of the anchor line and considerable noise from the sail itself.

Another option is to sheet the forward part of the sail to one side so that the boat is actually sailing to one side of the anchor rode. The boat should swing out until it reaches an equilibrium between wind and topside windage, where it should hold position fairly steady, while adjusting itself to minor changes in wind speed. Locking the rudder a few degrees to one side may also help keep the boat pointed in the same direction.

The Sailrite sail arrived too late to test in high-wind condi-

tions, but we will be following up on the performance of both these designs in various conditions.

PS VALUEGUIDE RIDING SAILS

MAKER	SAILRITE	BANNER BAY
MODEL	$ Riding Sail (large)	★ FinDelta (No. 2)
PRICE	$99*	$385
PRICE SOURCE	sailrite.com	bannerbay marine.com
DESIGN	Triangular	Split wing
SAIL MATERIAL	Top Gun	6 oz., 7 oz. Dacron
MATERIALS QUALITY	Fair	Good
CONSTRUCTION	N/A*	Good
EASE OF SETTING	Excellent	Good
PERFORMANCE	Good	Excellent

★ Best Choice $ Budget Buy *Buyer assembles from kit.

THE FINDELTA

Banner Bay's FinDelta's three-panel design uses the forward or leading edge sail as an airfoil fin "spoiler," while the two wings work constantly to center the boat, reducing the chance that the boat will start swinging.

According to Banner Bay, as the boat tries to swing, the sail's forward fin generates a thrust vector to one side only, gently realigning the boat. By comparison, a traditional, single panel anchoring sail still allows some degree of "sailing" at anchor as the sail backs and fills from one side to the other, often resulting in flogging.

The FinDelta's design also reduces one of the most common complaints of traditional riding sail users: noise. The FinDelta doesn't require attachment to the backstay—an excellent conduit to transmit the vibration from flogging anchor sail—and so noise is greatly reduced.

Analysis provided by Banner Bay through a NASA-funded Space Alliance Technology Outreach Program (SATOP) and conducted by University of Central Florida's Mechanical, Materials and Aerospace Engineering Department found that the FinDelta design is up to 26 percent more effective at realigning the boat, particularly during the early stages in the swing.

The FinDelta is available in two sizes, the FinDelta No. 1 ($325) for boats up to 35 feet and the FinDelta No. 2 ($375, the unit we tested) for boats from 35 to 47 feet. According to Banner Bay, a third size is on the way, the FinDelta No. 3 for boats over 47 feet (price was not yet available). All FinDelta sails are constructed of 6- and 7-ounce sailcloth (the fin is 7-ounce fabric, the wings 6-ounce fabric) and include a free storage bag and RopeTie cleat to snug your sail down.

Rigging the FinDelta is a bit more involved than a traditional riding sail, but the instructions are clear. After raising the sail the first time and determining how best to rig it to your particular boat, it takes only a few minutes to set up and remove. The sail is typically hoisted using the main halyard, although the topping lift or a spare halyard can also be used. Once raised, it assumes a three-sided pyramid shape with the forward fin secured around the boom (the fin's bottom roughly 6 inches or less above the boom), and the wings attached aft, spread as close to a 45-degree angle as possible.

The FinDelta unit we tested had some modifications over the first model. Most of the changes were meant to make it easier to rig. In the new version, the base of the fin is a few inches longer and the base of the wings a few inches shorter. The sail is also a few inches taller to compensate for the loss in wing area. Grommets were added at the bottom of each wing a few inches back from the fin, allowing users to trim the ratio of fin and wing areas by pulling them together with a short piece of twine.

According to Jess Gregory, Banner Bay president, these modifications accomplish two things: the high-aspect ratio allows the sail to sit closer toward the stern (a position well aft is most desirable with an anchoring sail) and, as the wings are shorter fore to aft, it allows for a more desirable "spread" on boats with more narrow sterns.

Gregory told *PS* that the biggest rigging problem results from extensive bimini arrangements on some boats that make it difficult to find a place at the stern to tie the wings without chafing the Sunbrella. In response, Banner Bay is developing a Check the Fit Kit, a likeness of the sails made of string. When tied at all attachment points it becomes a virtual wire frame outline of the sail.

Practical Sailor conducted some initial testing with the FinDelta while at anchor during a weeklong summer trip on Chesapeake Bay. After the initial trial-and-error period, we were able to raise and lower the sail in about 2 minutes.

During testing, we experienced a maximum of 10 to 15 knots of wind while at anchor. The FinDelta performed as advertised with no noticeable noise from the sail itself. At one anchorage, we experienced opposing wind and current

Getting the riding sail to fit around your existing running rigging or bimini top is part of the challenge.

conditions, and even when the boat was not aligned with the wind, the sail didn't flog excessively or produce an appreciable amount of noise.

Materials Comparison

David W. Baxter, owner of Baxter Sailmakers, a well-respected loft in Norfolk, Va. (www.baxtersailmakers.com), carefully examined each of the tested riding sails and offered the following insight:

"The Top Gun fabric used in the Sailrite kit resists abrasion and UV rays and is good for a variety of marine covers, but it is more prone to stretching than Dacron. Stretch can equate to increased sail flogging. If the sail sees minimal use (a half-dozen times or so per season), it will probably hold up OK. Cruisers or other boaters who spend more time at anchor will want to go with a more robust material.

"While the instructions were pretty easy for a sailmaker to complete using a commercial-grade sewing machine, it would be harder for the do-it-yourselfer using a lighter machine to sew the Top Gun material. Sailrite says its kits can be constructed "on any home sewing machine," which is true—to an extent. Most sewing machines may be able to sew two or three layers of fabric, but problems (broken needles, improper feed, etc.) occur when trying to force them to punch through more layers of fabric, such as the installation of the corner patches for the sail.

"Purchasing the large riding sail kit and having a sailmaker assemble it will cost about $200-$250. If you have a suitable machine and the sewing skills necessary to use it, you'll save money but will likely spend three to five hours putting it together (compared to the one hour it'll take an experienced sailmaker to do it)."

The FinDelta: "Overall, the FinDelta seems well designed. Since both sides load up at practically the same time, it should be a lot quieter than a traditional anchor-riding sail. It also should allow for less swing.

"The sail is robustly constructed, but the grommets are a bit too small, particularly when compared with the heavy construction of the sail as a whole. In my opinion, a larger, pressed-in ring (or sewn-in ring with webbing) would be better. It is a concern that the smaller grommets could deform in higher winds, causing them to elongate and come out."

Chapter 3

Storm Trysails

A storm trysail rarely gets the close look it deserves. Designed to replace the mainsail in a severe storm, it spends most of its life in the sail locker.

The sail is required by offshore race rules and is a must for ocean-voyaging boats, but most modern production boats aren't even set up for a trysail.

The trysail hoists on the mast, but must be capable of flying independent of the boom. To make setting the sail as easy as possible, the boat's mast typically has a separate parallel track for the trysail. Feeder tracks that route the trysail into the mainsail track can work in some cases, but are generally less desirable. Stand-off tracks for in-boom furling, as well as some stack packs, and static lazy-jack systems can complicate a retrofit.

Trysail sheet blocks should be mounted port and starboard, allowing the sheets to lead fairly to a winch. Snatch blocks are not the first choice for this job.

It is best to work closely with a sailmaker and/or the boat's designer to get the right size and shape trysail. It should be cut flat, and the center of effort located to optimize stability and helm balance.

Generally, the trysail's clew should be just above the boom, its tack just above the furled mainsail's head, and its head near the mid-point of the mast. It must be configured so that sheets clear dodgers and boom gallows. Corners and edges must be heavily reinforced. Always stow the sail with pendants and sheets attached.

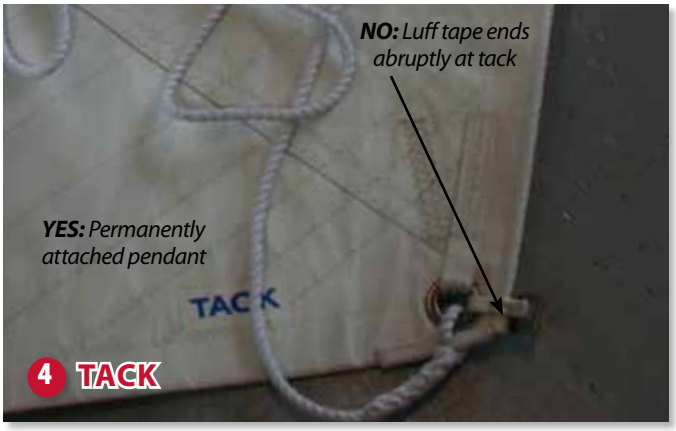
International Sailing Federation (ISAF) Offshore Special Regulations state that a storm trysail's luff and foot shall not exceed 17.5 percent mainsail luff x mainsail foot length. A cruising trysail will often be smaller. The ISAF regs also cover construction details. Aromatic polyamide fibers are out, but Spectra and Dyneema are fine. No headboards, no battens. A high-visibility cloth or patch is a must.

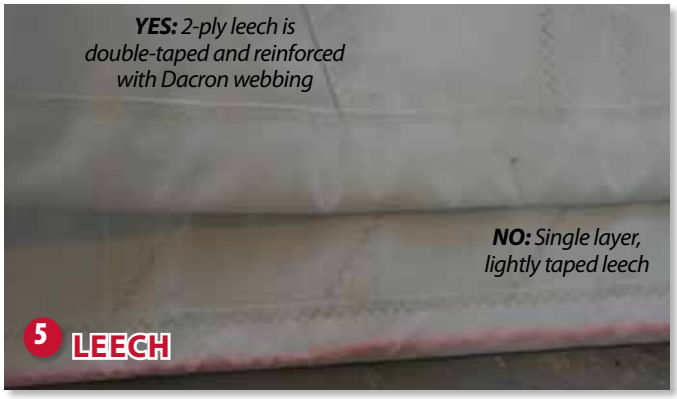
Practical Sailor toured Port Townsend Sails (*www.port-townsendsails.com*) in Port Townsend, Wash., owned by sailmaker Carole Hasse. Hasse's loft, which caters mostly to cruisers and traditional boats, is among several that were recommended in past *Practical Sailor* reader surveys.

Hasse's sails feature a lot of hand stitching, particularly for chafe protection. This raises the cost, but it also brings the project within the reach of the do-it-yourself sailmaker who is handy with a palm-and-needle. With your input, any good sailmaker can craft a rugged trysail.

The accompanying photos on the following page compare two Dacron trysails for a mid-size cruiser. Both have about the same shape and cut, but a close look at the details reveals important differences. The observations in the photo captions serve as a guide for inspecting or commissioning a trysail, but many also apply to a heavy-duty cruising mainsail.

The trysail on this Island Packet 420 hoists on an integral track. The sheets and pendants are pre-rigged on the sail, so it is always ready to deploy. Some trysails also incorporate slides into the head pendant to stiffen the mast column.





1 **Head:** Double slides at top, close spacing between intermediate slides, a bolt-rope tapering into the leech, high-visibility patch, and excellent chafe protection give the left hand trysail a clear strength advantage at this vital corner.

2 **Clew:** The big clew section on the left-hand sail is secured by three internal Spectra straps and a full bolt-rope wrap. It is strong and easy to fix, but will hurt if it whacks your noggin.

3 **Tack:** Full bolt-rope wrap, chafe protection, multiple layers of cloth, and Spectra webbing mark this well-built tack.

4 **Tack:** The luff bolt-rope, hot-knifed at the foot, offers little reassurance at this corner. Chafe protection is limited, and reinforcement is unexceptional.

5 **Leech:** The well-reinforced leech of the top sail will better resist flogging than the folded over single-layer leech below it. Webbing in the top sail eliminates the need for a leech line.

6 **Luff:** Hand-sewn luff grommets add expense, but they are user serviceable, create less chafe, and they last. Cheap stamped grommets (at left) will corrode in short order.

Chapter 4

Reefing Staysails

What we've found is that given careful preparation and a modicum of good luck, you can sail around the world in almost anything.

There's one tenet of cruising dogma, however, that we have found to be so true, so repeatedly that we are convinced of its validity. For safety, convenience, and performance, the only choice for the foretriangle configuration on most boats is the double-headsail rig, with a relatively small roller-furling genoa on the headstay, and a roller-furling heavy staysail on an inner forestay.

When we left Rhode Island, westbound round the world, *Calypso*'s foretriangle was a bit of a compromise. We had a relatively large (135%) roller-furling genoa, and a removable inner forestay with a fairly small, hank-on heavy-weather staysail. I would call this an adaptation of the coastal cruising rig, with a nod toward offshore sailing.

My thinking was that the big genoa would be useful in light air, and could be reefed for heavier air. When it started to blow hard, we would furl the headsail, and I would go forward to raise the staysail, which was kept hanked on in a bag at the inner forestay.

With the inner forestay on a release lever, I could remove the forestay to make it easier to tack the fairly large genoa when not using the staysail.

In practice, we never removed the inner forestay. On the few occasions when we tacked upwind in light air-offshore, you might go days without tacking, even when the goal was dead to windward. I merely reefed the genoa before tacking to make it easier to pass between the inner forestay and the headstay.

I dreaded going on the foredeck to set the staysail, and often put it off until far too late. Setting the sail required unzipping the storage bag, hooking on the halyard, then going back to the mast to raise the sail. By this time, mind you, it would always be blowing 30 knots or more, and headed upwind, the foredeck would be pretty wet and wild. While I was hoisting, my wife would start to trim the sail while it thrashed about and threatened to tie its sheets in knots. No fun.

A year later, we bit the bullet and installed a big Furlex 300S furler on the inner forestay. We have never looked back. In fact, we have seen more and more boats converting to this rig. The changeover is obviously easier if you already have an inner forestay, but this rig is so much better than anything else that it's usually worth the trouble to install, even on a boat without an existing inner forestay. (See "A Look at Sails Volume 2: Headsails and Furlers" for more on headsail furling gear.)

Although commonly referred to as a cutter rig, it's more properly called a double-headsail rig on most boats. A cutter rig implies, among other things, that you normally sail with two headsails: a jib and a staysail. In most cases, boats with a double-headsail rig use one headsail at a time: the big reefing headsail on the headstay, or the smaller staysail on the inner forestay.

NAYSAYERS

There's a lot of prejudice against a reefing inner forestay, particularly when the staysail is used as the heavy-weather headsail. Conventional wisdom states that a heavy-weather headsail should hank onto the forestay, since it could rip out of the foil of a furler. There's also fear about the reliability of furling systems.

In my view, a properly designed and properly installed heavy staysail on a reefing inner forestay is a far safer and more efficient rig than its hank-on cousin. With a proper halyard lead and a correctly built staysail head, with a luff-tape head pendant if necessary, a headsail in a luff-groove device is as well-attached to the stay as a hanked-on sail. The luff-groove sail will also usually have a better shape due to the even tension on the luff and the lack of local distortion around hanks.

The advantages of the reefer/furler are obvious. There's no more going onto a pitching foredeck to set the sail. The sail is under complete control as it is unrolled, so there's less risk of damage or entanglement. Because it's easily set, the staysail will be used more often, and more likely at the proper times. You will have a more versatile rig, since the foretriangle can be changed from full size to almost infinitely small from the safety of the cockpit, and with relatively little work.

The permanent inner forestay, when coupled with running backstays, offers dramatically greater fore and aft support for the mast, reducing the risk of rig failure.

In my view, the naysayers are wrong.

That said, there are many sailors who stand just as firmly behind their choice of a hank-on staysail, particularly one that is to be used for heavy weather. Simplicity and the ability to more quickly set a dedicated, flat-cut sail in a storm at sea (preferably well prior to its onset) outweigh the convenience of furling gear in their minds. For another interesting view of staysails, sailmaker Carol Hasse has an article on her website: www.porttownsendsails.com/articles.htm.

THE STAYSAIL

First and foremost, the furling staysail is your heavy-weather headsail. The maximum size the sail should be is 5% of the height of the foretriangle squared. For a boat with a 53-foot foretriangle height—typical of a masthead 40-footer—the maximum area of

the staysail would be 140 square feet.

This is actually quite large for a storm headsail on the typical 40-footer. However, it is a very good size for a heavy-weather headsail on the same boat. With a properly sized furler and properly designed staysail, the sail can be safely and efficiently reefed to a much smaller size for the really hard going, giving much more versatility than the non-reefing staysail commonly used for heavy weather. The non-reefing staysail will either be too large for storm conditions, or too small for "normal" heavy weather, which is far more common.

The cut of the staysail will be determined by the location of your sheet leads. The sail may have to be cut fairly high at both tack and clew to clear foredeck obstacles such as a dinghy carried upside down forward of the mast.

A low-cut, high-aspect-ratio staysail will be more efficient for upwind sailing, but is less forgiving of sheet lead changes when the sail is reefed. The low-cut sail also puts much greater loads on the lead blocks due to the greater deflection angle of the sheet at the block. Generally speaking, a higher-cut staysail is less efficient, but more forgiving of trim errors. For most of us, the choice of a high-cut sail is a no-brainer, all other things being equal—which they seldom are.

In practice, most boats have a short piece of T-track for the headsail lead, and don't change the lead as the sail is reefed. This is almost an essential compromise, as going forward to move a lead block partially defeats the purpose of this do-it-from-the-cockpit system. A short piece of track allows for variances in the cut of the staysail, and lets you tweak the lead block position at your leisure, before the sail is used in anger.

Some boats now come with a boomed staysail. Although this has some significant advantages in trimming the sail, it has the disadvantage of putting a solid swinging spar on the foredeck. If the main boom is potentially the most lethal piece of gear on a boat, a staysail club must be considered in a similar light.

A reefing staysail is not a one-size-fits-all proposition. It should be custom-made for your boat by a sailmaker with real experience in offshore sailing. This is no place for a discount sail. The sail should have the full array of controls, including leech line, foot line, and telltales. Sophisticated cuts are fine, as long as the materials and design are suited to the conditions in which the sail will be used.

Conventional wisdom says that the cut of the staysail doesn't matter much since you won't go upwind when it's blowing 40 knots. In offshore cruising, nothing could be further from the truth. Along with two other boats, we were caught in a local gale just 30 miles out of Oman, on the Arabian Peninsula, at the end of an Indian Ocean crossing. It was almost dead to windward. Snugged down to two reefs and well-cut staysail, we covered the distance in five hours, beating the other two boats in by two to three hours, never tacking. Each of the other boats was forced to tack at least twice, and both ended up motorsailing to make it in. I'd like to say that it was our sailing ability that made the difference, but the autopilot did all the steering after I quickly discovered that it did a better job than I did. The good staysail, however, made a huge difference.

In 30,000 miles of offshore sailing, we have only reefed *Calypso*'s staysail a few times. In practice, we go upwind—not by choice, mind you—with full staysail and double-reefed main (a total of about 370 square feet of sail area) in winds of up to 40 knots. Beyond that, we'd just as soon not go upwind unless absolutely critical, thank you.

Despite having a separate trysail track on the mast, the trysail stays in the bag. Two deep reefs have done the job in all the conditions we have encountered, although we have sailed off the wind with no mainsail at all a few times. For offwind sailing in really heavy air—over 35 knots—a scrap of rolled-out genoa will keep the boat tracking better than a staysail by shifting the center of effort further forward.

SIZING THE FURLER

Don't make the mistake of choosing a furler that's too small. Just as in winches, there's no such thing as a furler too big. The larger the diameter of the furler drum, the easier it is to reef or furl the staysail, and the less likely you are to overload any of the components.

Don't size the furler based on the size of the staysail. The loads on the 140-square-foot staysail of a 42-foot cruising boat will be huge compared to the loads on a similarly sized jib on a smaller boat, because the staysail will be used in much heavier weather.

Be sure the staysail furler requires the same size luff tape as the primary headsail furler. The larger luff tape will give added security against pull-out, and will allow you the option, in case of an emergency such as the destruction of your jib, to set the staysail on the headstay as a small jib.

As a general rule, if your headstay furler is sized properly, going down one size for the staysail furler will be a reasonable choice. Aboard *Calypso*, we used identically rated furlers for both the genoa and the staysail. It is massive overkill on the staysail, but it gives peace of mind that far outweighs the penalty in cost, weight, and windage.

FURLING LINES AND LEADS

Some furler kits come with a furling line. With others, you provide your own line. We like to use a hard-lay, high-strength line such as a double braid with a Spectra core and a polyester jacket. Lines with a firm lay are harder to handle, but they seem less prone to being wedged into the turns of line already on the furling drum.

Chances are that the furling line will lead to your secondary cockpit winches for additional grunt power in reefing or furling in very heavy going. If that's the case, the furling line must be sized not only to fit the furler drum, but to fit the self-tailer of the secondary winches.

If you're going to put the furling line on a winch—and you will, at least in some circumstances—you have to be aware of the risk of damage to the rig if you try to reef or furl the sail when there's some problem with the system, such as a seized furler bearing or an hourglassed sail. We've seen more than one headstay and forestay pulled completely out of a boat by an adrenaline-pumped crew furiously grinding away without paying attention to what's going on up there on the foredeck. If it's harder than normal to reef the sail, look for a problem before applying more grunt. Needless to say, care here is even more critical if you put the furling line on a powered winch, or if you have a powered furler.

Furling lines don't last forever. They tend to wear most at turning blocks, winch leads, rope clutches, and in the drums of self-tailing winches. Replace double-braided line whenever the cover starts to shred or chafe through.

We use heavy-duty Lewmar Superlock clutches to hold furling line loads. Because these are probably getting close to their working load limit in very heavy air, we leave the loaded furling line on the winch as a backup in these conditions.

Furling line leads can add considerable friction to the entire system, making reefing more difficult. On staysail furlers, the first lead block is usually mounted on a stanchion slightly aft of the furler drum. This will result in high side loading on the stanchion. You don't want this lead to result in a right-angle turn for the furling line. Although it may clutter the deck more, it's better to install the first lead block further from the furler, on the next stanchion aft.

The block should also be mounted as low on the stanchion as possible—consistent with the correct line entry angle to the furling drum—to minimize leverage on the stanchion. In extreme cases, it may be necessary to use a deck-mounted high-load turning block for the first point of deflection.

Whether deck-mounted or stanchion-mounted, the first furling-line lead block must be able to swivel.

From here aft, the angle of deflection is relatively small, and the loads on the stanchions are far less. We have used Schaefer Clear Step lead blocks on both headsail and staysail furling lines for 30,000 miles with no problems. These blocks require flushing with copious fresh water at regular intervals to keep the bearings free-running, and must be periodically examined for ultraviolet degradation of the sheaves.

With any fixed stanchion-mount blocks, it's critical to keep the blocks properly aligned with the line to reduce friction. Changes in the heights of the blocks on the stanchions as you move aft must be gradual, with minimal vertical deflection between blocks.

Fairleads and blocks without roller bearings have no place in this application. There's enough friction in the system already, so there's no sense in adding to the problem. The bigger the lead block sheave, the lower the friction will be.

RUNNING BACKSTAYS

Perhaps the strongest argument against any inner forestay system is the need for running backstays. Runners can be a nuisance. As generally rigged, they require changing over from one side to the other as the boat is tacked.

Surprisingly, we've found the runners to be more of a problem in downwind sailing than upwind. We use the runners all the time, upwind and down, in light or heavy air, just for the additional rig support, even when the staysail is furled. That just reflects our ultra-conservative way of sailing offshore, and may not be necessary on other boats.

Upwind, the runners are necessary to minimize pumping of the rig, which at the very least reduces the efficiency of the staysail. Most cruising rigs are so overbuilt that the typical runner arrangement, with the runners tensioned by a four-part self-cleating purchase, does not really provide significant additional tension on the inner forestay. For that, you need to put the runner tail on a winch. Runner blocks must be carefully chosen for the expected load, particularly if you expect to tension the runners using a winch.

Were we rigging a new boat, we would configure the runners with a retractor line from either the flying block or the lower block to a point on deck just aft of the lower shrouds. The retractor would lead from that point aft to a clutch. Swapping over the runners would then just require a couple of easy maneuvers from the cockpit, rather than a trip on deck.

When we rigged our boat, Phil Garland of Hall Rigging convinced us to install runners of ultra-low-stretch Technora, rather than wire. The T-900 runners are far lighter than wire, and do not chafe the main on the leeward side when sailing upwind with both runners on. (Racing boats usually use runners of Kevlar or PBO "rod," which is even lighter and lower in stretch.)

Generally speaking, a normal masthead rig with a permanent backstay is not going to fall down just because you take your time with the runners.

CONVERSION

If you already have an existing removable inner forestay, 90% of your work is already done if you want to convert to a furling headsail. If you're starting from scratch, the installation will be much more complex. You have to locate a suitable strong point for the lower termination of the inner forestay, and find a suitable location on the mast for the upper termination, halyard block, and running backstay tangs. You also have to determine sheet leads, and locate a suitable spot for the lead blocks. This may require local reinforcement of the deck.

Consultation with your boat's builder, a yacht designer, or an experienced rigger may be required. Once these issues are resolved, the installation is much the same as a conversion from an existing non-reefing staysail setup.

Installing a reefing staysail may seem like a big job, but if you're serious about long-range cruising, whether coastwise or around the world, this is a rig configuration that will greatly simplify your sailing in a wide variety of conditions. It's definitely worth the trouble.

Chapter 5

Snatch Blocks

Snatch Block Test Report • Block Longevity

The snatch block was developed to be installed and removed from the mid-region of a working line, and it has been loved and cursed by racers and cruisers alike. Most sailors use the hardware to lead spinnaker sheets and guys, function as a temporary turning block for a preventer, or to provide the right angle for an outboard genoa sheet lead. Many cruisers have found that a snatch block can be used as a friction-free fair lead when kedging off an unseen sandbar. Snatch blocks can also be used in sea anchoring: Cruising icons and well-known authors Lin and Larry Pardey (www.landlpardey.com) describe in their "Storm Tactics Handbook" how they use rugged snatch blocks and a guy to maintain the boat's attitude to the wind and waves during nasty weather.

In short, this versatile piece of hardware is a welcome addition to any gear locker, and today, there are more interesting variations of the technology than ever before.

Snatch block preferences can vary greatly according to particular needs. Race-oriented sailors will want something strong, light, and efficient, while robust construction and reliability rank high for cruisers.

Practical Sailor's ideal snatch block will be rugged, serviceable, and made of high-grade materials that won't fail in demanding saltwater-sailing conditions. The snap shackle and opening mechanism should remain fast under extreme flogging, yet be easy and quick to open by hand. The ideal block will rotate and pivot freely so that it provides a fair lead at a wide range of angles. A becket is a nice feature, particularly on a block meant for light-air sails, since a collapsing sail will likely let the block fall noisily to the deck if it is not supported from a lifeline by a light line or shock cord. Every element, bearings included, should be as maintenance-free as possible, and highly resistant to the sun and seawater.

WHAT WE TESTED

We asked manufacturers to send us a pair of snatch blocks appropriate for the genoa sheets on a cruising boat in the 35- to 40-foot range. We did not specify line diameter or working load—or even the use for which the block was intended, something that an ordinary consumer should do.

Ultimately, we were sent blocks from six manufacturers—Antal, Garhauer, Harken, Lewmar, Schaefer, and Wichard. The blocks' working loads ranged from 1,980 pounds (Wichard) to 5,000 pounds (Schaefer). Sheave diameter ranged from 2¼ inches (Antal and Wichard) to slightly over 3¼ inches (Garhauer). For historical perspective, we included a collection of similarly sized blocks dating back more than two decades. Not every snatch block manufacturer was represented in this test, but the selection offers a good cross-section of the blocks available today.

All but two of the blocks we tested had hinged cheeks that opened outward. The Antal and Garhauer cheeks rotated on swivel pins, so that they always remained parallel to the sheave. Testers found both types worked well, and their final ratings were based more on performance (See "How We Tested"), ease of use, and construction quality, than on their opening mechanism.

To capture a line under load in the Garhauer 60SN snatch block (shown here), users must bend the line. (Photos by Ralph Naranjo)

PS VALUE GUIDE
SNATCH BLOCKS

BRAND/ MODEL	ANTAL 9060	GARHAUER $ 60SN	HARKEN ★ 1609	LEWMAR ✓ SZ2	SCHAEFER 11-99	WICHARD 34500
PRICE	$209	$125	$299	$152	$281	$130
SAFE WORKING LOAD	2,860 lbs.	3,500 lbs.	3,500 lbs.	3,500 lbs.	5,000 lbs.	1,980 lbs.
SHEAVE DIAMETER	2.36 in. (60 mm)	3.5 in. (89 mm)	2.5 in. (63 mm)	2.83 in. (72 mm)	3 in. (76 mm)	2.19 in. (56 mm)
WEIGHT	9.4 oz. (w/o snap shackle)	21.4 oz.	19.8 oz.	33.7 oz.	36.9 oz.	8.6 oz.
FRICTION	22/38 lbs. *	8/12 lbs.	8/12 lbs.	13/22 lbs.	11/20 lbs. *	20/37 lbs.
LATCH TYPE	Rotating cheek	Rotating cheek	Opening cheek	Latch	Latch	Latch
BEARING	Bush/ball	Ball	Ball/roller	Bush	Bush	Bush
SNAP SHACKLE	Lashing	Trunnion (Ronstan)	Trunnion	Universal	15-degree pivot	Universal
SHEAVE	Plastic	Aluminum	Glass/Delrin	Delrin	Aluminum	Plastic
CHEEK FENDERS	Rubber	None	Urethane	Polycarbonate	Urethane	Rubber

✓ Recommended ★ Best Choice $ Budget Buy * Block not tested with identical mate.

HOW WE TESTED

In our testing of six new, top-quality snatch blocks, we looked at real-world hardware ergonomics, and we measured, tugged on, and took apart each piece of gear. We rated each block on line loading ease, both with a slack sheet and with one that was already under tension.

Low friction was deemed a desirable trait, so we built a jig that used hydraulic pressure to induce line load. This allowed us to put each set of blocks under identical load and measure how easily their sheaves turned. We monitored the load in the closed loop with a strain gauge and used a spring scale to measure how much force it took to move the tensioned line.

Our definition of efficiency was defined by how easily the line loop moved under fixed loads of 100 and 200 pounds.

We compared several older weathered and worn snatch blocks with the new being evaluated, and we also tested a set of Harken fixed Black Magic blocks as a benchmark for low-friction operation.

Using a magnet, magnifying glass, and manufacturer specifications, testers rated the quality of each block's metal components. To test corrosion resistance, we soaked each block for three days in a saltwater bath and noted any visible oxidation.

ANTAL

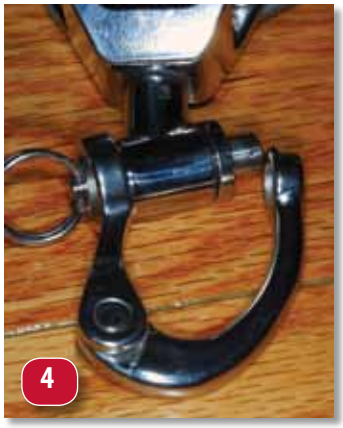
Antal's aluminum snatch block got high marks as a functional design. Its rotating cheek plate offered side loading, and the latch mechanism was simple and straightforward. The block is actually a synthetic rubber-coated aluminum cage block with a composite resin-and-fiber main bushing. Small ball bearings lie between the sheave sides and the cheekplates, but despite innovative design, the block was anything but friction free.

Antal had submitted two different sized blocks for testing, so we initially assumed that the "stickiness" problem might be due to the small diameter (1½ inches) of the 9040/SN sheave. Our solution was to retest with the 9060/SN and substitute the Black Magic bullet block we used as a control. Even with this switch to the most friction-free block as a partner for the larger Antal, the Antal 9060/SN scored the poorest in our friction test. These results clearly indicated that the bearing system of the Antal snatch block is nowhere near as efficient as the free-spinning Harken and Garhauer products. Several of the simple axle and bushing blocks also out-performed the product in the friction test.

Bottom line: The Antal side-rotating snatch block gets good marks for design execution and operation, but it demonstrated poor performance in friction abatement and has a limited range of movement.

GARHAUER

The 60/SN features a cheek plate rotating opening with a pin stop that makes the latching process a simple, two-handed operation. The friction-free spin of the Torlon ball bearing race enables these blocks to score as well in the tension test as the Harken blocks.



1.)Testers liked the design execution of the Antal 9060's side-opening block. 2) The one-handed, push-button Harken was testers' favorite. 3.) The line must be bent slightly to fit into the side-opening Garhauer. 4.) The trunnion-type snap shackle on the Harken block uses the locking pin as a pivot point, allowing a full range of motion.

Garhauer's Ronstan trunnion-type snap shackle allowed for a wide universal pivot action. The ball bearing race is slightly exposed to sunlight, and it would make sense to stow these blocks below when they're not in use. The anodized alloy cheek plates and innovative, pressed-ring sleeve keep the bearings permanently captured, but in dusty, salty areas, a regular routine of fresh water washing will extend the life of the non-replaceable bearings.

When attempting to insert a sheet under load into the open side of the Garhauer block, the configuration of the opening would not allow the line to feed straight into the block. The sheet had to be bent slightly to conform to the block's architecture.

The Garhauer was the block most affected by the corrosion bath test, actually losing a small amount of aluminum at one of its pointed ends.

Bottom line: Although it's not as easy to load as others in the test, the Garhauer was exceptionally friction-free, light, and priced right. It's our Budget Buy.

HARKEN

This one-hand operated, bottom-opening snatch block, was one of the testers' favorites. Not only is it user-friendly, and the most efficient in our friction testing, but its rugged construction promises years of heavy-duty use. The investment-cast stainless steel body is a chunky piece of metal that adds some extra weight, but it also stabilizes the load handling and provides a secure point to attach the rugged trunnion-action snap shackle.

Harken's snatch block design is fast and easy to latch as well as release. It provided the most convenient means of capturing or releasing a sheet under load. The geometry of its snap shackle is such that when working with a loaded line, the snap shackle can be easily locked onto a padeye.

The thick rubber padding on the cheeks minimizes gelcoat chipping caused by light-air sheet slackening, and the roller bearing-supported sheave rotates on a central axle that smoothly latches to the articulating side cheek. Our only concern was the magnetic permeability of its sheave pin. All other blocks had completely non-magnetic sheave axles.

Bottom line: The Harken block was a top performer in testing, is quality constructed, and easy to use and maintain. It gets the nod for *PS* Best Choice.

LEWMAR

Elegantly simple, this hefty traditional snatch block would be a wise choice for those looking for ultimate reliability and do-it-yourself repairability. All it takes are two 9/16-inch wrenches or sockets to loosen the sheave axle pin and pull apart the easy-to-assemble block. When the latching operation starts to get sloppy, a new set of dowel-like rubber grommets can be installed to return it to just-like-new status. Those cruising far afield and those who leave their snatch blocks rigged and exposed to the elements won't go wrong with Lewmar's rugged design. The bearing system in these blocks is a simple Delrin sheave running on a metal bushing, and the frame, latch, and universal pivoting snap shackle are all stainless steel.

The Lewmar survived the corrosion test fairly well, but showed some oxidation around its latch. It was also only one of two test blocks that is easily disassembled.

Bottom line: Well-designed, rugged, and easy to use, the Lewmar block is *PS*'s Recommended block for off-the-beaten-path cruisers.

SCHAEFER

Another tried and proven product is Schaefer's traditional snatch block design, and we looked at its range of three differently size blocks. Our test pair were the large 11-99 and medium 07-99 models. They are identical in all aspects, except size and safe working load, which were 5,000 pounds for the large and 3,750 pounds for the medium.

These blocks cannot be disassembled, but their simple, rugged design promises years of reliability. The large sheaves and rugged cage structure operated smoothly, with fairly low-friction operation, and potential cosmetic deck damage caused by the block's heft was prevented by the addition of shock absorbing urethane side plates.

Schaefer's snap shackle was not the trunnion type, limiting articulation to about 15 degrees off the vertical. In certain conditions—snapping the block to an open toe rail, for example—this limited range of movement could cause the snatch block snap shackle to hang up, and possibly cause some damage to the block.

Stainless steel roller bearings reduced friction on the classic Nicro-Fico snatch block (at far right). The Antal C. Fibre snatch block (at right) uses lower-friction Delrin ball bearings, but the sheaves' small diameter put it at a disadvantage compared to the modern snatch blocks PS *tested.*

Such problems are less likely to occur if the block is supported with a shock cord.

Schaefer's peened over, cold formed, stainless steel main axle pin showed some signs of oxidation after the corrosion test.

Bottom line: The Schaefer block is held back by a limited range of movement and high friction readings.

WICHARD

The Wichard block's latch mechanism opens the entire top portion of the block and is pinned closed by a piston-like extension of the main axle. The block handled efficiently during testing, but it was on the small side in comparison to other competitors. When it came to friction testing, it was clear that sheave size, or roller/ball bearings make a difference. The block's small size and bushing-type bearings, not surprisingly, yielded higher friction readings in our test.

Bottom line: Like most Wichard hardware, this snatch block is well-engineered and nicely finished. Poor performance in the friction test put this one behind the leaders in our test.

OLD TIMERS

Along with obvious signs of corrosion and physical deterioration, the working antiques we tested scored poorly on friction tests, and the worst examples of corrosion were directly linked to broken axle shafts and cracked snap-shackle pivots. The oldest Gibb tufnol blocks and a silicon-bronze roller-bearing Nicro/Fico product looked pretty bad, but still worked reasonably well. The silicon-bronze chrome plating was all but gone, and a green patina covered the metal, acting as a natural protective coating to hold any further corrosion at bay. In a pinch, disassembling these blocks, cleaning, and lubricating them with a simple lithium grease or higher-tech product can return them to satisfactory usability—a trait that holds value to long-distance voyagers.

CONCLUSIONS

If you're a performance-oriented sailor, ball- or roller-bearing supported sheaves really count. Harken and Garhauer blocks stole the show when it came to friction-free operation, which will make light-air spinnaker trimmers smile. Cruisers with smaller winches should also check these out.

A trunnion-type snap shackle or universal joint improves attachment—insuring universal movement. This wider range of bending prevents a snap shackle from being damaged due to variations in sheet lead angles or padeye design. The improved articulation makes odd lead angles tolerable, and allows the snatch block to self align with the loads imposed.

Harken and Garhauer provided trunnion-type snap shackles, while Lewmar and Wichard used a universal toggle-type attachment to achieve a similar range of movement.

Antal's snap shackle and Schaefer's modest 15-degree range of movement were less versatile. Antal does offer a lashing option that may appeal to some racers, but one of the advantages of a snatch block is its ability to be moved from one attachment point to another as quickly as possible, and a snap shackle is better suited for this.

Bigger blocks mean larger diameter sheaves, and the benefits include better load distribution on the bearing surface and less point load on the line itself. Our friction test showed a clear trend, revealing that once ball and roller bearings were removed from the equation, bigger blocks run smoother than smaller blocks.

The two-step attachment process to setting up a snatch block ranged from butter-smooth to downright difficult. Once again, Harken topped the charts with its unique clam shell-like, push-button opening process. Of the side-opening types, testers preferred Antal's approach. However, Garhauer's use of a Ronstan trunnion-type snap shackle was a big hit, and its large-diameter sheave and roller bearings helped yield excellent friction ratings.

Only the Antal and Lewmar blocks were easily DIY disassemblable, as compared to nearly all of those made a few decades ago. This is likely a market response to today's sailors who replace rather than repair broken gear, a game plan that's hard to implement at sea or in remote landfalls.

Harken's easy-to-operate, friction-free, front-loading snatch block gets the Best Choice kudos. Lewmar's bulletproof traditional entry was rugged, easy to refit, well-constructed, and our Recommended choice for the long-range cruiser. Our Budget Buy, Garhauer's proven side loader, is a cost effective competitor.

Snatch Block Longevity

Structural quality has a lot to do with both how a block functions and how long it will last. We rated each snatch block tested based upon the materials it was made from and the attention to detail seen in the construction. The observed deterioration and

Although less resistant to corrosion than 316 stainless, the hardened magnetic, martensitic stainless steel in the snap shackles is stronger (far left). Magnetic components on older blocks, like this sheave axle bolt (at left), were more prone to failure.

under-load failure seen in the older products we inspected provided insight into potential failure modes.

Among the older gear, signs of physical deterioration (rust and crevice corrosion) directly correlated with an increased tendency to fail under conditions that were a small percentage of the block's original safe working load. Magnetic permeability, or the habit of some lower grades of stainless steel to be attracted by a magnet, also directly correlated with metals prone to chemical corrosion. Broken parts from older snatch blocks had an 85 percent correlation with magnetic permeability. From that evidence, we determined that the less magnetic stainless steel components (316 alloy) are better suited to the marine environment.

Of the new products, snap shackles across the board were magnetic, and were made from either 17-4 PH, 15-5 PH high-strength stainless steel, or other, similar precipitation-hardened martensitic stainless steel, rather than weaker, but less corrosion prone, 316 stainless steel. All of the high-strength alloys have the anti-corrosion quality of 304 grade stainless steel, while the 316 alloy contains a chromium-to-nickel ratio that all but eliminates magnetic tendencies, and is more noble on the galvanic scale.

It was not surprising to see that older blocks showed considerable corrosion and cracking around snap shackle bodies and pivot pins, but less around higher grade, 316 stainless steel snatch block cheek plates, and other parts. In an annealed state, even low-grade stainless (304) is non-magnetic, but cold working and polishing can induce magnetic traits in such lower grades of stainless steel. Thus, when a poorer quality metal is pressed into a complex shape and highly polished to create an initially shiny surface, it actually becomes more prone to failure.

As noted, many different grades of stainless were used in the blocks we tested, and all were mechanically abraded and electro-polished (an electro-chemical process that causes ferrous metal contaminants to be removed from the surface.) The result was a gleaming array of shiny stainless steel that ranged from absolutely non-magnetic, to metal that was as vigorously attracted to a magnet as high-ferrous content mild steel. Experts consider magnetic permeability of a stainless steel alloy to be a pretty fair indicator of material grade in 300 series alloys. However, magnetic quality is a symptom rather than the cause of a problem in marine hardware. It is indicative of high-strength alloys and lower grades of austinitic 300 series stainless steel. All are more corrosion prone, and this characteristic, rather than the magnetism itself, is the real issue when it comes to the durability and longevity of marine hardware.

The axle bolts on all of the blocks tested, except for the Harken snatch block, showed no magnetic permeability. Older snatch block axles that failed under load were seriously corroded and displayed significant magnetic permeability. Some investment-cast stainless steel block parts were attracted to a magnet (Lewmar and Wichard). Others were not (Harken and Schaefer), and only Antal's web- or line-lashed snatch block showed no magnetic properties at all.

The long story short, is that 316 stainless, even cold formed and highly polished, shows little if any magnetic permeability. However, it is seen less and less in modern hardware—especially when a strong metal is required to get the job done.

Chapter 6

Mainsheet Travelers

Midsize Traveler Test • Test Followup: Garhauer

Properly installed and functioning mainsheet travelers are versatile devices, offering sailors a number of key advantages over simple mainsheet rigs traditionally used aboard sailing craft. These newer systems permit you to sheet to windward in light air to enhance your vessel's pointing ability; they allow you to de-power the sail in puffy conditions without touching the mainsheet; and they enable the mainsheet to be substituted for a vang when sailing upwind.

Mainsheet traveler systems are appealing for several reasons, including: "almost frictionless cars," "modular system components that let you lead the mainsheet and control lines in virtually any configuration," "installation so simple even a child can do it," and, "almost unbelievably low prices." Those observations also apply to today's mainsheet travelers, and equipment evolution in the intervening years has rendered the bulk of these products even more efficient.

WHAT WE TESTED

PS gathered products from five of the six companies most recognized for fabricating or selling this kind of sailhandling equipment for midsized boats in the U.S.—Antal Marine (represented in the U.S. by Euro Marine Trading), Harken Yacht Equipment, Lewmar, Ronstan, and Schaefer Marine. The sixth, Garhauer Marine, opted not to send us a traveler because the company was in the process of introducing a new system that wasn't available in time for our test. Two other companies were considered—Frederiksen (now part Ronstan), which did send a car and track for a smaller size boat, and Rutgerson, of Sweden, which wasn't able to provide products in time for our test. (We'll also examine that later.)

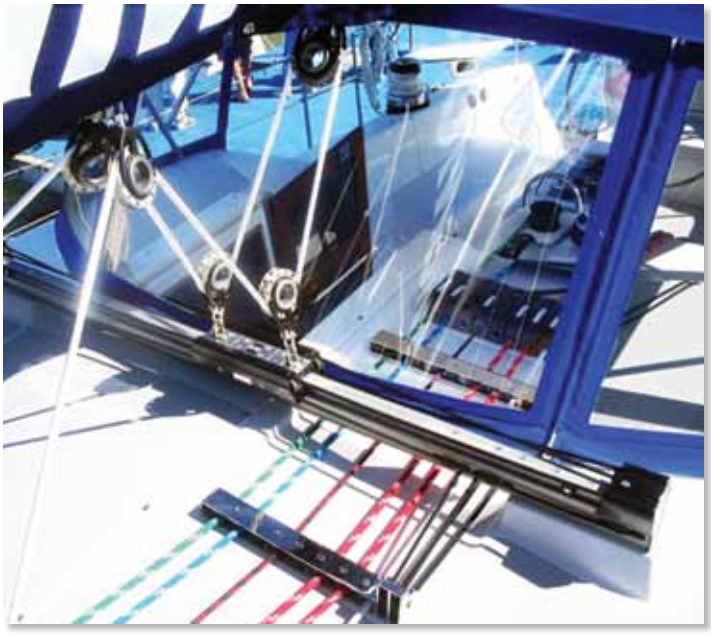
From each company, we requested a section of track, a car appropriate for that track on a sailboat 34 to 36 feet LOA, and equipment for a 4:1 control line. The track, we told them, should be four feet long and would have to span a 28-inch opening (as in a cockpit footwell or companionway application), unsupported. We will note here that those travelers set forward for mid-boom or three-quarter-boom mainsheet arrangements are thought to be subjected to greater loads than those set up for boom-end sheeting. Each of the manufacturers whose products we tested offer guidelines for various applications, including working load limits, and buyers should take care to purchase a system rated for their intended application.

TEST METHODOLOGY

For this test, instead of fitting our specimens to an actual boat, we built a jig to evaluate several parameters. We initially wanted to quantify how much force would be required to move the car along its track if the attached 4:1 mainsheet were under a 400-lb. load. We also wanted to know how much each manufacturer's track would flex in this application. We also closely examined each unit with the following areas in mind: electrical isolation, sliding smoothness, track strength, flexibility of mounting, car control, mainsheet block attachment and support, center of effort angle, instructions, form and fit, and cost.

Each traveler system was secured to a 2 x 6 board on our jig using four points of attachment. We used a varying array of fasteners as required by the design of the track (some require countersunk machine screws and some hex-head bolts).

For our initial experiments regarding side force, we mounted a spare track and traveler car at the top of our jig and attached a Dillon dynamometer to it. The mainsheet purchase from the car and track under test was led up to the dynamometer. We put the mainsheet under a load of 400 lbs. and led the 1:1 traveler control



Suitable for loads up to 4,000 pounds, the rugged Garhauer traveler can span areas up to five feet without support. (Photo by Ralph Naranjo)

Value Guide: Mainsheet Travelers

	Antal Marine	Harken	Lewmar	Ronstan	Schaefer
Price *	$900	$933.90	$669	$675	$1,010.65
Car Smoothess (vertical)	1 (tie)	1 (tie)	4	5	3
Car Smoothness (45°)	1	2	3	4	5
Electrolysis Isolation	Yes	No	No	No	No
Track deflection (inches)	.289	.073	.082"	.240"	.087"
Car COE angle**	65°	52°	64°	55°	76°
Car Safe Working Load	2,200 lbs.	2,300 lbs.	2,090 lbs.	1,935 lbs.	3,750 lbs.
Car Controls	roller bearing sheaves	roller-bearing sheaves	sheaves on bushings	roller bearing sheaves	roller bearing sheaves
Instructions	no instructions provided	diagramed instructions	no instructions provided	no instructions provided	no instructions provided
Track Mounting	pre-drilled, 4" O.C. for 8 mm countersunk machine screws	hex-head bolts slide inside track; rectangular washers provided	hex-head bolts slide inside track bottom, no rectangular washers provided	installer drills the holes in this track and chooses hardware	pre-drilled 4" O.C. for 1/4" countersunk machine screws
Form-Fit-Function	Ergonomic design, stand up block, smooth operating car with dual races of ball bearings, takes torsional load with minimal friction; track must be supported throughout its length.	Substantial track, lowest COE angle minimizing torsion; smooth operating car with captive, recirculating bearings; T-bolts on track provide installation flexibility.	Substantial track, T-bolts provide installation flexibility, 1 1/8" diameter blocks with bushings for car control. Car ball bearings can be changed without removing car from track, but not as easily as Antal's.	Simple light-duty track and car; track must be drilled by installer, and must be supported throughout its length; very low-profile car with single layer of ball bearings.	Strong, high-profile track, SS ball bearings inside SS wheels provide bulletproof car design; considerable torsion introduced with lower sheet angles, 1 ¾" diameter blocks with Delrin sheaves and Torlon bearings.

*includes all components
**see sidebar

line outside the jig via a hole bored in its side to a spring scale. Then, by way of repeated pulls, we quantified the force necessary to pull the car along the track. We learned early on that the force required, given this configuration, was almost inconsequential. In most instances it didn't exceed 12 lbs. to start the car rolling, and once rolling, the force required to pull it was much less than that. This, we surmised, is a testament to the engineered efficiency of the bearing systems used in these travelers.

Then, using the dynamometer, we led the mainsheet to a point 16 feet above the traveler and forward by about three feet. This, we felt, would simulate the force vector, (but not the exact force) exerted on a traveler car with the mainsail let out on a close reach, essentially introducing a torsional component to the load. We then resumed our pull tests using the spring scale and learned that for all but one of the units we tested, there was little difference in the force required to move the car along the track.

To gauge track deflection under load, we led the mainsheet to a fixed point on the upper support of the jig, and using the dynamometer to measure, we again applied 400 lbs. of upward force with the purchase system. Using digital calipers, we gauged the deflection, first measuring the position of the tracks when unloaded and then when under load.

As a final evaluation, we attempted to determine smoothness by sliding each car back and forth on its track by hand through multiple cycles. Using this method we determined a ranking for that car and track assembly that seemed most smooth, and judged all others against it. This aspect of our test relates more to elegance of design than function, but a product that works more fluidly is likely to function well for a longer period of time than one that's susceptible to binding or increased friction.

ANTAL 4113

Antal Marine's 4113 traveler car ($652 including toggle) is milled from aluminum that is hardcoat anodized. The 4510 track ($140) is anodized as well. The system is rated for boats up to 36 feet LOA. Interestingly, we noted that this car represented the lone product in our test that is assembled with its aluminum parts isolated from its stainless parts by way of nylon bushings or washers. Galvanic corrosion with these products can occur when the anodized layer is compromised (through scratching, or cracking, which might be brought about by over-tightening a stainless fastener). This is a small, but important aspect, indicative of Antal's attention to detail.

This car is also the only one in our test that utilizes two races of ball bearings to resist friction along the track. The lower layer bearings are Torlon balls, where the highest loading exists. The top bearings are Delrin. The car rides along the track with the bearings making contact with the track in two grooves. The lower groove with the Torlon balls sustains the upward forces, while the top groove with the Delrin bearings comes into play with side or torsional loads. This car prevailed in our smoothness test, principally because the second layer of bearings allows it to roll with minimal friction when under a torsional load. An additional feature we like is the fact that the car's end caps are engineered in such a way as to keep the car on the track should the ball bearings fail.

The company engineers the system with an access port on each side of the car so that the bearings can be removed from the races and replaced simply by backing out a stainless Philips head machine screw. Three cars in our test allow the user to remove the bearings without taking the car off the track, and this one is the easiest. We think that facilitating this operation will promote better maintenance over time.

The toggle attaching the mainsheet block is fashioned from a bent stainless steel plate that surrounds a thick phenolic rubber bushing, which controls and buffers the fore and aft movement of the support. This toggle plate is connected to the car by way of a 7/16" stainless steel pin. The car was fitted with double blocks for the control line (4740 $147 each).

Antal offers either plunger stops for this system, or 1:1, 2:1, 3:1 or 4:1 stackable control sheaves. Additionally, cam cleats can be mounted either at the track ends, or on the car carriage itself. The 4250 control sheaves ($184 each) Antal supplied are milled from aluminum and hardcoat anodized. They mount on a rectangular channel that fits over the track and has a soft but resilient urethane pad (4280 $11 each) to cushion the impact between car and end piece. On top is a broad aluminum plate with holes bored in it for the servo cam cleat (4410, $77 each) to be positioned at one

of three angles. The only drawback of this assembly is that the channel piece has two lengths of stainless steel threaded rod set in it for securing to the boat, but these can't easily be removed.

In our tests, the Antal track experienced the greatest deflection, but we acknowledge that it's not meant to run unsupported across any expanse, and should be fastened every four inches via the pre-drilled holes. Euro Marine Trading told us the track should be installed with a support member like a stout section of teak to aid it in spanning any space.

Euro Marine Trading didn't send any instructions with its traveler system because the company doesn't ordinarily sell direct to the end user, but usually supplies its travelers to riggers for installation. Nonetheless, there's nothing complicated about installing this system except that the cars are shipped on a short piece of loading track and installers must be careful to slide them onto the track without losing the bearings, because they are not captive. This system, with all its parts, can be purchased whole for $900.

HARKEN 1618

Harken Yacht Equipment in Pewaukee, WI, offered its 1618 high beam track ($108) with a 1627 car and toggle ($196.30), and 1633 double sheave control end fitting with cam cleat ($265 each). These parts are rated for use on boats up to 34 feet. The track, car, and end fittings are all milled from aluminum that is thereafter hardcoat anodized. The track comes with eight rectangular washers (Harken calls them "bolt slides") intended to fit over 1/4" mounting bolts and slide into a channel in the bottom of the track. The advantage of this approach is that the fasteners can be placed wherever it's most convenient and appropriate, but Harken recommends spacing them no less than 4" apart, with two on either side close to where the span begins.

The car rides along the track on recirculating Torlon ball bearings that are held captive by twin stainless steel clips so that the car may be removed from the track without worrying about the balls dropping out. The clips are made from 17-7 stainless that is heat-treated to improve strength. Having captive ball bearings is a handy feature for installation and we think it would enhance maintenance as well. With the car removed from the track, the bearings can be snapped out of the races one at a time if they require replacement, and new ones snapped back in. Harken's car is the only one among those we tested that is engineered in this way.

To achieve the least friction, the Torlon balls bear on grooves in either side of the track. Harken's advertising touts the car's low-profile design, which means that the pivot point of the toggle attachment isn't far above the surface of the track where the bearings sit. In fact, Harken's car has the lowest center of effort angle of all those *PS* tested, which means that it has a very efficient load transfer under side loading. This takes place when the boom is anywhere off centerline.

Though Harken's car has end caps that will tend to keep it on the track should the bearings fail, these are not as large or as close-fitting as those on the Antal and Lewmar cars.

The 1627 car is fitted with a stout, stainless steel toggle to both support and connect the mainsheet blocks. This toggle is investment cast from stainless rather than bent out of a plate, but not unlike the Antal toggle, it surrounds a durable urethane support bushing that also limits and buffers the fore and aft travel of the toggle. The toggle has "ears" on either side which are formed to accept stainless steel clevis pins where control blocks (2638 $49.80 each) can be attached. Harken claims that attaching the controls to the toggle instead of the car reduces the loads on the car.

Harken's 1618 track experienced the least deflection of all the ones tested, though it was essentially in line with that measured on Lewmar and Schaefer's tracks. This track lacks the holes that would enable it to be fitted with pin-stop controls, though the company does offer those for this size traveler. It also offers single or double sheave control ends fabricated from its patented Carbo material, or single or double sheave controls built of stainless sides. These control units sit on an anodized aluminum base and mount with a single screw fastened to the track, so there's no need to bore additional holes in the boat.

Harken also accompanies its products with detailed diagramed illustrations that enable DIY owners to install the equipment without confusion. And Harken is one of two companies that also sells its traveler system in kit form (car, control blocks, and end fittings), minus the track. The system we tested lists for $933.90.

LEWMAR TRAVELERS

Lewmar is revising its mainsheet traveler systems, and the new system is described by the company as an amalgam of the old Ocean and Racing systems, which are still available. The company sent us its track 29162315 ($114) and 29432300 car ($212), fitted with two double control line sheaves 29172012 ($65), and two end fittings 29472836 ($129 each). Each end fitting consists of an anodized aluminum base with two nylon sheaves, a Ronstan cam cleat, and a cast stainless becket. All these parts are rated for use on boats up to 36 feet.

The car body and end fittings are milled from aluminum and thereafter hardcoat anodized. The track is extruded and mounts in the same way as Harken's, with 3/8 hex-head bolts meant to slide into a channel in the bottom of the track. Lewmar specifies mounting the bolts on 4" centers, with at least three mounted on either side of the span. The bolts are to be mounted with washers underneath their heads, and washers should also be set underneath the track for each bolt. No fasteners were supplied, but the equipment arrived with the car already on the track and the end fittings in place as well.

Measuring 3.43" wide by 1.56" tall by 8.25" long, Lewmar' car is the largest one we tested. It's nonetheless a low-profile car, which utilizes recirculating Torlon ball bearings that ride in grooves on either side of the track. The body of the car is complemented by twin tubes that contain the ball bearings as they rotate back toward the track, and twin end caps, which can be removed to service the balls. These end caps are also milled from aluminum alloy. On top of the car, six holes are tapped to accept the bolts that thread through the control sheaves and affix them to the car. The outermost holes on either end of the car are fitted with stainless inserts so that galvanic corrosion will not seize the bolts over time. *PS* wondered why the other two holes hadn't been treated in the same manner. Lewmar does coat the bolt ends with a synthetic lubricant before assembly as a protective measure against seizing. The control sheaves themselves are made of a

hard nylon and turn on bushings rather than bearings.

The mainsheet attaches to the car by way of a stout stainless steel D shackle contained by a pin held captive inside the car. (Lewmar also offers a forged stainless steel toggle not unlike the one on the Harken car.) The shackle articulates fore and aft, and twin urethane pads attached to the car keep the shackle from banging into and damaging the aluminum.

Lewmar accessories include friction stops that can be used on this track, which are activated by a winch handle. However, most sailors would likely opt for traveler controls with multiple part purchases, and for that reason the company offers one or two-sheave control end fittings, either with or without cam cleats. These fittings mount to the track by way of stainless steel Allen-head bolts that thread through holes tapped into the end fitting and simply tighten on the top of the track to lock the fitting in place. Lewmar treats them with Loctite to ensure that they won't release. These bolts also serve as the axle for the sheaves' bushings and to lock the cam cleats in place. Collectively, these end fittings represent engineering that uses the fewest number of parts for a number of functions.

Lewmar also sells its traveler system in kit form, with three sizes offered to accommodate boats up to 44 feet. The kit includes a different car and end controls from the one we tested, and because it's intended for retrofits, no track is included. The system we tested sells for $669.

RONSTAN RC 12204

Ronstan provided its RC 12204 Series 22 low-profile car ($140), along with its RC 1224 Series 22 high-profile track ($93), which is rated for boats up to 33 feet. The company also sent its 12284 end fittings ($95 each). These have a single sheave and no cam cleats. Ronstan does offer double-sheave fittings—the RC00411 control sheave ($54 each)— with the option of a stainless steel arm, fairlead, and cam cleats, RC00421 ($72 each). We used all of that to calculate the price shown in our chart.

This is the lone track that we tested which didn't come with pre-drilled mounting holes. Ronstan has other tracks that are pre-drilled, but feels that spanning applications require a degree of customization regarding the location of the mounting holes, and thus leaves the drilling up to the installer. The lack of holes also enhances the strength of the track for spanning purposes. Having the flexibility to drill your own holes can be an advantage for custom installations, but because properly countersinking a hole and getting it in the right location requires care and the precision of a drill press, we feel Ronstan's strategy will have limited appeal for DIY owners. Ronstan also manufactures a high-profile track (no. 1225) for spanning greater distances.

Ronstan's car and end fittings are milled from aluminum alloy and then hardcoat anodized. Like the majority of its competitors, the car also operates on recirculating Torlon ball bearings. Alloy end caps are screwed to each end of the car with stainless fasteners. The company claims these can be removed to service the ball bearings without having to remove the car from the track, but it's not easy to do. Though these end caps would also tend to keep the car on the track if the bearings were to fail, they aren't as beefy as those on the Lewmar and Antal cars, nor do they fit as closely to the track as the ones on those cars.

This car had the lowest profile of all those we tested—at just 1.01 inches high—and is also the lightest one at 8.1 oz. Like most of the other cars in our test, it's versatile in that any of several control line attachments can be made. On either side of the mainsheet attachment shackle are tapped holes where a single or double control block could be attached. The mainsheet is attached to the car by way of a stout stainless steel shackle that pivots on a pin inside the car. This shackle articulates fore and aft, but there is no provision to keep it from hitting the side of the car. However, Ronstan does offer a stand-up spring kit to resolve this issue.

Ronstan's end fittings fit over the track, and are pre-drilled for countersunk fasteners. Mounted atop by way of stainless bolts and nuts are alloy sheaves that turn on Torlon ball bearings, all kept in place by stainless plates. The inboard end of the fittings have urethane knobs installed that protrude out to accept the impact of the car should it slide all the way to the end unimpeded.

The system we tested sells for $675.

SCHAEFER

Schaefer's traveler system arrived fully assembled, complete with two 12' sections of 3/8" braided control line. We'll state right up front that this system is overbuilt for our test due to the fact that it's rated for boats up to 45 feet in boom-end applications (up to 42 feet for mid-boom applications). The 72-92 ball bearing car with double stacked Delrin sheaves ($471.75) that is the heart of this system, is rated for a safe working load of 3,750 lbs., almost 1,500 pounds more than the other beefiest car in our test. Admittedly, this system is an apple among oranges for comparison purposes, but Schaefer's next size down is only suitable for boats up to 27 feet long.

Schaefer's 42-84 track ($180.75) was also the beefiest in our test. Fashioned from extruded aluminum alloy that is hardcoat anodized, it measures 1.5" high by 1.5" wide, and a four foot section weighs 4 lbs., 12 oz. This track, which is treated with a Teflon coating to reduce friction and wear, deflected fractionally more than Harken or Lewmar's tracks, which are both similar in size. Schaefer's track has countersunk holes (for 1/4" fasteners) on 4" centers. It also came with two 74-91 track end stops ($20.35 each), a 74-83 double control with cam ($120.60) and a 74-84 double control with cam ($120.60). A 78-49 stand-up adapter to connect the mainsheet is optional ($76.25).

Schaefer's car, which is milled from aluminum alloy that is also hardcoat anodized, is almost 5.5" long and weighs 2 lbs. 8 oz., making it the true heavyweight of our test group. Three stainless steel wheels are affixed on either of its inside surfaces. These wheels, which rotate around stainless axles on stainless steel ball bearings, run along the upper and lower ledges of the track as the car moves. The mainsheet connects to the car by way of a stand-up, spring-loaded adapter through which a clevis pin is inserted. (This piece we didn't request, thus didn't test.) The mainsheet can also connect to that same clevis pin, which pierces holes bored in the apex of a stout triangular bracket that is bolted to the top of the car with three stainless bolts. The outermost of these same fasteners are used to support the sheaves on the car for the traveler control system. The body of the car is not engineered (as are the others we tested) to remain on the track in case the axles or bearings fail, but in over 20 years of making this design,

Having the sheaves integrated into the end fittings shields the Torlon bearings from UV rays.

Schaefer says there's never been a failure.

For traveler controls, Schaefer offers a combination of options including a dead-end bail, a single sheave, or a double sheave. These are mounted on track ends that fit over the track and are fastened to it by way of stainless machine screws that are threaded into holes tapped into the track. The track ends provided to us for our test had no buffering system, so car and end fitting will meet metal-to-metal, which isn't a desirable arrangement.

The control sheaves are made of Delrin. Sandwiched between stainless steel plates, they roll on Torlon ball bearings. The track end controls include similar options, with the sheave-cam combination pre-drilled, allowing three different cam positions.

Though we deemed Schaefer's car and track system nearly bulletproof, it does have one limitation. Two factors affect torsional loading: the width of the track, and the height of the car's center of effort, defined as the pivot point of the cars toggle or shackle. Schaefer has a wide track and the highest center of effort angle in our test. This means that when the boom is off centerline with the force vector extending along the mainsheet being other than vertical, Schaefer's traveler system will experience higher torsional loads than its competitors.

The Schaefer system we tested retails for $934.40. Add the stand-up adapter ($76.25), and it totals $1,010.65.

CONCLUSIONS

All of the products we evaluated appear to be well-engineered and suited to the task of controlling the mainsheet orientation on a mid-size sailboat. We found their overall functionality and load capacities to be more than acceptable, and didn't discover any flaws in concept or workmanship. That said, several of the products stood out from the others due to their engineering. Schaefer Marine's wheel-bearing car appears to take the old-school approach, eschewing ball bearings in horizontal races and beefing up the car material. At its narrowest, the aluminum car is nearly a third of an inch thick (.323"), and on the sides, where the wheels are affixed, it's almost a half inch (.414"). From a visual perspective, its engineering seems almost crude alongside its competitors, but there's a lot to be said for the reliability of a stout, simple device when you're well offshore in big winds and waves. And Schaefer likes to point out that Torlon bearings do degrade over time, whereas stainless ones last much longer.

Each of the other cars and tracks appear to be the products of complex engineering. In the case of Antal Marine's car, this is evident in the use of two races of ball bearings. This car took top honors in our two car smoothness tests. With Harken's car, advanced engineering has resulted in captive ball bearings and the lowest car center of effort angle in our test. Lewmar's car is also highly engineered and thoughtfully assembled. And Ronstan's car has achieved its minimal profile—it is the smallest one we tested—through improved engineering. However, we felt that Ronstan's decision to have the installer drill his or her own holes in this track was more a drawback than an advantage. These holes must be precision drilled, and once they're done, the track's anodized surface is compromised.

Overall, we like the advanced engineering of Harken's car and we applaud the company for including diagramed instructions with its products. The bullet-proof fabrication of Schaefer's system is also appealing, but we cannot overlook that it has the highest car center of effort angle in our test, no buffer to withstand impact between car and end fitting, and the highest price.

Antal would be our No. 1 choice save for its price. For those sailors who want elegant engineering, a fractionally smoother car, and better corrosion resistance—and don't mind paying a premium for all that—this is the choice. Harken's would rank second. For the rest of us, it's hard to resist Lewmar's more accessible price. Lewmar builds a car that is also elegantly engineered, though it is quite long, which lessens the amount of distance it can move the mainsheet. Still, at $230 less than Antal's system, we think we can live with a little less efficiency.

Test Followup: Garhauer Traveler

Released after our initial test, the Garhauer traveler is weighty and solid. The new mainsheet traveler offers strength, performance, and redundancy at an attractive price.

Garhauer Marine is a name that has appeared in *Practical Sailor* with regularity over the years, and in almost every instance those references carry adjectives like "robust," "sturdy," and "economical." One of the latest products from this Upland, Calif., company—an established manufacturer of blocks, line organizers, vangs, and other deck hardware—is the Unibody Mainsheet Traveler. Unibody (UB) is the term company president Bill Felgenhauer and his colleagues have given to their line of gear in which the principal components are machined from solid pieces of metal. This traveler deserves some of the same descriptions.

Garhauer's Unibody system is based on a stout I-beam-shaped track extruded from 6061 T-6 aluminum, which is hardcoat anodized. One notable difference between Garhauer's traveler and those in the initial test is that the base of this track is nearly double in size, adding substantial weight, but also rigidity so that this product can easily span cockpit footwells or companionways unsupported.

However, the primary distinction of the UB travelers is that the sheaves on which the traveler's control lines turn are integrated into the car, end fittings, and the track. The advantage of this, according to Guido Garguilo, Garhauer's in-house traveler specialist, is that this arrangement minimizes snags. And hav-

PS VALUE GUIDE MAINSHEET TRAVELERS

MODEL		ANTAL MARIN ✓	GARHAUER ★ $	HARKEN ✓	LEWMAR ✓
PRICE *		$900	$495	$934	$669
CAR SMOOTHNESS	VERTICAL	Excellent	Excellent	Excellent	Good
	45 DEGREES	Excellent	Excellent	Good	Good
GALVANIC ISOLATION		Yes	Yes	No	No
CAR SAFE WORKING LOAD		2,200 lbs.	4,000 lbs.	2,300 lbs.	2,090 lbs.
CAR CONTROLS		Roller bearing sheaves	Roller bearing sheaves	Roller bearing sheaves	Sheaves on bushings
INSTRUCTIONS		None	None	Diagramed instructions	None
TRACK MOUNTING		Pre-drilled on 4-inch centers for 8 mm countersunk machine screws	Pre-drilled countersunk holes on 4-inch centers for 1/4-inch machine screws	Hex-head bolts slide inside track; rectangular washers provided	Hex-head bolts slide inside track bottom; no rectangular washers provided
FORM, FIT, & FUNCTION		Ergonomic design, stand up block, smooth operating car with dual races of ball bearings; takes torsional load with minimal friction; track needs full-length support	Beefy construction, excellent operation; car moves on four races to counteract torque; control sheaves integrated into traveler body, protecting bearings and ending snags; sheave bearings captive, allowing sheaves to be removed for inspection	Substantial track; lowest C.E. angle, minimizing torsion; captive, recirculating bearings; T-bolts on track provide installation flexibility	Substantial track; T-bolts provide installation flexibility; 1 1/8-inch diameter blocks with bushings for car control; car ball bearings can be changed without removing car from track, but not as easily as Antal's

$ Budget Buy ✓ Recommended ★ Best Choice

* Includes all components

ing the sheaves integrated in this fashion also means that their Torlon ball bearings aren't exposed to damaging UV rays. Another difference is that the UB traveler system's control lines have a 5:1 purchase; the others were 4:1.

Unibody traveler systems come in three models for boats from 27 to 60 feet LOA. On the midsize MT-UB-2, which is intended for boats from 33 to 45 feet, the anodized aluminum car is a full 10 inches long, 4.8 inches wide, and stands nearly 3 inches tall. (This whole system, including 5 feet of track, car, end fittings, and control lines, weighs 33 pounds. Those that *PS* tested six months ago average 20 pounds.) The track itself is 2.3 inches high, 1.5 inches wide, and more than 0.5 inches thick at the narrowest point. Beefy is the appropriate adjective here.

The reason for this oversized equipment, according to Garguilo, is to resist torque and distribute the loads from the mainsheet over a greater area of the track, which promotes better control, he said. It's suitable for mainsheet loads up to 4,000 pounds, and can span areas up to 5 feet unsupported.

The track itself comes bored with countersunk holes for 1/4-inch bolts on 4-inch centers. The car moves along the track by means of four separate races filled with Torlon ball bearings, one race in each corner of the car. The placement of the races, Garguilo told us, counteracts torque even under heavy loads. Stainless steel bolts (3/8 inch) with firm rubber caps serve as the stoppers at either end of the track. To remove the car for inspection, you have to take one of these bolts out, which wouldn't be an easy task, and depending upon where the track was mounted, it might also have to be unbolted from the deck to remove the car. But all the sheaves can be easily removed for inspection because their Torlon bearings are captive and won't fall out.

All the components of this system—end fittings, mainsheet connection shackles, sheaves, etc.—are fixed in place using stainless bolts with hex heads. Except for the stainless bushings at the center of each aluminum sheave, everywhere that dissimilar metals come into contact, Garhauer applies Tef-Gel (a lubricant paste commonly used in the marine industry) to inhibit corrosion and seizing. According to Garguilo, the Tef-Gel also prohibits the intrusion of moisture.

We judged the motion of the UB traveler car to be almost equal in smoothness to the travelers from Antal Marine Hardware and Harken Yacht Equipment, which tied as winners in that portion of our recent test. Garhauer uses three elongated, D-shaped shackles to connect the blocks of the mainsheet purchase system. All of the other travelers we tested had only one attachment point.

And unlike all but Schaefer's traveler system, these shackles pivot in an athwartships plane. The result is that the center of effort angle on Garhauer's UB traveler is much greater than all of those in our last test. (*PS* used center of effort angles in that test to rate each traveler's ability to handle torsional loading—the greater the angle, the lesser the ability to handle such loading. The angles are defined by a triangle drawn using the width of the track at the point where the bearings touch it as the hypotenuse, and the pivot point of the car's mainsheet toggle or shackle as the apex of that triangle.) Despite this assessment, we doubt the UB Traveler will have any problem withstanding torsional loads due to the oversize aspect of all its components.

THE BOTTOM LINE

The Unibody Traveler is sold fully assembled—including end fittings and traveler control lines. The *PS* test version cost $495. That's $174 less than Lewmar's mainsheet traveler, which we judged as the overall winner of the initial test. All you need to do is mark your holes, drill them, and mount the track on deck. Though this product can't be modified for crowned decks, it does carry a 10-year guarantee. If bullet-proof is what you prefer in deck hardware and weight isn't a consideration, this product should serve you well.

Chapter 7

Solid Vangs

It's been more years since *Practical Sailor* evaluated rigid boom vangs. Given the rapid evolution of sailing hardware, it's high time we take another close look.

In the last report, we wrote that Hall Spars and Rigging's QuikVang was the best all-around product, if you were game to ignore prices. Garhauer Marine's vang was our Best Buy due to its rugged construction and economical price, and Spinlock's then new Powervang was the product of choice for the racing set. If you owned a larger boat and wanted a lightweight vang, your best bet was Selden's Rodkicker. As that test indicated, determining the appropriate rigid vang for your boat and your style of sailing is not a one-size-fits all affair. The process is fraught with conditional answers that only you can supply.

First, you have to determine whether you want a rigid vang primarily for supporting your boom. If that's the case, then the performance of the vang may be less important to you than the cost and the product's purported longevity. If you want a vang that will allow you to make fairly precise refinements to your mainsail trim as well as support your boom, you'll be looking more closely at how easy it is to adjust and its range of adjustability. Then, you have different types. Do you favor a spring-loaded, gas-cylinder, pneumatic, or rod vang?

Our evaluation included all four types. It's important to note that you shouldn't install a rigid vang on a boom that rotates, as this will compromise the gooseneck fittings on the vang or the boom itself. Also, standard, off-the-shelf rigid vangs like the ones *PS* evaluated here are not suitable for use with in boom furling. For those applications, you'll want heavier-duty equipment.

VANG TYPES

Gas-cylinder vangs: Using pressurized cylinders and rods, these vangs offer a reliably consistent resistance. They're usually lighter than spring-loaded vangs, but the pressure inside the vang's cylinder can't be adjusted by the user.

Spring-loaded vangs: When compressed inside their housings, steel springs offer a reliably consistent resistance. Springs weaken, but you'd have to subject a vang to tens of thousands of cycles for that to occur. These vangs tend to be heavy, and the spring(s) can squeak.

Pneumatic vangs: Similar in design to gas-piston vangs, these products rely upon pressurized air for resistance. Because pneumatic vangs are fitted with valves, the pressure in their cylinders can be adjusted by the user.

Rod vangs: These vangs rely on bending fiberglass rods to develop resistance. They're very light, and have essentially no moving parts to wear out, but the sole manufacturer *PS* is aware of, Seoladair, only makes them for boats up to 40 feet.

HOW WE TESTED

For this test, *PS* amassed a group of eight rigid vangs from seven manufacturers. We asked each company to send a vang that would be suitable for a 36-foot sloop with a 13-foot boom. We told them that we were upgrading from a 4:1-purchase soft vang, that our objectives were convenience and safety, and stipulated that there were no suitable fittings on the mast or boom for attaching the new vang. We also mentioned that the mainsail on this boat weighed 50 pounds, and we described the spars as having rectangular grooves for the attachment fittings.

Selden Mast, which manufactures three different sizes of the

Marine Products' VangMaster Grant is made of 6061 T6 aluminum tubing that is hard-coat anodized and impregnated with Teflon. The end fittings are also machined from aluminum and hard-coat anodized. (Photos by Dan Dickison)

PS VALUE GUIDE BOOM VANGS

MANUFACTURER	MODEL	PRICE *	TYPE	WEIGHT	INSTRUC-TIONS	LINES & BLOCKS	WARRANTY	RETURN FORCE	STROKE
FORESPAR	Yacht Rod (Medium) ✓	$873	Spring	11 lbs.	Good	yes (w/ cam cleat)	3 yrs.	600 lbs.	7 in.
GARHAUER	RV20-1 SL $ RV20-1 AL ✓	$374 $429	Spring	12 lbs.	Fair	Yes	10 yrs.	650 lbs.	8 to 12 in.
HALL	QuikVang (B 18) ✓	$1180	Spring	11 lbs.	Excellent	Yes (w/ cam cleat)	3 yrs.	600 lbs.	6 in.
MARINE PRODUCTS ENGINEERING	Vang Master (M4) ★	$1100	Pneumatic Piston	7 lbs.	Excellent	Yes (w/ cam cleat)	4 yrs.	500 lbs.	16 to 18 in.
SELDEN	Rodkicker 20	$685 (without tackle)	Gas Piston	10 lbs.	Good	Yes (w/ cam cleat)	3 yrs.	876 lbs.	7 in.
SEOLADAIR	Boomkicker	$482	Rods	4.5 lbs.	Excellent	Yes	5 yrs.	600 lbs.	16 in.
SPARCRAFT	Ocean Vang	$362	Springs	10.5 lbs.	Poor	Yes	1 yr.	300 lbs.	15.7 in.

$ Budget Buy ✓ Recommended ★ Best Choice *As installed, prices will vary by as much as 20 percent depending on installation

Rodkicker, loaned us a mast and boom display mounted on a pallet, and we used this as a test platform for each vang. We looked closely at the vangs as well as the mounting fittings, which can vary according to the type of spar you have. We operated each vang multiple times and examined the construction quality, noted the stroke range, maximum return force, as well as the ease of use, and overall weight.

VANG MASTER

Marine Products Engineering is a small manufacturing firm based in San Pedro, Calif., that also builds pneumatic actuators for doors, lids, and some other applications. Proprietor and designer Doug Grant has been building vangs for 14 years, and he is the supplier for Melges Boatworks and Ultimate Sailboats. His Vang Masters range in size from 24 inches to 9 feet.

Grant uses 6061 T6 aluminum tubing that is hard-coat anodized and impregnated with Teflon. The end fittings are also machined from aluminum and hard-coat anodized. Except for the sheave and jaw attachment pins, MPE doesn't use any stainless steel. These vangs operate with an 8:1 cascading purchase system using Harken blocks (including a ratchet block and cam cleat), the last part of which runs through a sheave in the upper end of the vang.

Grant says he presets the cylinder pressure on each vang, but he also includes a bicycle pump so that an owner can make his own adjustments. To change the pressure, you simply pump the vang up to whatever pressure you need to keep the boom level.

The lightest vang, the Vang Master also provided the smoothest action. This was surprising, because others like the Hall QuikVang or those from Garhauer come with greater mechanical advantage. The Vang Master VM-4 offers 16 to 18 inches of stroke range with up to 500 pounds of return force, and comes with a four-year warranty that covers any breakage under normal use. It sells for $845, including the pump, but not the end fittings ($110 for the boom, $145 for the mast).

GARHAUER MARINE

Known for its rugged, if heavy, products, Garhauer Marine provides deck hardware for Catalina Yachts. The company supplied two vangs for our test: the RV20-1SL with a stainless outer tube, and the deluxe RV20-1AL, with a 6061 T aluminum outer tube, integrated purchase fittings, and a larger aluminum sheave in the head. Both vangs are intended principally to support the boom and both rely on 1½-inch diameter stainless steel springs — four in each case — to offer the resistance.

Garhauer includes in its price custom mast and boom fittings that are polished, beefy 316 stainless pieces with finely welded or machined components. The vangs featured similarly rugged construction. Except for the composite sheaves built into the vangs' forked ends, all the sheaves in the 20:1 purchase are anodized aluminum, which spin on Torlon ball bearings.

These vangs have a wide stroke range — 8 to 12 inches — and they reliably returned our boom to the same position. Their construction appears to be bullet-proof (they carry a 10-year warranty) and they have the lowest prices of any vangs that passed our test ($374 for the RV20-1SL, and $429 for the deluxe RV20-1AL, including end fittings). Yes, they're also the heaviest products, but not by much. Their main disadvantage is that, once they are

Marine Products' Vang Master is expensive, but super-smooth, this aluminum pneumatic vang is our top pick overall.

installed, the resting height is not as adjustable as it is in other vangs.

FORESPAR

Forespar's Yacht Rod is made of a polished stainless steel inner tube and an Awl-Grip coated aluminum outer tube, and anodized aluminum forked ends. The Yacht Rod uses a single stainless steel spring for resistance. It's marketed as both a device for supporting the boom and for trimming the sail in cruising or racing applications.

The Yacht Rod, which is built in three sizes, has a 4:1 tackle using Harken fiddle blocks and 7/16" line. A section of Spectra line attaches to that and runs through an aluminum sheave in the upper end's fork to create an 8:1 purchase.

Forespar offers several sizes of mast and boom end fittings for its Yacht Rods (sold as part of the package or separately). The majority of these are fashioned from polished stainless steel. The welds on the fittings that were sent to *PS* were solid and well executed.

The outer tube has four holes at four-inch increments that accept a fast pin to adjust the boom's height and allow a wide range of resting positions. This would be a handy feature to temporarily lift the boom in order to raise or lower a dodger or bimini. Forespar's otherwise excellent installation instructions lacked a detailed drawing of the mast end, which would be a big help.

This vang was simple to install and operated fairly smoothly, but the spring did squeak slightly when compressed. The medium-size Yacht Rod has a stroke range of 7 inches, and provides 600 pounds of return force. It comes with a warranty of three years and sells for $873, including the tackle and end fittings.

HALL QUIKVANG

Roughly five years ago, Hall Spars introduced the pneumatic QuikVang 2000, but, citing "complexities with its use," has stopped production. Hall plans to introduce a new vang, which we'll test and present in a future issue. For this evaluation, we looked at the conventional

QuikVang, a top performer in previous tests, and a product that Hall has been building for 20 years.

Marketed principally as a sail-trimming device, the QuikVang has anodized aluminum tubing and end fittings as well as a stainless steel spring. A Delrin plug in the inner tube acts as a piston to compress the spring when the 18:1 purchase system is tensioned. Delrin sleeves between the two tubes reduce friction and snug tolerances between the spring and the outer tubing keep the spring in column. Once installed, you can adjust the vang's resting height in one-inch increments by loosening the set screws on the adjuster knob.

The purchase system features Harken blocks and Yale Dacron braided line, and includes a ratchet block and cam cleat so you don't need any additional deck hardware for basic operation. Three parts of the purchase use stainless wire over aluminum sheaves, which are mounted in the jaws of the vang. Hall's end-fittings are machined from aluminum and then hardcoat anodized.

The QuikVang was easy to install and adjust. It operated smoothly and reliably returned the boom to its initial position. One convenient feature is a ratchet that lets you release the control line under heavy load. And Hall's booklet of instructions is very complete, including information on installation, operation, and maintenance. This model has a stroke range of 6 inches, 600 pounds of return force, comes with a three-year unconditional warranty, and sells for $906, not including end fittings.

SEOLADAIR'S BOOMKICKER

Seoladair, a small manufacturing firm just outside of Chicago, IL, produces stowable fenders, rolling boom bales, and the Boomkicker. This product is simple and will suit owners who want something to support their boom and work in tandem with an existing soft vang.

The Boomkicker, which is sold in five sizes for boats from 14 to 38 feet, is simply a set of fiberglass rods. The rods are held captive at either end with hardcoat anodized aluminum collars and attach to the mast and boom via durable, machined and anodized aluminum fittings. Users can further customize the Boomkicker by cutting the rods to a shorter length.

Garhauer's RV20-1SL is less than $500, either version (stainless-steel tube shown) offers great value.

The Forespar Yacht Rod is one of the easiest to adjust vertically after installation.

PS found the Boomkicker simple to install and easy to use. The 1500 we tested came accompanied by a 4:1 tackle using Harken blocks (and cam cleat) as well as a short section of Spectra run through an additional block to create an 8:1 purchase. Also included was an aluminum attachment tang for the purchase system, as well as a drill bit, stainless fasteners, and a tap to secure the fittings to the boom. (In most cases, the mast fitting uses the luff groove for attachment and no drilling or tapping is necessary.) At 4.5 pounds, the Boomkicker is the lightest in this test. The model we tested offers 600 pounds of return force with a stroke range of up to 16 inches, and carries a five-year warranty. It sells for $309, not including tackle, which we found for $173.

Last year, Seoladair introduced a new sliding boom fitting, which includes a 16-inch section of aluminum track and a car for the upper end. Without this, the Boomkicker drop outs out of the boom when it's raised well above horizontal. This is to prevent overloading of the fittings. We'd definitely shell out the extra $108 for the new boom fitting.

SELDEN'S RODKICKER

Selden's Rodkickers come in four sizes for boats from 22 to 60 feet and use gas-pistons for their return force. These pistons are mounted inside rectangular anodized aluminum extrusions that are mated to anodized aluminum end-fittings secured with Monel rivets. This vang came with an external 4:1 block and tackle using Rutgerson fiddle blocks with a cam cleat, which Selden sells as an option. The tackle connects to a large stainless wire that runs over a composite sheave integrated into the vang's upper end fitting, creating an 8:1 purchase.

We tested the Rodkicker 20, which is rated for boats from 35 to 42 feet. To specify its vangs, the company first looks at righting moment and rig type, and thereafter considers the weight of the boom and sail. The Rodkicker 20 claims a stroke range of seven inches and a return force of 876 pounds using the normal gas piston. The inner extrusion is capped by a composite plug, which acts as a bushing.

The Hall QuikVang is time-tested and has lots of purchase (18:1) and a smart spring design.

It took *PS* testers about 20 minutes to read the instructions and assemble the Rodkicker 20, which arrived in three boxes. It mounted easily to the machined boom (aluminum) and mast (stainless steel) fittings that the company supplied. The first time we used it, this vang took the most force (roughly 60 pounds) to compress, but it operated smoothly after that. Bernie Beasley at Selden told us that operation of each vang relies on the weight of a full boom and sail resting on it. With that factored in, he said, we wouldn't have experienced as much initial resistance.

Selden offers a two-year warranty on the Rodkicker. The 20 sells for $685, not including tackle. We were impressed by several aspects of this vang. Where clevis pins are used to connect the vang to the boom and mast, the end fittings have recesses to keep the cotter pins from sticking out and doing damage. And the boom fitting uses three Allen screws for attachment. These can either be tapped into the spar or dogged down for compression attachment. Selden also offers a universal boom bale for booms without an integral track.

SPARCRAFT

Based in France, Sparcraft has manufacturing facilities for mast, booms, and rigging systems there and in the United States at Charleston Spars in Charlotte, North Carolina. The Ocean Vang uses anodized aluminum tubes that compress a stainless steel spring by way of an external 4:1 purchase system to deliver a return force of 300 pounds The vang has sheaves integrated into its end fittings, and there are no external blocks, which simplifies the arrangement, but limits the amount of purchase available. (Some vangs are sold with additional external tackle.) The polished, 316 stainless-steel brackets for mast and boom come in various sizes and configurations.

Installation was simple and straightforward, which was good because the vang arrived with no instructions. You'll need to lead the control line to a swiveling, pivoting block mounted on deck because the sheaves in the vang don't articulate and the line won't otherwise lead in a fair fashion when the boom is off centerline.

PS found two problems with the Ocean Vang. Its spring was squeaky and it didn't regularly return the boom to its initial point after we installed it. When we opened the unit, we found that the design doesn't keep the spring in column. When the spring moves off-center — as is almost certain to

occur any time the spring is under load — the spring rubs directly on the outer tube, producing friction and squeaking. We applied some WD 40 and the vang worked more smoothly and squeaked less, though it still didn't perform satisfactorily.

Jim Kulibert, Charleston Spars' director of sales, told us that our experience was an anomaly. He says the company has furnished hundreds of these vangs to boats over the years and they never receive complaints of squeaks or binding.

This size Ocean Vang retails for $279, which includes the control line, but not the brackets for the mast ($39) or boom ($42). The vang carries a one-year warranty.

CONCLUSIONS

For cruising sailors, it's most important that a rigid vang works to support the boom and secondarily to trim the mainsail. If simple support is what you're after, almost all of these products are suitable. Factor in ease of operation, and you can whittle that group down by excluding the Sparcraft's Ocean Vang, which we have given a Don't Buy rating.

If post-installation adjustment is the next criterion, you can overlook the vangs from Selden and Seoladair, which worked perfectly well in all other aspects. So, you're left with our selection of vangs from Garhauer, Forespar, Hall, and Marine Products Engineering (the Vang Master). The Garhauers offer limited adjustment pre-installation, the

Yacht Rod adjusts in 4-inch increments, the QuikVang in 1-inch increments, and the Vang Master's range is virtually unlimited.

If you want a basic rigid boom vang that is well built and functions smoothly for the least dollar outlay, Garhauer is the clear choice. Astoundingly, these rugged vangs are about half the price of those from the other builders, and with a 10-year warranty, they are hands down our Budget Buy.

If you are interested in a smoothly operating vang that you can use to reliably control your mainsail, those from Forespar or Hall fit the bill and earn our Recommended rating. But of all the vangs, the Vang Master from Marine Products Engineering has the best adjustability, the smoothest operation, the longest stroke range, and the longest warranty of these three, and thus, even with it's high pricetag, it is our Best Choice overall.

Contacts Directory

BANNER BAY, 201/452-2834, www.bannerbaymarine.com

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GARHAUER, 909/985-9993, www.garhauermarine.com

HALL, 401/253-4858, www.hallspars.com

HARKEN YACHT EQUIPMENT, 262/691-3320, www.harken.com

LEWMAR INC., 800/362-7212, www.lewmar.com

MARINE PRODUCTS ENGINEERING, 800/833-0008

RONSTAN, 727/545-1911, www.ronstan.com

SAILRITE, 800/348-2769, www.sailrite.com

SCHAEFER MARINE, 508/995-9511, www.schaefermarine.com

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