Practical-Sailor.com
www.practical-sailor.com

Practical Sailor's gear and boat reviews take the guesswork out of your buying decisions.

Volume 28
Number 11
June 2002

RSS/XML

Home
Current Issue

Also In This Issue
Boat Review

Previous Issue
Get Web Access Now
Start a Subscription
From the Editor
Letters
Back Articles
Sample Articles
Boat Reviews
Sample Boat Reviews
Tools & Techniques
In Future Issues
Sailing Books
Links
Customer Service
SEARCH

Block Efficiency

In the workaday world of the ubiquitous block, a bit less friction can be an appreciable thing. No high-pressure heroics here, just a lot of heaving and hollering.

The most universally found piece of mechanical gear on boats is the block. It's what a landlubber calls a pulley, but the sea-going world is so jargon-bound that most marine dictionaries can't stand even to list the word "pulley."

Small blocks like these are jacks of all trades on deck and aloft.

That fascinating 1885 maritime classic, "Paasch's Illustrated Marine Dictionary," published in Antwerp by Capt. Henry Paasch, lists 58 kinds of block. (The Paasch dictionary is otherwise noted for its stunning, old-fashioned line drawings.) Another reference, "The Visual Encyclopedia of Nautical Terms Under Sail," assembled in 1978 by a big-name British committee (including Alan Villiers, no less, and G.P.B. Nash, who at the time ran that time-zero place in Greenwich, England), shows—besides garden varieties like fiddle and snatch—cat blocks, cheek blocks, hook blocks, jack blocks, jewel blocks, made blocks, monkey blocks and ninepin blocks and that's only halfway through the alphabet.

In perhaps no other bit of gear is traditional or snobbish nautical terminology so glaring. Besides the pulley/block foolishness, there's the roller, which sailors call a "sheave" (pronounced, of course, "shiv"). The sides plates are "cheeks." The thing on some blocks where you tie the end of a line is called a "becket," and you don't feed a line through this thing, you "reeve" it, or if you did it yesterday, you "rove" it. The free part of the line before you get to the "bitter end" is called the "fall."

You use a block to change the direction of a line, or in a tackle (a.k.a. "handy billy"), which is pronounced "tay-kul" by purists, if you please. The tackle can be a single whip, butt, double whip, gun tackle, luff tackle, burton (Spanish or plain), tail jigger, garnet, etc.

Let us now see how far we've come since British tars aboard Nelson's Victory, on their way to Trafalgar to rain a hellish humiliation on the fleets of both Napoleon and the Spanish, used grooved deadeyes to sweat up the rigging. You know deadeyes—round or oval disks of hardwood, grooved, with holes for the rigging tensioning lines. Deadeyes, used for centuries, were the precursors of blocks (as well as turnbuckles).

The Evolution

Blocks for commercial use in heavy-duty industries like fishing, manufacturing, utilities, and construction are made by companies looking primarily for brute strength, durability, and unfailing performance. Life is more difficult for companies making blocks for pleasure boats. Besides all of the above, their added burden is that the blocks must be small, light, and as friction-free as possible. If they can be handsome too, so much the better.

Nearly 10 years ago, a major change came with the development of what Practical Sailor called "hollow" blocks. In response to a 1992 America's Cup syndicate request for a high-load, low-weight block with less friction (which would mean that smaller, lighter winches could be used), Harken put their computers to work, using finite elemental analysis, and developed the custom America's Cup blocks. Soon smaller versions of the block were offered to the rest of us.

In a review in the Nov. 15, 1994 issue, PS discussed what Harken dubbed "Airblocks," Frederiksen calls "Orbit" blocks, Lewmar calls "Ocean" blocks, and Garhauer calls "Light" blocks.

By substituting a big hub (often part of the cheeks, which eliminates the straps) with lots of bearings for a conventional small axle, and a bushing or a couple of races of plastic or stainless steel ball bearings, the hollow blocks greatly expand the bearing surface, make a block lighter, stronger and more durable, and much cheaper to make. For non-Keynesian progress, how can you beat that?

A bonus of the hollow block is that the large hole in the middle makes it possible to use webbing (or a lashing) to affix the block in almost any manner.

There are those who hold that the forces on bearings, especially shock loads, call for something more substantial than a bunch of loose balls or plastic rollers. They tend to stick with solid axles with solid bearing sheaves of either plain metal; very modern composites (like anodized aluminum impregnated with Teflon®), or old reliables like Oilite® (oil-impregnated bronze), Garlock®, Excelite®, and others, all made of sintered (powdered and reformulated) metals.

Another engineering advance in recent years has been the universal head, allowing the block to swivel and automatically align the line, or be fixed. For the manufacturer, the adjustable head cuts down on the number of models, and for the consumer makes it less likely that the block won't work.

Block Makers

Most of the companies catering to the yacht market offer a full range of blocks for pleasure boats of any size. Here's a general rundown, in alphabetical order:

Antal gear is made in the glorious city of Padova, a half-hour drive west of Venice and the site of the world's second-oldest (1222) university (Galileo taught there). Venitians (and Shakespeare, of course) called it Padua.

Antal makes 45, 55 and 65mm blocks of anodized aluminum with double ball bearings and stainless couplings. They are unique in that they can be assembled as modular components that can be dismantled and transformed with naught but a screwdriver. For instance, a triple block can become two singles; various heads and shackles are interchangeable; cam cleats can be added, and parts can be easily replaced.

On the big luxury boat end, Antal makes blocks of exotic composites (up to 230mm, for 30mm or 1" line). For big racing boats, Antal makes what it calls "Shell" blocks, mostly for running backstays.

A half-dozen years ago, the venerable old English firm of Barton re-entered the US market with

a new line of deck gear that includes no less than seven sizes of blocks up to 70mm, every one of them with a choice of plain brass or twin-race Delrin ball bearings.

Because the cheeks are made of glass-impregnated nylon in a flat black color with sheaves of pure white acetal resin, the Barton blocks have a comfortable, conservative appearance, and are reasonably priced.

Frederiksen? When a hard-racing Dane named Gert Frederiksen (he now has a lightweight, 28-foot trimaran built of carbon fiber) decided to make deck hardware, he wanted the highest possible strength-to-weight ratio, with absolutely minimum friction.

Frederiksen's "Orbit" blocks, all hollow, run from 60mm to 180mm, all of specially-coated aluminum with Delrin balls and Torlon rollers—and optional titanium swivels and shackles. All can be webbed.

Frederiksen offers several other lines, including one called "Racing Blocks", 50 to 100mm. All are expensive. It is strange that Frederiksen offers only a one-year warranty.

Seemingly at the other end of the scale is Garhauer, which makes some of the strongest blocks we've seen. Garhauer enjoys high repute because of its extremely low prices and a 10-year guarantee on its beautifully simple, stainless steel hollow blocks.

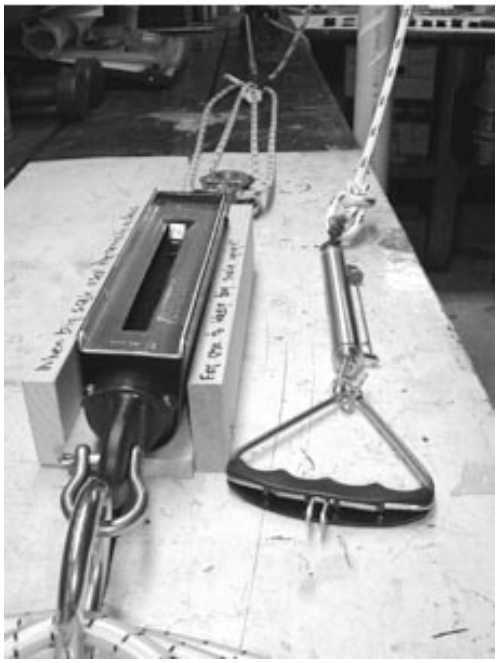
Because the SS blocks tend to be heavy, Garhauer introduced last year a line called "Unibody" blocks. Half the weight of stainless steel equivalents, each Unibody block is milled from a solid block of high-grade aluminum, with extensive use of Delrin for mating surfaces, Torlon bearings, and very few fasteners. An astoundingly simple design (and thus inexpensive to make and sell), they cost only a bit more than stainless equivalents. The snatch blocks in the Unibody line are outstanding. The Unibody blocks are offered with optional heads and shackles of titanium, a metal which Garhauer has intimated may take over the whole line.

A longtime leader in blocks and famous for putting ball bearings in everything possible, Harken probably has the most extensive range of blocks on the market—from its little 16mm AirBlocks, to the carbon-fiber Carbo Airblocks® (the first blocks that could be webbed), the unusual TiLites (for attachment with Spectra line, which eliminates the post and shackle), to bullet blocks (big and little), to Hexaratchets®, to 150mm Black Magic Airblocks, to custom blocks of any size or description.

Working in black hard-anodized aluminum, polished stainless, or titanium, Harken strives for lightness, to please the racing set. It struggles to keep prices within range of the not-so-demanding weekend racers and cruising sailors. Most of its gear is made in Italy. The Harken catalog and website have become standard reference works in the sailing community.

As is often the case, the little guy, in this case the old British firm of Holt Allen, frequently comes up with startling changes. Holt makes a not-too-exciting range of blocks, from 20mm to 40mm, mostly with plain axle bearings. However, at the 2002 Chicago trade show, Holt unveiled its "Dynamic Bearing Blocks" in 20mm and 40mm sizes. What Holt's designers have done is reduce the parts in a block to two body halves, a sheave with two races of stainless steel ball bearings, and a one-piece strap/shackle whose anchor-shaped ends are set into the cheeks and require only one rivet

to assemble and hold in place. (A swivel shackle requires several more parts.) The result is a super-light block that Holt says has as much strength in the 40mm size as a 50mm Delrin bearing block.



Anther English company, Lewmar offers an amazing range of blocks, made of stainless, aluminum, or plastic, in ball bearing and plain axle versions. The lackluster Ocean series uses plastic cheeks and sheaves, stainless straps, plain axles, and a clever universal head. The Racing series has ball bearings. A stainless steel series, running from 105mm to 175mm, has aluminum sheaves, composite axle bearings, and side-thrust ball bearings. The stars of the Lewmar line have been the bayonet-fixed aluminum versions—that is, until this past January, when Lewmar introduced at the Chicago IMTEC show its new "Syncro" blocks. Said to be the product of a "complete re-think," the new blocks have a composite bearing that "combines high compressive strength with an incredibly low coefficient of friction." Lewmar claims other design breakthroughs for the new blocks, but maybe the most significant statement in its literature is: "The increased use of bearing blocks has often blinded us to some of the original principles… Through the use of recent composite materials…and the correct line size for a given sheave, this new block can reduce friction to within 1% of our best bearing blocks."

The simplicity of its design also may make it inexpensive to produce, which is not reflected in the price ($36.50) quoted to Practical Sailor. That's a suggested retail list, which might discount to about $28. These new blocks didn't make it into Lewmar’s 2002 catalog.

Ronstan, the Australian manufacturer, offers an extensive line beginning with what it calls "Lightweights," which are little blocks made of a single piece of bent stainless, a white plastic sheave, and a rivet, and sell for as little as $10. The Australian maker's range runs from 20mm to 100mm, with stainless or plastic bearings in the smaller blocks and composite bushings in the high-load models and larger sizes. Ronstan blocks are fairly conventional except that, like Schaefer and Wichard, some of its blocks have a two-stage bearing system, with the ball bearings at work at light loads and a solid bushing taking over on heavy loads.

RWO is an English company with a relatively limited range of blocks from 19mm to 76mm, but they offer virtually all sizes in plain or ball bearing versions. They don't look as modern as some other blocks, but are perfectly solid and serviceable.

Dollar for dollar, pound for pound, the conservative Schaefer has always been hard to beat. The employee-owned company makes very straight-forward, honest, rugged gear. Its blocks are metal—stainless or aluminum. Schaefer's catalog is sprinkled with comments, "Unlike our competitors' plastic designs," and, "Damaging UV rays...and knocks from decks and spars can turn an ordinary, plastic block into a cracked, unusual shell."

Schaefer makes stainless steel and anodized aluminum blocks with Delrin or aluminum sheaves in all sizes from 27mm to 102mm. Those with ball-bearing options have double-Delrin races running in shaped races. For larger blocks, Schaefer uses a powerful Nomex/Teflon/glass fiber bushing that it claims is immune to everything harmful.

Finally, there's the French firm called Wichard, which is noted for its shackles and snap hooks. Although the newest kid in the block business (they jumped in about five years ago), Wichard states baldly, "The world's strongest blocks are made by Wichard."

Wichard has a stainless range of little blocks—from 17mm to 25mm, and a mid-range of plain bearing blocks—from 12mm to 55mm. It's possible that they bought those unexciting lines from a French manufacturer named Maillard. The best Wichard blocks—18mm to 75mm—are the two-stage ball-bearing blocks mentioned earlier in this report and also illustrated in the photo on page 10. Wichard has two even larger blocks with two races of Delrin balls and a one race of rollers.

The Evaluations

Because the basic purpose of a block is to is to guide and redirect various control lines, the more easily it works, the better it fulfills its purpose.

To try out these modern marvels, Practical Sailor gathered up 40mm blocks (or the nearest equivalents) for close examination and a "loss-to-friction" experiment. The 40mm-size was selected because they're small enough, with moderate working loads, to make possible bench testing by hand.

No block is friction-free. The nearest you might come to that would be a finely made block with a line running through it at a very slight angle. That would place very little load on the block. Even then, if you put 10 pounds on the pulling end, you'd get slightly less than 10 pounds at the working end. As the bending angle increases, it's more and more important that the block be as friction-free as possible. The heat that can affect blocks is created not by the sheave but by the line, which must move considerably as the large arc (fibers on the outside curve) travels at a different rate than the small arc (the compressed inner curve).

For light loads, it's generally held that blocks with ball or needle bearings are best. A light load generally would be defined as a load well below the stated safe working load (SWL) of any size of block, big or small.

When the load reaches toward the upper limits of any block's SWL, most block manufacturers prefer a solid axle bearing, perhaps with a self-lubricating bushing of some special material mentioned earlier.

Fred Cook, the chief executive officer of Schaefer, said: "The safe working load is what's important. Keep in mind that that is the load at which damage begins...material starts to flow. Then comes bending of the cheeks or axle, deformation of the ball bearings, stretching of the shackle and so forth. Worse, any deformation encourages corrosion...

"Breaking strength is a useless specification. Don't even think about it. That's why we don't state the breaking strength of our blocks."

Practical Sailor's testing of 40mm blocks steered clear of even the SWL and sought instead to measure and compare, at loads well below safe working loads, how friction-free each sample might be under typical day-to-day loads.

On the test bench, a horizontal four-part tackle was set up, with the fall leading finally through an overhead single block (the block being tested). The 4:1 tackle expanded the output and made it more measurable. The rig might be said to resemble a mainsheet tackle or vang system.

At the output or load end, a big Chatillon Iron Clad Model 140 spring scale (which has a 200-pound limit) was interposed between the 4:1 tackle and a heavy shock cord arrangement to

dampen the loads.

At the pulling (or fall) end, a smaller Chatillon Model IN-50MRP (which has a maximum needle) was attached to the fall. For ease in the repetitious work, the scale (which has a maximum of 50 pounds) was fitted with an RWO Model R4110 trapeze handle.

All blocks used had swivel heads to assure fair leads (any side loads severely affect a block's SWL). The line used was within the limits specified for all of these blocks. (The angle through the single block being tested was between about 80° and 90°, which according to a commonly used loading formula, would add about 40% to the load on the block.)

The arrangement made it easy to get (theoretically) loads up to 200 pounds with pulls of 50 pounds or less, and to test each block over a fairly good, albeit light range. In fact, of course, you never get a 4:1 advantage in these arrangements, because there are losses all through the system.

Both the small Chatillon scale, which has quarter-pound graduations, and the large one, which has two-pound marks, are considered to be reliable for extended use under difficult conditions. They are certified for accuracy to one graduation. If needed, both can be zeroed easily.

Each block was rigged, then "pulled" multiple times. Between all pulls, slack was removed from the tackle, and the scales zeroed. The "pull" numbers for each block were recorded and averaged; the "AVG" numbers on the chart (pages 8-9) can be regarded as an "efficiency rating." They're simply a ratio of effort expended to work produced. In other words, if the fall were to be pulled to a limit of 30 lbs. on the small scale, and a result of 90 lbs. were recorded on the big scale, the rating would be 3.00.

The Results

First of all, this test indicated clearly how pronounced the losses in mechanical advantage can be. With the effort expended through the 4:1 tackle and test block, the system never yielded anything near the theoretical load of four times the pull.

Although we carried out our plot to make five pulls in each range for each block—light (5-16 pounds), moderate (17-35 pounds), and medium (36-50 pounds)—it turned out that there was little difference in any block's performance among those ranges; the blocks shrugged off all these levels of effort as about the same. So we simply tallied and averaged the numbers for 15 pulls of each block—and did find some interesting variations (see chart).

In a separate round of pulls to the 50-lb limit, results varied from 130 pounds (65%) for the Frederiksen block to as little as 114 pounds (57%) for the plain-axle RWO. Interestingly, the results of the straight 50-lb pulls don't always reflect the efficiency averages obtained through the 3-range, 15-pull series. This would perhaps indicate some slight differences in efficiencies between the blocks at low loads, and that those efficiencies vary as the load increases. These differences would have to be measured with greater sensitivity than we could manage with spring scales and eyeballs.

For most sailors the differences between these blocks would hardly be noticeable when considered one block at a time, but when you multiply an inefficiency (or an efficiency) by several identical blocks that might be in a system together, the differences would be more pronounced, especially for racing sailors. Even then, however, we suspect that at these loads, no difference would be so significant that it couldn't be negated by a half-hour of trimming practice.

On the question of ball-bearings vs. plain axles, the 12 blocks with ball and/or needle bearings had a relative efficiency average of 2.47. With the seven plain axle blocks, the average was 2.41. With a 50-pound pull that would mean loads of 123.5 pounds for the fancy blocks and

120.5 pounds for the plain axle blocks.

Perhaps the only observed peculiarity in the ball-bearing/plain bearing matter was that Lewmar's new "Syncro" plain bearing block did better than its much-admired block with many bearings. Lewmar may be onto something with this new block.

Our low-pressure efficiency ratings put the Frederiksen block at the top, followed closely by Garhauer and Schaefer, tied for second.

Given the negligible differences between all these blocks, if we were in the market, we'd weigh price at least as heavily as efficiency. In that case we'd consider Garhauer a Best Buy, but would also look at the 11 other blocks selling for $20 or under, and decide which would fit best with other deck hardware and systems.

Also With This Article
Click here to view "Blocks: Efficiency Ratings."

Contacts— Antal (Euro Marine Trading, 62 Haley, Newport, RI 02840; 800/22-7712; www.euromarinetrading.com. Barton (Intra), 30 Samuel Baronet, New Bedford, MA 02745; 508/995-7000; www.bartonmarine.com/. Frederiksen (Maritime Supply), 12 Plains, Essex, CT 06426; 860/767-0468; www.maritimetrading.net/. Garhauer, 1082 W. Ninth, Upland, CA 91786; 909/985-9993; www.garhauermarine.com. Harken, 1251 E. Wisconsin, Pewaukee, WI 53072; 262/691-3320; www.harken.com. Holt (Holt Allen), 177 Lynden Rd., Lynden, OR ON L0R 1T0; 888/390-3242; www.holtallen.co.uk. Lewmar, 351 New Whitfield, Guilford, CT 06437; 203/458-6200; www.lewmar.com. Ronstan, 7600 Bryan Dairy Rd., Largo, FL 33773; 727/545-1911; www.ronstan.com. RWO, 1025 Parkway Industrial Park Dr., Buford, GA 30518; 770/945-0564; www.rwo-usa.com. Schaefer, 158 Duchaine, New Bedford, MA 02745; 508/995-9511; www.schaefermarine.com. Wichard, 47 Highpoint, Portsmouth, RI 02871; 800/852-7084; www.wichard-usa.com/.