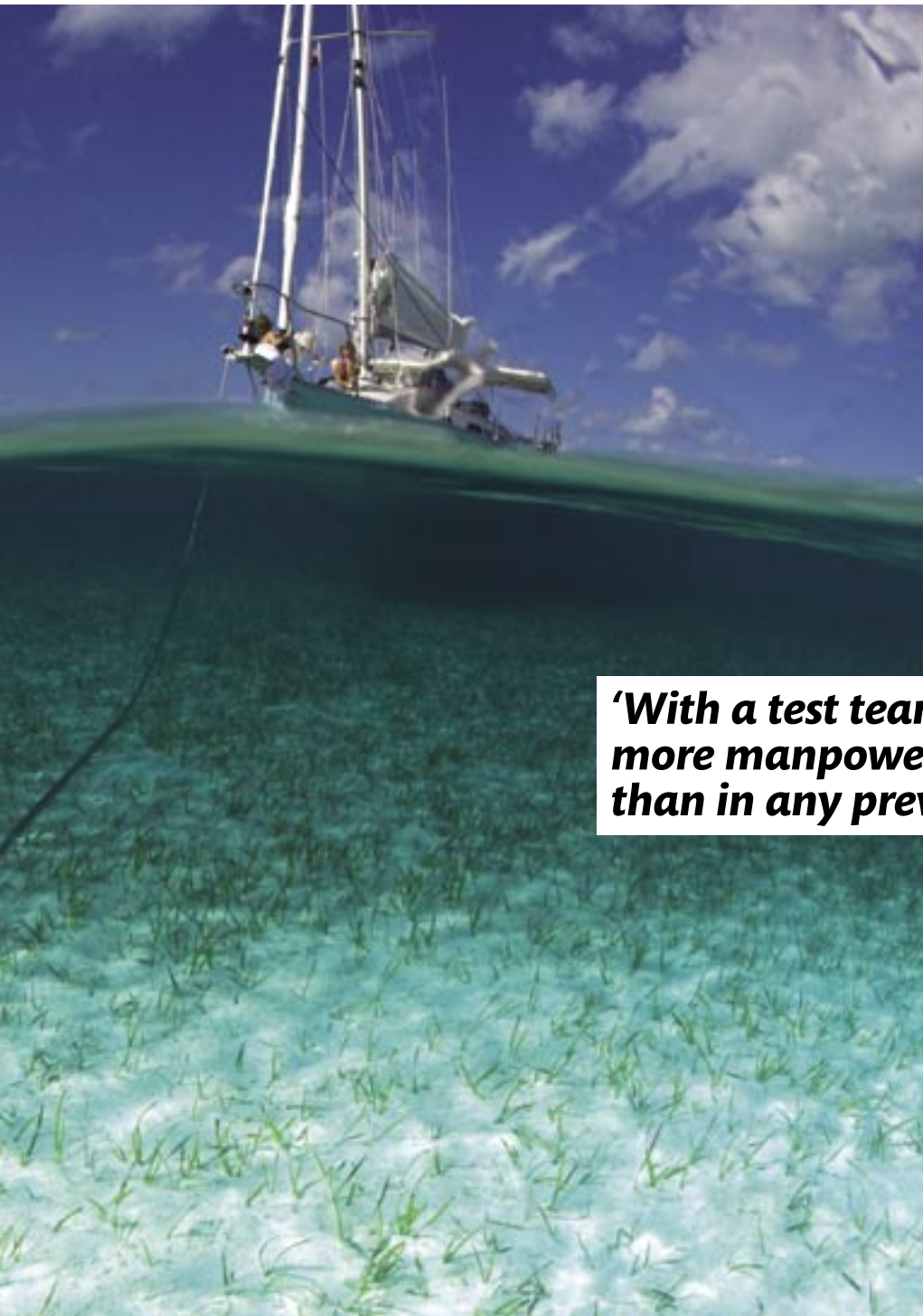


Ultimate holding power

Which anchor holds best?

We spent three days testing 14 anchors using 5,000 lb-plus force - equivalent to storm-force winds on a 40ft yacht. The results may surprise you. Toby Hodges and Bill Springer report



'With a test team of 10, we used more manpower and brainpower than in any previous YM test'

How do you choose an anchor? Are you looking for a 'lunch hook' or heavy-duty hardware on which you can stake your life – and your yacht – when a storm blows up and turns the anchorage into a maelstrom?

Choosing an anchor used to be easy – choices were limited to CQR plough-types or Danforth-types. Most sailors continue to place their faith in these, but isn't it time we looked seriously at the claims of a new generation?

Yachting Monthly collaborated with *SAIL* magazine in America to carry out the most comprehensive group test we have ever performed. Over three days in California we conducted tests on 14 anchors – a mix of traditional, proven designs, several 'new-generation' models and some futuristic-looking newcomers.

Testing the anchors beyond 'normal conditions' at maximum loads was our main objective – because when a gale blows up that's when anchor performance is critical and you rely on your ground tackle's ultimate holding power.

Anchor tests are notoriously subjective. There are so many variables: windshifts, waves, currents, different seabed conditions, different cable or chain configurations, and varying scope. We aimed to keep variables to an absolute minimum in one main location, to discover how quickly the anchors set and to record their ultimate straight-line holding power. The weather was ideal with light-to-zero wind and a faint swell. Further tests were carried out at two other locations off Santa Cruz with slightly different seabed conditions.

Each anchor tested is available in a range of weights, but we used anchors recommended by the manufacturer for a 35-40ft yacht. Each was tested at least three times at 5:1 scope at one location and again at the two further



Our powerful test boat was *Shana Rae*, a 48ft research vessel with a 375hp Caterpillar engine driving a 40in propeller which could produce a pulling power on the anchors more powerful than gale-force winds



With tons of anchors, chain and equipment to move around we needed a big test team. *YM's* Toby Hodges (right) stands next to Chuck Hawley, who spearheaded the West Marine group



Which of the 14 anchors here would perform best in simulated Force 10 winds? The results surprised even the experts

MAIN PICTURE: Each anchor was attached to 20ft of 5/16th inch chain cable and 108ft of 12-strand nylon rope for the 5:1 scope test - this was lowered into a depth of 20ft.

BELOW: The Spade anchor awaits hoisting aboard



locations. A bottom sample was taken at each location with a core-sampler. We used a known depth (20ft), dropping each anchor in fresh holding ground alongside the last position, which was confirmed by GPS. Depth was measured by echosounder and leadline.

Anchors were attached to the 20ft of 5/16in chain cable and 12-strand one-inch nylon rope. Why didn't we use all chain? It's true that it will add weight and give a better pulling angle, but an all-chain cable doesn't absorb shock loads. Experts say that in extreme conditions the best compromise is a rope-chain combination that has the elasticity to absorb some of these loads. The cable was connected at the inboard end to a digital dynamometer linked to a laptop PC and the powerful test boat's engine idled

'The top performers were further tested at a deliberately short scope of 3:1'

until the anchor was set. Revs were steadily increased until the anchor dragged, broke out or reached the maximum failsafe load we had set of 5,000 lb - when the test was terminated.

Anchors that failed to set at 5:1 scope were tested at 7:1 scopes. And the top performers

were further tested at a deliberately short scope of 3:1 - both to replicate what might happen in a crowded anchorage and to see which anchor finally broke out and under what load.

Veering tests were also conducted - motoring over anchors at 90° and 180° angles, to see if/when they broke out and how quickly they re-set. The main tests took place off Santa Cruz Harbour, California, east of the pier. Core

samples revealed the top five inches of holding ground was fine-grained dark sand on top of harder almost clay-like sand. The second location in the same bay west of the pier had similar holding, but slightly less densely packed sand. And the third location, New Brighton

Beach, a few miles down the coast, was similar but with a slightly harder, clay-like sand underneath. Finally, on land we set

up a beach-drag using a powerful RIB so the team could record how each anchor rolled and buried itself.

THE TEST TEAM

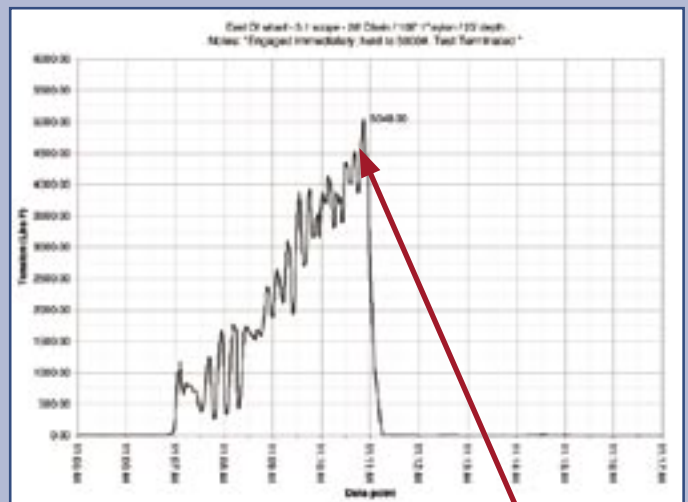
With a test team of 10, we used more manpower, and brainpower, than in any previous YM anchor test. The team included YM's technical editor, Toby Hodges, Bill

» DATA GRAPH EXAMPLES

NON-SET GRAPH

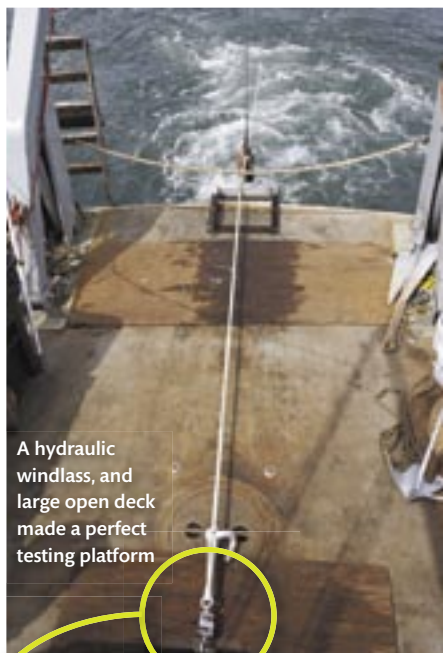


MAX RESISTANCE GRAPH



A graph was produced for every single anchor test conducted. This one shows the results for an anchor that failed to set after dragging on the bottom for three-minutes

An example of an anchor that reached our maximum of 5,000 lb as we gradually increased load over four minutes before terminating the test



A hydraulic windlass, and large open deck made a perfect testing platform

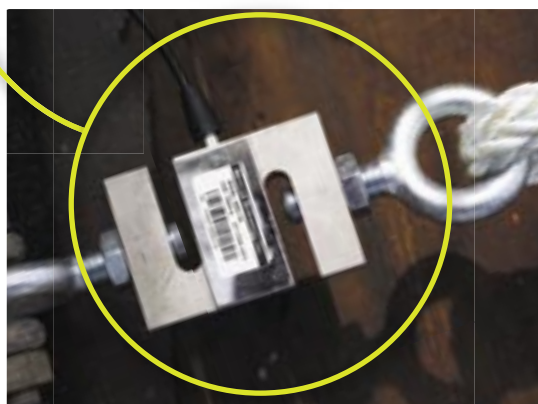


American muscle: As *Shana Rae* takes the strain, the anchor's resistance produces whirlpools of turbulence and a bar-tight cable

Main ph

» DATA CRUNCHING

The digital load cell attached to the anchor cable automatically sent two to three readouts to the laptop PC every second. Thanks to computer-savvy Phil Cowley, West Marine's product tester, the data was automatically fed into an Excel spreadsheet and was accurate to two even pounds. This eliminated human error and showed exact load recordings for every pull we conducted. A second digital readout on deck (below right) provided live tension feedback



Springer, Senior Editor at *SAIL* magazine, based in Boston, Jeff Mozer from *Power & Motoryacht*, and a West Marine team headed by Chuck Hawley, Vice-President of Product Development. Chuck has conducted more anchor tests than anyone we know, since West Marine tests all the products it stocks. And as if to prove how independent the tests were, West Marine's own copy of the Danforth anchor, the Performance 20, surprised us by failing to set at a variety of scopes and locations.

At the end of each test day, the team reviewed the results and crunched the numbers – from core samples to strain-gauge data. Back in the office we conferred via telephone conference calls to confirm analysis and discuss.

WHAT LOADS CAN ANCHORS EXPECT?

In YM's May 2006 issue we conducted destructive tensile tests on anchor

connectors and reported some typical loads experienced by yachts at anchor. The load forces on an anchor cable in storm force winds on a 35ft yacht equate to around 1,800 lb, according to the American Boat and Yacht Council. But these values do not take wave forces into account. Alain Fraysse has a

spreadsheet online at www.tinyurl.com/5goox that shows a 35ft (10.7m) boat in a 60-knot wind will experience maximum dynamic loadings of 5,940 lb. That's wind forces alone, taking yawing into account, but not waves and snubbing forces, which could be 10 times the static loading. But even if we were to revert to the ABYC's wind-force figures alone, then we

can see that a Storm Force 11 will exert over 5,000 lb of pressure on a 40ft boat.

But before our maximum 5,000 lb load was reached, we also wanted to see how each anchor acted at lower loads, notably how quickly they set and how long they held.



In YM's May 2006 issue we carried out destructive lab tests on anchor connectors, chain and shackles

YM BACK ISSUES
Order back issues by calling: 01733 385170 or copies of previous articles from: 01202 440832

CORE SAMPLES



Core samples of the seabed were extracted. A layer of dark sand sat on top of finer, clay-like sand at each of the three locations.

BREAKING OUT

Some of the new-style anchors set so firmly in our tests that they proved difficult to break-out. *Shana Rae* had a 375hp engine and hydraulic lifting gear to provide the muscle. The

best method for yachts recovering a stubborn anchor is to motor directly over it while taking up the slack in the chain. Leave it taut and it should break out in its own time



THE ANCHORS

» FORTRESS FX37

Weight: 22 lb (10kg) **Price:** £476.00

The Danforth-style Fortress anchor is made of corrosion-resistant aluminium and is as strong as steel but only half the weight. It can

be flat-packed for shipping and has proved the perfect kedge anchor and storm anchor for many users. The sharp flukes have adjustable angle settings for soft mud and sand.

The Fortress's ability to dig in instantly and hold was astonishing – especially as it weighs only 22 lb, one of the lightest anchors tested. At 5:1 scope it dug in immediately each time – its cable quivering like a bow-string as the test boat's 375hp engine produced whirlpools

of turbulence. We terminated the test at the maximum 5,000 lb pull. The anchor hadn't budged.

We subjected it to a further test at 3:1 scope, and it gave an amazing 4,500 lb-plus resistance, though the shank bent slightly during our veering test. Up to this point, the Fortress endured severe abuse and won through. This is a lightweight anchor which should prove dependable in an emergency.

Price: £476



One of the lightest anchors, the Fortress set instantly and held steadfastly



» DELTA

Weight: 36 lb (16.3kg) **Price:** £162.63

The Delta is a one-piece plough-type anchor made from manganese steel with an angled shank and ballasted tip. Designed to be self-launching, it has a lifetime guarantee. It set quickly and gave good resistance, averaging around 3,000 lb before breaking out. But in the first three pulls at 5:1 scope in our first test location it failed to reach maximum 5,000 lb load – ploughing a trench through the seabed (more than 700ft in one pull recorded on GPS!).

At the second location at 5:1 scope, it set quickly and held at 5,000 lb in slightly more loosely packed sand. It didn't perform so well at the shortened 3:1 scope, where it averaged around 1,200 lb resistance. In the beach pull tests it set quickly and firmly. The Delta was one of the better, more consistent performers.

Price: £162.63



Despite ploughing a 700ft trench in one pull, the Delta was a consistent performer

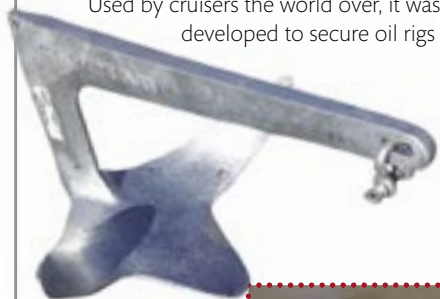


» CLAW

Weight: 36 lb (16.3kg) Price: £58.35

The Claw is Lewmar's version of the Bruce anchor which has been around since 1972.

Used by cruisers the world over, it was developed to secure oil rigs



to the ocean floor. Bruce no longer make yacht anchors, hence our testing this version. The Claw is made from a single piece of high-grade steel and stows well on the bow-roller. We were surprised that it was one of the worst performers in our tests. The maximum resistance at 5:1 scope was 886 lb – for a brief spike before breaking out. The tension graphs showed that the anchor never penetrated properly, setting and releasing rapidly or simply scraping the bottom. Was this because the

Claw doesn't share the original geometry of the Bruce design? Were the Claw's flukes simply not sharp enough to penetrate the harder clay-like sand? We recorded similar results at 7:1 scope. The beach-pull trials showed the Claw ploughing a longer trench down the beach than most. Our conclusions were that the flukes of the Claw weren't sharp or weighted enough to penetrate.

Price: £58.35

Beach trials showed the Claw can plough rather than penetrate.



» CQR ('secure') 35

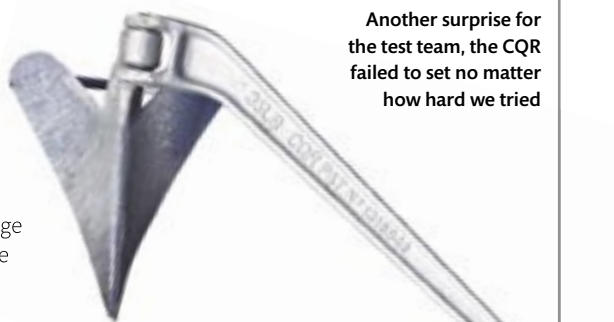
Weight: 38 lb (17.24kg) Price: £313.50

The faithful CQR plough anchor, originally patented by Simpson-Lawrence in 1933, is now marketed by Lewmar with the same drop-forged construction as S&L's. We were surprised, therefore, that during the first three tests at 5:1 scope it failed to set. No matter how slowly we went, or how much we tried to manually coax the anchor to set, it seemed to skip along the seabed. Even at 7:1 scope it failed to penetrate. It set and held briefly at 2,000 lb at our second location, but released

instantly and didn't re-set.

On the beach pull, it also failed to penetrate as well as most and dug a long trench. The CQR has a sharp point, but we concluded there may not have been enough weight over the tip to penetrate the hard sand. The combination of a heavy shank and hinge means it can also slide along on its side without engaging.

Price: £313.50



Another surprise for the test team, the CQR failed to set no matter how hard we tried



» OCEANE

Weight: 38 lb (17.24kg) Price: £170



The Oceane's shank makes it difficult to stow

The Oceane was developed as a cheaper, lighter alternative to the Spade. Its shank is positioned to provide weight over the tip but its shape is awkward to stow on a bow roller. A 'shark fin' on the shank stops the point damaging the bow. The Oceane was a good example of why it's worthwhile testing at different locations. It failed to set at the first and third locations – even at 7:1

scope it only managed a brief dig-in at 800 lb – but at the second location it set and held at maximum 5,000 lb pulling power on multiple pulls. Since our tests, the Oceane has been superseded by the 'Sword', which looks a promising combination of the Spade's proven design and Oceane's budget price.

Price: £170

'The Oceane was a good example of why it's worthwhile testing at different locations'



» SPADE 80

Weight: 34.4 lb (15.6kg) **Price:** £321.95

The Spade, launched in 1999, was a revolution in anchor design with French inventor Alain Poiraud pioneering the use of a concave blade. It's the blade's effective surface area that gives holding power, rather than weight, but it uses

a wedge-shaped 'ballast chamber' to ensure weight is over the tip – so the Spade dug in where the CQR ploughed a trench. Another plus is that the Spade's shank disconnects for stowage. Make sure you tighten the Nylock nut – one sailor lost his yacht because he didn't.

The Spade has proven itself in most tests and ours was no exception. At 5:1 scope it

repeatedly held at the maximum 5,000 lb and on the veering test we recorded up to 5,400 lb! The beach-pull tests showed how the weighted tip dug in instantly, with no drag-time. On shortened 3:1 scope and at the third location results were mediocre, but it remained one of the top three performers.

Price: £321.95

The Spade dug instantly where the CQR ploughed a trench



ROLL-BAR TYPE ANCHORS

These anchors are designed with a 'roll-bar' that causes them to self-right on the seabed. Like the Spade anchor, it's the spoon-like concave blade area (excepting the convex Sarca), not the weight, that provides the ultimate holding power. They penetrate the harder seabeds with ultra sharp fluke tips.

» ROCNA

Weight: 32 lb (14.5kg) **Price:** £241

The Rocna incorporates clever ideas from different designs into an extremely effective anchor. A long, angular Delta-esque shank meets a large concave surface blade area associated with the Spade, with a chisel-blade tip and 'skids' on the back of the blades to ensure rapid penetration. Like the Delta, it has no moving parts and is self-launching. Designed by sailing veteran and New Zealand boat-builder Peter Smith, Rocnas are made from alloy steels with a 'hot-dip' galvanised zinc finish. Weight is in the tip, not the heel.

The Rocna was a powerful, impressive performer in our tests, recording instant sets at multiple 5,000 lb maximum (or near max) pulls at 5:1 scope. On the second 5:1 pull, it released suddenly at maximum tension when revs were reduced, only to reset instantly at 4,300 lb of resistance, which was astonishing for an instant set. It was less impressive at 3:1 scope and under veering tests, but remained a consistent top performer.

Price: £241

The Rocna rolls sets and holds instantly and was one of the top performers



» BUGEL

Weight: 32 lb (14.5kg) **Price:** £586

The German-designed stainless steel Bugel, made by steel-manufacturer Wasi, was the first of the 'new-age' anchors to use a roll-bar. The flat, triangular blade is

smaller than most, with a sharp tip. The shank is set at an acute angle to drive the tip down under force. It comes with the patented Wasi Powerball – a swivelling stainless-steel anchor connector.

At the first location the Bugel performed well at 5:1 and 3:1 scopes averaging over

2,000 lb resistance during four pulls and recording a 4,000 lb spike. At the other test locations, performance declined. The smaller surface area of the blade may explain why its holding power never matched some other roll-bar models.

Price: £586

The Bugel was the first to use a rollbar



» PERFORMANCE 20

Weight: 26.3 lb (11.9kg) **Price:** £106 + tax

The Performance 20, West Marine's version of the Danforth-type anchor, failed to impress our test panel and caused much debate when

we were consistently unable to get it to set at various scopes and locations. A maximum spike of just over 1,500 lb at 5:1 scope was recorded at the third location, where the seabed was less dense with brown sand on decomposing clay. But even at 7:1 it failed to set at our main, first location. The other Danforth-type anchor on test, the Fortress,

proved beyond doubt the effectiveness of the design. So were the flukes on West Marine's version simply not sharp enough or was the angle at which they are set wrong? Either way this proves the geometry of anchor design is an exact science.

Price: £106 + shipping and import duty

Danforth-type
but disappointing
results



» MANSON SUPREME

Weight: 35.9 lb (16.3kg) **Price:** £218

Another
powerful roll-
bar type showed
excellent
performance



Manson is a New Zealand company specialising in high-tensile stainless-steel anchors. Its Supreme anchor, launched last year, is similar to the Rocna design. It also copies Sarca's shank slot: the shackle slides forward to trip the anchor. Its penetrating tip is claimed to set in the anchor's own length. At our first test location it set immediately and held to the maximum 5,000 lb pull. Even on

3:1 scope it held to an astonishing 4,612 lb. It was unfused by the veering tests - refusing to budge at 5,000 lb from all angles. At other locations it wasn't quite as steadfast, but still set and provided around 2,500 lb of resistance. Its downside, like the other roll-bar anchors, is that it's awkward to stow, except on the bowroller.

Price: £218

'The Manson was unfused by the veering tests - refusing to budge at 5,000 lb from all angles'



» SARCA ANCHORIGHT

Weight: 33 lb (14.8 kg) **Price:** £234.95

Designed for optimum holding in a wide variety of seabeds, the SARCA (Sand And Rock Combination Anchor) is the result of six years R&D by Australian Rex Francis. This 'new-generation' anchor was the first to use a slot in the shank - allowing the shackle to slide forward so you can trip and recover it if fouled in rock or coral. The convex blade shape helps create a vacuum and the slots break the suction for recovery.

On every 5:1 pull at all locations it set quickly, recording a maximum peak of 2,962

lb. Its average holding power was around 1,500lb. Even when we drove the test boat over the anchor to simulate veering, the Sarca held at 1,000 lb-plus and also on the 3:1 scope test.

The ideal anchor will hold in every seabed and the Sarca certainly deserves credit for coming close. It may not have as much holding power as other roll-bar anchors, but it was a consistent performer.

Price: £234.95

Designed to
conquer all
seabeds, the
SARCA has some
unique features



THE SHAPE OF THINGS TO COME?

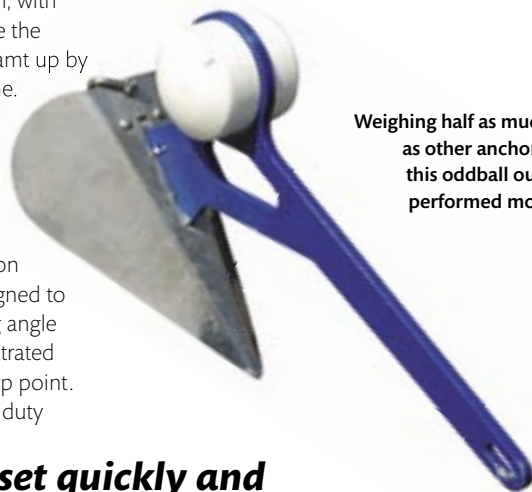


None of these anchors are available in the UK yet, but we have included them to give readers a unique example of how anchor design is evolving



» HYDROBUBBLE Weight: 16 lb (7.26kg) Price: £134 + tax

This Heath Robinson-looking design, with its curious 'bubble' on top, looks like the 'floating anchor' April Fool joke dreamt up by YM's former editor, Des Sleightholme. It soon wiped the smile off our face when it withstood multiple pulls on 5:1 scope at 5,000 lb – our maximum. And it weighs a mere 16 lb, the second lightest on our test! It set quickly and worked well on every drop. The bubble float is designed to help it settle at the ideal penetrating angle and the upside-down V-blade penetrated and dug in without the aid of a sharp point.
Price: £134 + shipping and import duty



Weighing half as much as other anchors, this oddball outperformed most

'The Hydrobubble set quickly and worked well on every drop'



» BULWAGGA Weight: 28.6 lb (13kg) Price: £188 + tax

Another weird creation, the triple fluke configuration looks like a sculpture for the Turner Prize. It is painfully awkward to stow and can't be taken apart. Yet, whichever way it falls, two flukes dig in. It certainly set

quickly – holding at 5:1 scope with a peak resistance of around 2,500 lb averaging around 2,000 lb. At 3:1 scope, performance fell off dramatically.
Price: £188 + shipping and import duty

Awkward to stow, it set quickly



» XYZ Weight: 12.8 lb (5.8kg) Price: £159 + tax



The test team thought this was the most futuristic-looking anchor – the shank and fluke unlike anything we'd seen before. The shank has a knob to help it flip over if it lands upside-down. In our beach test it dug a long trench. No

matter how hard we tried, we could not get the XYZ to set in any of our tests. Its peak holding power was just 300 lb. It was also the lightest of the group, weighing in at 12 lb 8 oz.
Price: £159 + shipping and import duty

'No matter how hard we tried, we couldn't get the XYZ to set in any of our tests'



» CONCLUSION

One of the problems with anchor tests is that they don't represent the real world. We tried to go beyond the typical test programme, with its progressive straight-line pulls by extending our trials to include veering pulls, plus three different scopes, (from 3:1 to 7:1), and three locations.

So after three days, with a team of 10 people conducting more than 100 test pulls on 14 anchors, what did the data crunching tell us? One key finding was that the ability for an anchor to set quickly is almost as important as its ultimate holding power. The biggest surprises were that traditional designs

– like the CQR, the Claw (Lewmar's copy of the Bruce), plus West Marine's copy of the Danforth – didn't live up to expectations.

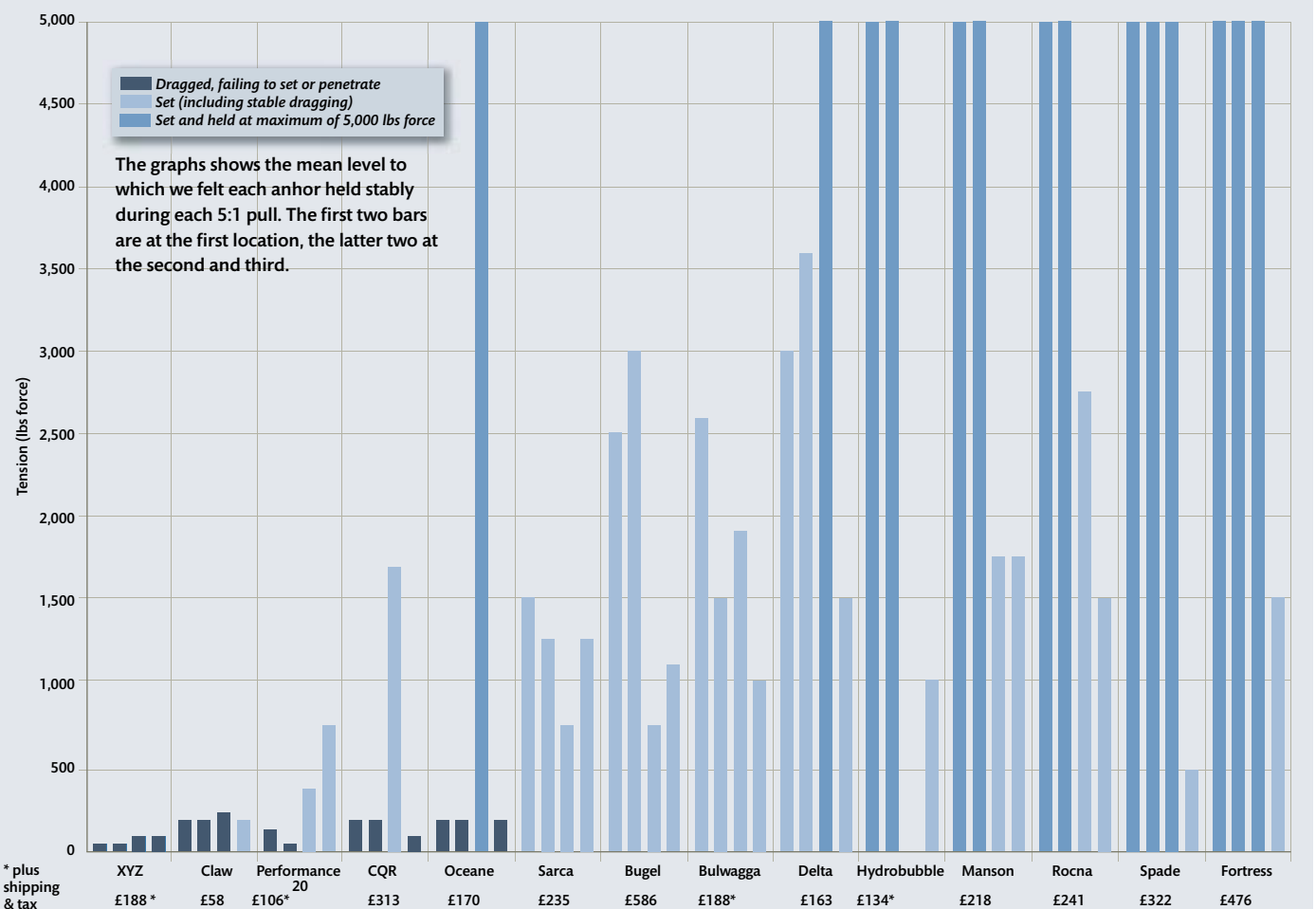
Was *Shana Rae* too powerful a testing platform? Using a smaller, less powerful boat in a separate mini-test, the team were able to get all the anchors to penetrate.

The new generation of 'roll-bar' type anchors were a revelation. You don't see many of these stowed on bow rollers in the UK, but they were truly impressive performers – especially the New Zealand-made Rocna and Manson. They showed extreme holding power as well as versatility and, along with the Spade and

Fortress, were the best performers.

The anchors that performed best in our tests were the ones that self-orientated themselves on the seabed with an optimum penetrating angle. By using a 'float' even the weird Hydrobubble exceeded all our expectations. So are new designs the way to go?

We are certainly getting closer to an anchor which will cope with all types of seabed. But we are not quite at the stage where blue-water sailors will give up carrying two or three different anchors to cope with the variety of conditions they will encounter.



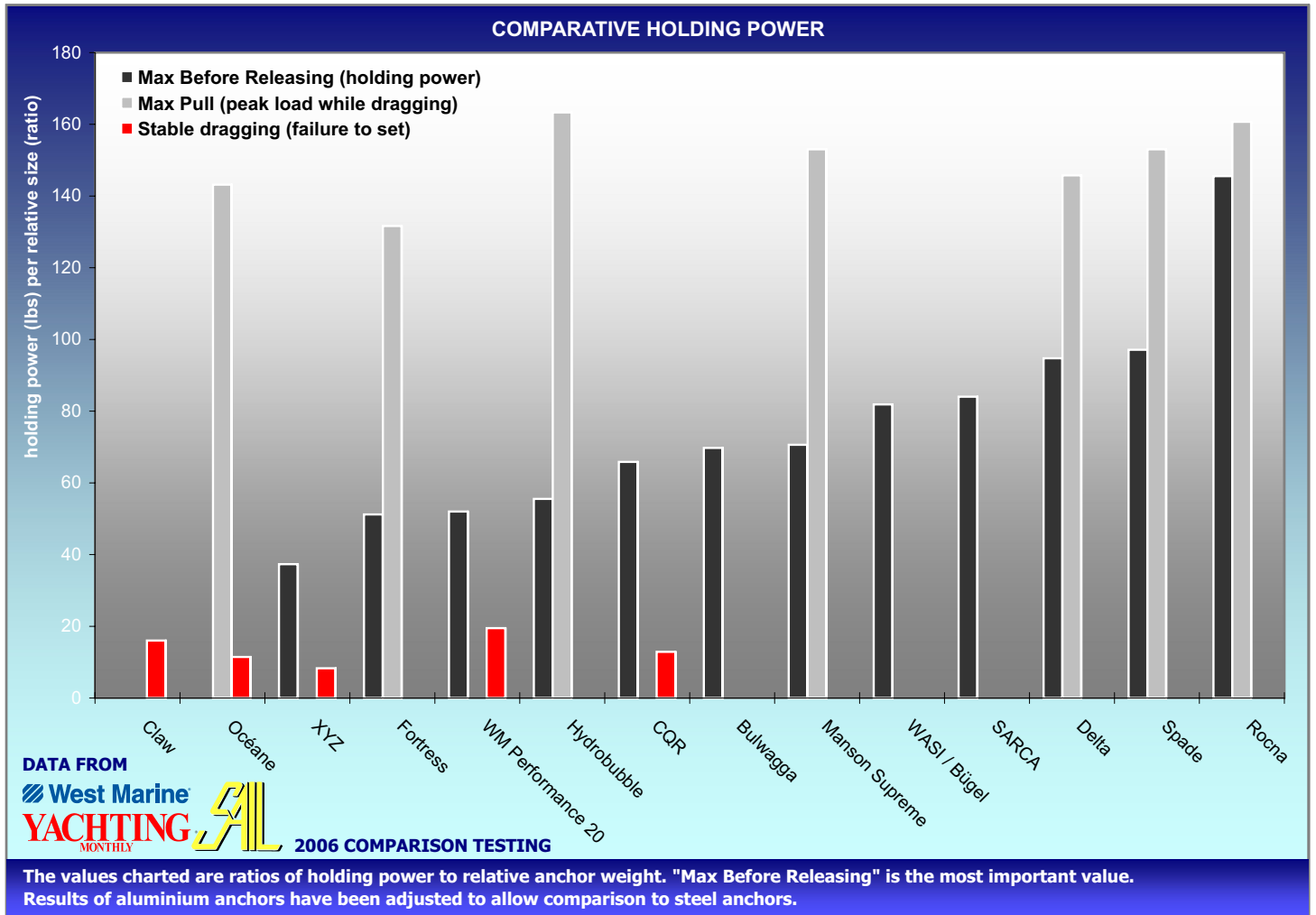
<p>FORTRESS FX37, CLAW & CQR Company: Lewmar Tel: 023 92471841 Web: www.lewmar.com</p>	<p>WEST MARINE PERFORMANCE 20 Company: West Marine Tel: 0800 895473 Web: www.westmarine.com</p>	<p>SARCA ANCHORIGHT Company: Holt Tel: 0208 789 5557 Web: www.holt.eu; www.anchorright.co.uk</p>	<p>HYDROBUBBLE Company: Anchor Concepts Tel: +1 888 282 2535 Web: www.anchorconcepts.com</p>
<p>DELTA Company: Proboat (in UK) Tel: 01621 785455 Web: www.proboat.co.uk or www.fortressanchors.com</p>	<p>ROCNA Company: Rocna Tel: +64 21 178 1076 Website: www.rocna.com</p>	<p>MANSON SUPREME Company: Superyacht Docs Tel: 02392 476566 Web: www.superyacht.com; www.manson-marine.co.nz</p>	<p>BULWAGGA Company: Bulwagga Marine Anchors Tel: +1 315 733 4600 Web: www.noteco.com/bulwagga</p>
<p>VWOCEANE, SPADE 80 & BUGEL Company: Blue Water Supplies Ltd Tel: 01534 739594 Web: www.bluewatersupplies.com</p>			<p>XYZ Company: XYZ Marine Products, USA Tel: 001 212 486 3912 Web: www.xyzanchor.com</p>

some notes from the designer of the Rocna anchor

concerning the West Marine / SAIL / Yachting Monthly testing

A problem with all anchor testing is that the many factors which make a good anchor are never considered - holding power is often the only one. However, looking over this magazine write-up, I am happy to see that a decent amount of effort has been put into this attempt. With three test locations and three different scopes, this testing can rightly claim to provide a good illustration of anchor performance. What's more, the range of anchors tested was complete, not just the usual handful of traditional types, so giving readers a good comparison.

Having said that, I must also say the write-up from *Yachting Monthly* is a bit disappointing. No real attempt is made to interpret the results in a comprehensive analytical manner. The graph on the last page leaves much to be desired. Accordingly, we provide you here with our own analysis of the results, a graph based on *SAIL* magazine's "average of peak strain at all locations" which better shows overall results:



concerning copies and variations of original anchor types

West Marine's line-up of fourteen anchors included several anchors that are just copies and/or variations of other types. Such copies present a tempting option, since they are usually cheaper than the genuine article. However, when a copier makes his imitation, he has two options. One is copy the anchor identically but take short-cuts to save money. The other is "improve" it, but most such modifications are done by people that don't understand the original design as well as its inventor does, and the changes are often nothing more than useless gimmicks.

Do avoid copies. Stick with the original genuine design and you'll be better for it.

concerning sales gimmicks

I wanted the Rocna to embody a philosophy of reliability, durability, and clarity of design. It is for this reason that it does not "feature" some of the gimmicks which crop up from time to time on various anchors. We promise a sensible general purpose anchor which is engineered to do its job as well as possible, and now proven to do so. It is my hope that fellow boaters will see the sense in this attitude, and consider the true value of the anchor they are entrusting with their boat's, and their own, safety and security.



Peter K. Smith