

## GEAR



# ANCHORED IN THE PAST?

Given the number of variables involved, it's hardly surprising that the subject of anchors causes heated debate. Apart from individual preference, different tests in different conditions invariably yield different results, so making sense of the available data is far from straightforward. Here, in his quest for the most efficient anchor, Australian skipper **Jon Neeves** trawls through some of the most recent information and draws a number of interesting and controversial conclusions.





**T**oday, new yachts are built from osmosis-resistant resins and our halyards are increasingly Dyneema. Sails at 'worst' are Dacron, while many have embraced Kevlar, Mylar and even carbon-fibre. Virtually all of us have discarded the sextant in favour of GPS and many, questionably, dispense with paper charts in favour of chartplotters.

In fact, if you strip out everything from a yacht that's been 'improved' over the last 10 years you end up with a pile of teak (and probably veneer at that), some chain and an anchor that was probably designed almost 80 years ago.

The choice of anchor depends to a large extent on the area you come from. On the east coast of America, for example, the Danforth, introduced in 1939 (or its copy) is commonplace.

Elsewhere, in Europe and Asia, most yachts boast either a CQR or the Delta (introduced around 40 years ago).

Some more adventurous owners carry a

Bruce (designed to secure oil rigs in North Sea mud), but even this is over 30 years old. Surely, I wondered, science must have moved on?

Until four years ago our interest in anchors was much like any other boat owner's – it was a necessary lump of unloved metal that needed to be hauled around in order to try to get a good night's sleep. We'd used a genuine 20lb CQR and a 20lb CQR copy (Hent) for years and now had a 40lb Manson Plough (ostensibly another CQR copy), plus a genuine 20lb CQR and a little 4.5kg sand anchor as back up. Our anchor wardrobe was similar to many other boat owners', »

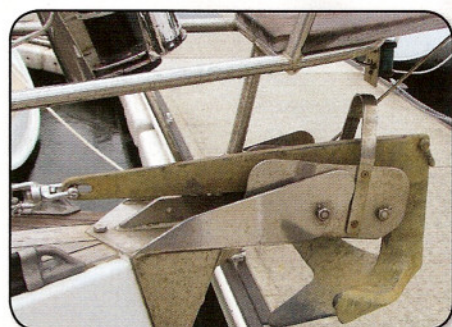
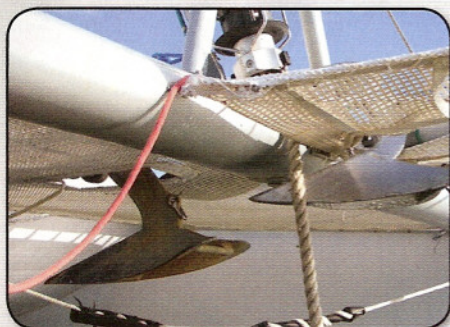
**Main pic opposite:** The range of anchors tested, including *Josepheline's* Manson Plough and CQR. There is nothing like seeing one's own anchors being tested to crystallise thinking. Anchors of the same type, but different weights, were tested and illustrated are – **top left:** four Super SARCAs; **top centre:** with roll bars a Manson Supreme with slot and a Rocna with the solid shank; **top right:** our little CQR; **bottom left:** a Delta and **bottom right:** our Manson Plough. Other Excels are in the centre.

**Above:** Little discussed is the environmental impact of anchors on the seabed. At low tide the middle trench produced by a Delta can clearly be seen, to the left is the trench dug by a CQR and the slight undulations to the right of the Delta trench are where the Manson Supreme and Sarcas were dropped. All the anchors were dropped at the same place and pulled for 10m. The Delta trench clearly exposes any seabed dwelling sealife to any opportunistic feeder.

**Top and left above:** The cage provides a place for the operator to keep tabs on the load cell and recorder, as well as providing power for them.

**Left below:** The Sarca Excel continues to bury itself until the resistance matches the load. Under a load 'too high' for the size of the anchor it is difficult to break the anchor free. Having over-loaded a small Excel it was necessary to wait for low tide to winch it free with the red rig.





**Clockwise from above:** A downside to scoop anchors with roll bars can be compression of the seabed into the scoop – if the anchor were to drag it can't be re-set without being cleaned; *Josephine's* original anchor wardrobe – a 40lb Manson Plough and a genuine 20lb CQR, supplemented by a Danforth and very small reef anchor. The bow roller assembly on many catamarans, and some monohulls, makes carrying anchors with roll bars difficult or even impossible; the Bruce anchor was developed for use on offshore oil rigs, but for industrial application has long been superseded. This is a common Chinese copy, but whether they meet the original specification in terms of design, raw material or manufacture is unknown; the Wasi Bugel was the first successful anchor to be marketed in Europe since the introduction of the Delta. Originals were made from stainless steel and introduced the roll bar. A heavy stainless fluke is welded to a heavy stainless shank with the self righting roll bar and no preferential weighting to the toe. Considered by some to be 'dated' it has considerable support in Europe, which has spawned a number of copies; in common with the CQR the shank of this Delta was always visible above the seabed. Under load, both the Rocna and Manson Supreme were always just subsurface, but the SARCA disappeared completely.



although, looking around, we noticed that Lewmar's Deltas were becoming increasingly popular. Our cruising grounds broadened and our ideas changed one windy night as a F8-9 cold front caused our anchor to drag and we were swept from a comfortable 6m to a thought provoking 2m of water in the time it took us to get engines running and Josephine (dressed in negligee only) to wrestle with the windlass.

Looking back, it's difficult to decide

whether the view of a virtually naked wife on the foredeck with the temperature in single figures or the vicious rocks rapidly approaching astern stick in my mind more. Sadly, I lacked time to photograph the event and fortuitously Josephine took all this in her stride as part and parcel of sailing. However, the night's events prompted us to improve our ground tackle.

## How do they work?

First we needed to understand the basics. Most yacht anchors, it seems, can simplistically be defined by three basic types – ploughs (CQR/Delta), plates (Danforth) and scoops (Bruce). Most of the others are variations on the same themes. Recently there's been an attempt to describe anchors as concave or convex, but that seems unnecessary in my view – everyone immediately understands a scoop or a plough.

Next, anchors can be hinged, like a CQR or Danforth, or fixed. Most are now welded steel, because its cheap, though some Danforths and 'genuine' CQRs are expensively drop-forged.

The Fortress, also a Danforth type, is an exception and is made from a Magnesium/Aluminium alloy, which is then pinned together (MgAl alloys being notoriously difficult to weld).

Of course, steel comes in a whole range of different qualities today and some manufacturers are taking advantage of modern high tensile steels with four times





**Top:** The Ultra is one of the newest anchors on the market and is so beautiful it would make an excellent coffee table decoration. It has a number of interesting design features and has a large surface area, but there is no technical information on its performance. Its major disadvantage, other than the absence of technical data, is that it is inordinately expensive when compared to its galvanised competitors.

**Above:** From left to right, an 11kg Hent CQR copy, a 13kg SARCA Excel and a 17kg Manson Plough. The thick shanks of the CQR and plough, which obstruct deep setting, are readily visible and the large surface area of the flukes of the Excel are immediately obvious. The Excel has a weighted and strengthened toe and a bismuth alloy steel shank.

the strength of mild steel, though it's not always easy to find out exactly what a particular anchor is made of.

These days, the good old Admiralty Standard Stockless (ASS), the sort you see on cargo ships and, in stainless form, on super yachts, is less common on sailing cruisers as is the even older Admiralty Pattern, AP, sometimes known as a pick or fisherman's anchor – though many say the AP is still the anchor that works best in areas of heavy weed.

The ASS and AP are still relevant as they are the basis for that most historic classification of anchors, High Holding Power and, more recently, Super High Holding Power. But, again, the fact that an anchor's performance is referenced to an anchor that was effectively superseded

at the end of the 19th Century seems quaint to say the least. The self righting shank, pioneered for the Delta, and the roll bars on some newer anchors (patented by Bruce in 1970), are attempts (largely successful) to ensure that an anchor positions itself, when it lands on the seabed, so the fluke tip has an immediate 'seabed penetration opportunity', meaning it's more likely to dig in. Slotted shanks are also available – on some Danforth copies for example, as well as the Manson Supreme and Super Sarca – to ease retrieval, but if used incorrectly can self trip the anchor.

A trawl through the internet produced some useful information from manufacturers and anchor experts (who in some cases work for the manufacturers), but the most useful non-commercial site we found was the one produced by Alain Fraysse (<http://alain.fraysse.free.fr>). Much of it requires a degree in applied physics and knowledge of the Greek alphabet, but it does contain a useful spreadsheet to calculate anchor loads for your own particular yacht under a variety of conditions and also demonstrates the benefit of introducing elasticity – usually in the form of a proportion of nylon warp – to the anchor rode.

We lack the background or expertise to comment on the validity of the Fraysse website, but it's the only one of merit we found and there's an absence of negative comment on the theory. The anchor loads derived from the website spreadsheet should be considered indicative only (some examples are given in Table 1) and, equally, the loads derived from the actual practical tests described here should also be used conservatively. Perhaps it's worth considering the information as a first attempt at quantifying a topic for which there are many variables.

## How good is a copy?

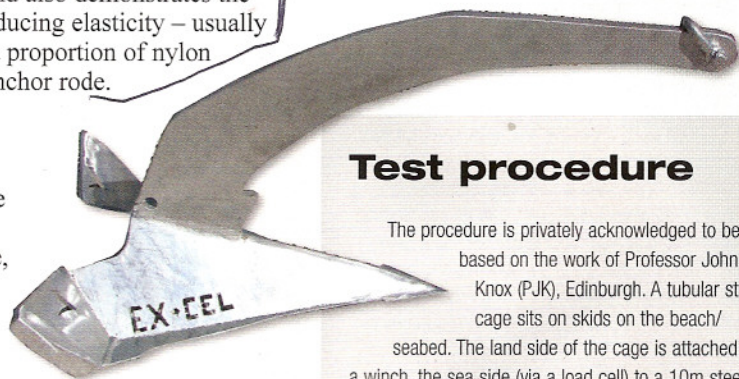
We soon found in our search for the perfect anchor that for such a simple item there are a plethora of manufacturers. In fact it's difficult to believe that so many companies can make a living out of anchors – more people must lose their

anchors than anyone cares to admit.

Oddly, few anchor manufacturers disclose any quantifiable (and verifiable) information on the performance of their anchors. Many of the manufacturers are household names – Wasi, Lewmar, Manson – but many anchors are unbranded and increasingly coming out of Asia. We've nothing against a Turkish or Asian product, but if a company is insufficiently proud to brand its product then perhaps we should be sceptical of its quality and performance.

Similar queries about copy anchors were commented on in a much-quoted article in a French sailing magazine, *Voiles et Voiliers*, May 2003 (beware edited versions). Also, more recently, in an equally informative anchor study made by West Marine of America in 2006 (and published in a number of boating magazines).

For example, the West Marine copy Danforth failed to set, whereas the Fortress – ostensibly similar in design – performed exceptionally. The French tests seldom found that a copy worked as »



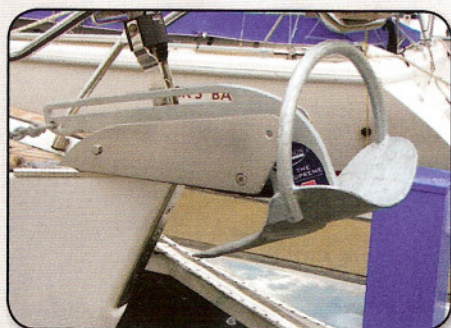
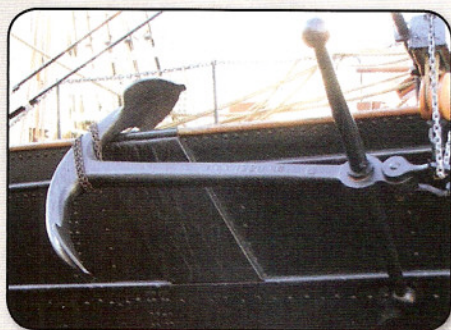
## Test procedure

The procedure is privately acknowledged to be based on the work of Professor John Knox (PJK), Edinburgh. A tubular steel cage sits on skids on the beach/seabed. The land side of the cage is attached to a winch, the sea side (via a load cell) to a 10m steel cable connected to the anchor. The cage 'joins' the load to the anchor and provides somewhere to house the operator, load cell and recorder. The skid sits at the water's edge whilst the anchor is placed underwater on its side on the seabed and pulled at a constant rate for 5-10m. Once a pull is completed, the whole assembly is moved 1m along the beach and another anchor tested. The winch, on a small truck, is capable of testing anchors up to about a 2T load. Typically, the anchors are 'set' in about 1m of water. When testing, the seabed to which each anchor is subjected is the same and the scope remains constant, usually at 10:1. The loading rate (winch speed) is constant and the rode is wire. The tests are conducted using anchors A, B, A, C, A, D etc, then the sequence is restarted. The test area was a low-lying tidal inlet with a range of different seabeds, of which five were tried.

To gain approval for commercial vessels, a 'new' anchor must be tested against one already approved, such as the Manson Supreme and Delta.



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**Clockwise from above:** The Manson Supreme is a scoop style anchor with a roll bar. The design of the Rocna is almost identical, except that the Manson carries a slot in the shank to enable setting and then easy retrieval in rocky or coral seabeds. Both the Rocna and Supreme perform exceptionally well, but can be difficult to stow on some bow rollers; a traditional fisherman anchor, seldom seen, except as a period piece (as in this example), because they are notoriously difficult to stow, have low holding power and, because only one fluke is buried, can self trip if the vessel drifts back over its own anchor; *Josepheline* and the British registered yacht *Blaze* after sitting out a storm in the aptly named Refuge Cove on Wilson's Promontory at the western entrance to Bass Strait. The winds had been gusting through 180° and sufficiently strong to lift spray off the surface. The best securement was for *Blaze* to use their 50lb CQR and two 1in warps tied, one from each transom, to two trees on the shore. We had one line ashore and set, at 90° to each other, two bow anchors, an Excel and a Danforth.

well as an original – CQR, Danforth or Bruce.

More recently, we were invited to attend tests performed as part of the development of new standards by the Australian Transport Council's National Marine Safety Committee (NMSC). These tests, along with the reports by VetV and West Marine, were most educational and formed the basis for our final decision.

## Understanding the info

We were lucky to be directly involved in the NMSC tests, because this allowed us



to introduce *Josepheline*'s anchors – our Manson Plough and genuine CQR – into their test schedule, which gave us real ownership to the results.

We had some restrictions or reservations in our choice of future anchors, because our bow roller won't allow us to stow an anchor with a roll bar. However, we decided that if we found a roll bar anchor that stood out, we would be quite happy to make some modifications. Furthermore, some anchors are expensive in Australia (Spade, Wasi Bugel and genuine Danforths), simply because they need to be imported.

All the anchors we looked at are available in the UK and usually from stock. For us, if an anchor stood out, we would find a way of getting it. After all, much better to buy an expensive anchor than risk a difficult discussion with your insurance company. Our options were further limited to primary producers – someone with a real belief in their product – rather than a slick marketing operation that might be inclined to subcontract to cheaper producers, so we ignored unbranded products and most of those promoted by marketing operations with no direct involvement in manufacture.

Our final list included the Spade, Wasi Bugel, Fortress, Danforth, Manson Supreme, Rocna, Sarca Excel, Super Sarca and Delta, plus our own genuine CQR and Manson Plough. We eliminated the Danforth and Fortress because we felt they might not have the range of application we required. They were fine in sand and some mud, it seemed, but not elsewhere, although given that it would be prudent to carry anchors compatible with a range of seabeds, the Danforth and

Fortress sit high on our list of fall back options, because they have very high holding power to weight ratios, at least for sand – particularly the Fortress.

We also eliminated Bruce anchors as being too limited in their range of seabeds (and for yachts, in our judgement at least, they simply don't seem to have the weight, or a sufficiently sharp fluke).

There are some other new anchors around, but most have yet to stand the test of time – either that or they lacked sufficient quantitative history to merit inclusion in our short list.

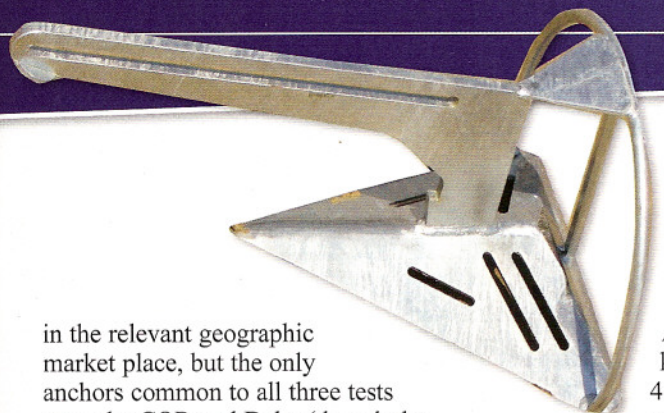
Oddly, a recurring design in our list (but untested) is the old standby, the fisherman, simply because, in our cruising grounds, an anchor that would work in weed would be a huge asset.

## The tests

The three tests that formed the basis of our final decisions – the French VetV, the American WM and the Australian NMSC – were all conducted on a range of anchors in as near identical test conditions as possible with attempts to make the tests as close to reality as practicable – though the conditions obviously varied between the three tests.

Each of the tests was conducted on at least two different seabeds and all were conducted without overly commercial overtones. The French and Australian tests were, comfortably, conducted with national accredited independent testing agencies in attendance and West Marine had a number of yachting journalists covering their tests in their attempt to make the results fair. The tests themselves were conducted on a range of anchors, reflecting their availability or popularity





in the relevant geographic market place, but the only anchors common to all three tests were the CQR and Delta (though the French and American tests included Danforth types and the Australians and Americans both tested a number of scoops). The French and American tests focused on anchors for 33-40ft yachts, say 15.5kg, while the Australians concentrated on 10kg anchors, for yachts up to 30ft. The Fortress website quotes two other tests along with the French test, but neither includes the newer anchors. A test conducted in Miami on a sand bottom found holding power ratios: Bruce 21kgf/kg, CQR 71kgf/kg, Danforth Hi Tensile 111kgf/kg and Fortress 361kgf/kg. A Dutch test in a tank (Vryhof

Ankers) gave: Bruce 23kgf/kg, CQR 28kgf/kg, Delta 41kgf/kg, Danforth 121kgf/kg and Fortress 411kgf/kg.

The Danforth website provides holding powers for a yacht sized anchor (8m-10m), but with no mention of bottom type or independent verification, as: Standard 30kgf/kg, Deepset 55kgf/kg and Hi-Tensile 56kgf/kg. The Fortress results are undoubtedly exceptional, but the CQR and Delta results roughly match those from VetV, WM and the NMSC.

## What did we need?

Our analysis of the results was based on two primary factors, holding power and ease of setting, but secondary factors also came into play – price and/or availability,

and user-friendliness (incorporating environmental issues). All the tests subjected the anchors to increasing load until breakout (think of it as dragging) – i.e. ultimate holding power. To simplify our choice, we produced a series of charts listing average ultimate holding power to (anchor) weight ratios for each of the three tests. Whereas ultimate holding power is critical (this generally increases with the weight of each design), a hierarchy can be developed by simply looking at the ratios. Once we had the best design(s) based on the ratios we could then fine tune our choice and return to Alain Fraysse's spreadsheets of calculated loads at anchor under varying conditions. Some cross-comparisons are possible, because there are common designs in »



**AVERAGE HOLDING POWER RATIOS KILOGRAM FORCE/KG**  
(holding power in KGF as a proportion of anchor weight in KG)

	VetV		WM	NMSC	
	France		USA	Australia	
	Sand	Gravel	Sand	Sand	Mud/shell
CQR	55	39		49	
Delta	26	23	37	27	39
Manson Plough					25
Fortress	57	3.8	100		
Guardian	50	5			
Steel Spade	60	20	64		
Rocna			69+	84	91
Manson Supreme			62+	70	78
Super SARCA				47	138
SARCA Excel				89	142

### Note:

Multiplying your yacht's anchor weight and a relevant average holding power ratio will give an 'order of magnitude' to compare with Fraysse's calculated anchor tensions. Data above is the average of multiple tests, the + symbol indicates it was tested to the limit of the equipment.

**TYPICAL YACHT ANCHOR ROPE TENSIONS CALCULATED FROM FRAYSSE'S SPREADSHEETS**

Yacht length (m)	Monohull								Catamaran		
	8	8	10	10	11.5	12	12	12	10	10	11.5
Wind Speed (Kn)	25	40	25	35	35	25	35	40	25	35	40
Tension, mixed rope (daN)	130	333	189	370	466	255	500	653	274	536	876
Tension, all chain (daN)	296	757	420	840	1059	580	1137	1485	622	1219	1991
Minimum anchor weight, mixed rope (kg)	6	11	8	12	14	9	14	17	10	15	22
Minimum anchor weight, all chain (kg)	10	20	13	21	25	16	26	32	18	28	40

**Notes:** daN is equivalent to kgf. Chain used 8mm (except 10mm on the 12m monohull). Water depth + freeboard = 5m. Anchor weight assumes CQR type (spreadsheet suggests 30 per cent lighter for modern types, but there is no indication of how this percentage reduction is calculated). Bottom type, medium (options – excellent, good, medium and poor).





all tests, but to us these comparisons are statistically questionable (though there are obvious trends), because there are simply insufficient results to stand up to serious scrutiny. Used with obvious health warnings and some considerable caution, it's possible to calculate an anchor weight for each specific anchor type for your yacht, based on Fraysse's loadings and the holding power ratios. There's considerable room for more independent testing to reduce some of the inconsistencies in the results currently published and to better define seabeds and how the common anchors perform in these seabeds. There's also room for the development of an anchor that might perform in areas of heavy weed.

Basically, the results have enough consistency to speak for themselves. The traditional anchors, CQR and Delta, are simply factorially and consistently outperformed by the anchors developed within the last 20 years. Good Danforth types still perform exceptionally well, but lack wide seabed type application and have a reputation – possibly apocryphal – of deforming under anything beyond a direct pull (ie when the vessel is yawing).

The scoops (which to us are a clever refinement of the Bruce), in the form of

the Rocna and Manson Supreme, have high holding power and set quickly – often within their own length.

Their exceptionally fast setting is a function of their sharp flukes – almost completely absent from a 'yacht sized' Bruce, which in its 'industrial' size can rely on weight to penetrate the seabed.

The Scoop's downside for us is that it would require a new bow roller, but they have a further negative attribute in that they compact the seabed within the scoop – possibly due to the constraint of the roll bar. This compacted mass of seabed is retained by the anchor when it's lifted, increasing the weight of the anchor and discouraging it to reset should it ever drag. Furthermore if, when the anchor is initially dropped, it becomes clogged with weed, then the only way to retrieve the situation is to lift the anchor, clear the weed and try to reset it – not a task I fancy on a cold, wet night.

There's little to choose between the Rocna and Manson Supreme, though on performance the Rocna has the edge. The designs are similar (almost identical) and though the Rocna came to market first, the Manson had a tripping slot. The Rocna

appears better crafted, but the cheaper Manson looks more than adequate.

There are no stand-out ploughs. The Delta, when it drags, produces a deep furrow in the seabed exposing all of the surface crustacean and worms as an easy feed to any predator and severely disturbs seagrasses. Is it any wonder some anchorages are now closed to yachts as a result of anchor damage? On that basis it might be fairer to ban damaging anchors.

Two anchors marry the positive attributes of the plough or scoop with those of the plate. The Spade is a shallow scoop and the Super Sarca and Sarca Excel are shallow ploughs. Both Spades and Sarcas, after initially setting and under increasing load, simply bury themselves into the seabed (as do Danforths), unlike the Rocna/Supreme, CQR and Delta, which never sink below shank depth. The Spade and Sarca carry this characteristic over a spectrum of seabeds. We've no experience of the Spade, but if load is continually applied to Sarcas they simply bury themselves deeper until the seabed resistance matches the load, resulting in exceptional holding powers (though less so in the Spade). But it demands patience when you want to lift the anchor. These anchors come up clean in most seabeds despite the Super Sarca's roll bar.

## So which one did we choose?

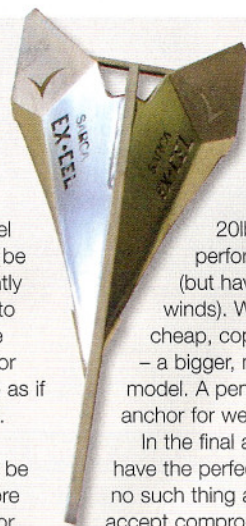
For us, it was fairly easy. The Sarca Excel has no roll bar, but a self righting shank, and combines the positive attributes of the plough, including the weighted fluke and plate. The sharpened fluke tip enables rapid setting and the slotted flukes have been incorporated to facilitate ease of retrieval. The Super Sarca was discounted for us simply because of its roll bar – though its performance as an anchor is excellent. Although the Spade enjoys some similar benefits, it is more expensive in Australia and there is always a nagging doubt regarding the slot and bolt joint between shank and fluke (we want to minimise the number of mechanical fastenings between yacht and seabed). It would also be interesting to see a comparative test of the Spade and Excel.

In the end, we dispensed completely with our 40lb Manson Plough (which bizarrely actually weighed 49lb) and replaced it with a 16kg Sarca Excel. Very crudely, we've exchanged a potential holding power of 914kg (averaging the CQR and Plough holding power ratio results and multiplying by anchor weight) to one of 1,424-2,272kg (varies with seabed) with the lighter Excel, which on an 11.5m

catamaran should provide comfort, based on Fraysse, beyond 35kn of wind with our chain and very elastic bridle.

Real life usage was a steep learning curve – we soon found that to set the Excel we needed a new technique. There would be no simple gentle reversing, instead we gently set it, then rev up both engines in reverse to about 2,000rpm to drive the anchor in. We also need to be careful, because the anchor set so quickly that *Josephine* would stop as if running aground and knock us off balance.

Contrarily, lifting the anchor needed patience. You have to wait for the chain to be vertical, then wait maybe 2-3 minutes before the action of waves/swell breaks the anchor free. Our old plough could be motored out, but not so the Excel. We've now used the Excel in a whole range of seabeds, muds, mixed shell and mud, sand and light weed in depths from 2m-10m. The only seabeds where we were unsuccessful was in those with really heavy weed. The most extreme conditions were in sand, in 3-6m depth (an area of 3m tides), 0.5m seas, with winds gusting to 35kn. We deployed all our 50m of 8mm chain with a



very elastic bridle system and sat, unmoved, for three days.

We shall still carry our 20lb CQR and have found it to perform despite the test results (but have never used it in 35kn winds). We will replace our small, cheap, copy Danforth with something – a bigger, maybe 15lb, brand-named model. A pending decision is finding an anchor for weed beds.

In the final analysis, I don't think we have the perfect anchor. I suspect there's no such thing and we may all need to accept compromise. However, I think we should continue to question and evaluate to encourage yet further development.

Finally, the downside.

Since sorting out our anchor requirements, it's proved unnecessary for *Josephine* to venture onto the bows indecently (un)clad, so that's a photo opportunity lost forever. And since I'm more relaxed, my malt whisky consumption has increased slightly – so good anchors come at a price.